Rohde & Schwarz Topex

Bytton LTE

Industrial-grade Cellular Router for 3G+/4G Networks

User's Manual

2013

topex-3.0.6-FA-S

Congratulations!

Thank you for buying the Bytton LTE product from ROHDE & SCHWARZ TOPEX S.A. and congratulation for your wise choice.

Bytton LTE has the following features:

- **Very High Throughput**

– download data rates up to 42 Mbps over HSPA+, depending upon the type of modem selected and the capability of the mobile network used
– LTE ready, data rates up to 100 Mbps over LTE networks with dual antennas
- wired (Ethernet) data transfers between clients up to 100 Mbps
- wireless local data transfers up to 54 Mbps with the standard 802.11g embedded AP and speeds up to 150 Mbps with the optional 802.11n wireless access point (also available with antenna Diversity feature)

- **Cross network capabilities – Dual SIM variant**

– the dual SIM version uses two SIM cards (not concurrently) for increased availability: when the primary carrier fails or you get out of the coverage area, Bytton LTE automatically switches to the second mobile data provider.

- **Rugged metal case, compact and reliable**

- the metallic case in ruggedized, ensuring reliable operation even in extreme environment conditions
- extended temperature range available upon request, up to the -30^{o}C to +80^{o}C!
- the compact size makes it easy to carry and use.

- **Remote control and monitoring**

– ready for machine to machine applications, including remote control and monitoring of the fleet of Bytton machines while located out in the field
– features one or two serial ports for connection to legacy equipments
– adapter device for mounting on industrial standard DIN Rail (to be placed in watertight enclosures for outdoors usage)
– dedicated Management Server, remote utility for Web-based administration and configuring of single units or group provisioning, distant monitoring and automated service managemnt tasks.

- **High Security**

– stateful packet inspection firewall for Internet connection
– 128 bits encryption for wireless clients, WEP and WPA with TKIP or AES encryption
– secure HTTP (HTTPS) access to configuration pages
– secure SSH remote management
- embedded VPN tunnels (GRE, IPSec, PPTP, OVPN)
- MAC filtering and 802.1x certificates authentication

- **Ease of Use**

– web based configuration interface;
– login as admin or superuser, allows access to simple or advanced configurations
– embedded server for dynamic IP configuration of the clients (DHCP)

- **Advanced Internet Connection Management**

– automatic connection establishment on traffic detection
– automatic disconnection on lack of traffic
– complete network address translation (NAT) support
- flexible assignement of physical Ethernet ports
- QoS (traffic marking and shaping for Layer 2, Layer 3 and Application Layer)

- **VPN and IP tunneling**

– versatile settings for IP tunneling
- embedded support for GRE, IPSec, OVPN, PPTP
- you can define up to 20 IPSEC tunnels
- allow easy building of secure virtual private networks
- other kinds of secure tunnels available upon request.

- **Bridge capability**

– you may define several bridges between up to four interfaces of the equipment,
- each bridge may be considered a kind of software switch that can be used to connect multiple Ethernet interfaces (either physical or virtual), while sharing a single IP subnet
- bridging a physical eth network interface of Bytton with an Open VPN-driven network tap interface at two separate locations, both distant Ethernet networks are merged as if they were a single Ethernet subnet.

- **OVPN available**

– in addition to other kinds of versatile, advanced tunneling that may be for VPN, Bytton provides support for the OpenVPN Client;
– OpenVPN is simple, very easy to install and configure
– it can be installed on nearly any platform, the configuration principle remains the same on any platform
– TAP/TUN interface options are available so you can choose to build either Ethernet (Bridged) or IP (Routed) VPNs with the embedded OVPN software.

- **Virtual Routing Tables**

- the Virtual RT feature acts like a logical router, using a single routing table for each instance
- provides a way to configure multiple routing instances on a single hardware router

- **Easy Firmware Updating**

– automatic update process using the web configuration interface, locally or remote

- **Low Power Consumption** (less than 10 Watts)

– the low power consumption means reduced heat dissipation, hence no cooling fans required
– no moving parts means you get higher reliability and no noise.

▪ **Serial Interfaces**

- variant with one or two programmable serial (RS-232) interfaces available; the serial interface allows remote control of “legacy” devices – older equipments that feature a serial interface
- TCP server option lets you to remotely access the serial interfaces via telnet.

▪ **Diversity antennas - MIMO Enabled**

- both the 3G+ modem and the WiFi access point of the equipment are available in MIMO variant - with two antenna connectors each; the usage of multiple antennas for diversity ensures higher speed, increased throughput or better signal quality.

- **Flexible ETH port assignment**

– the wan0/lan0 connector may be assigned, form the Web configuration interface, either to the LAN or to WAN/LAN (a second remote network)
- the local ETH ports may be grouped in a switch according to your requirements: all three, just two, or they can be allotted individual IP addresses for each; you can specify for every ETH port the speed, auto-negotiation feature, operation in full duplex of half duplex mode.
.

- **Advanced firewall**

– SPI firewall with “iptables” for filtering and NAT, fully configurable from the Web pages.

- **Static and Dynamic routing**

– You may completely define several static routes, using Quagga or Kernel for routing
– Quagga routing program (RIP, OSPF and BGP protocols implemented)

- **Advanced functions for the "superuser"**

– this login mode allows access to additional items in several Web configuration pages, while the section “Stuff” provides reporting via e-mail, self-provisioning by loading configuration files and testing the bandwidth

- **Various "services" available**

– besides the basic capabilities, of Voice and Data over advanced mobile networks, the Services section povides different additional features, such asa SNMP, VRRP, Telnet, email-2-sms, DDNS, NTP client, and so on;

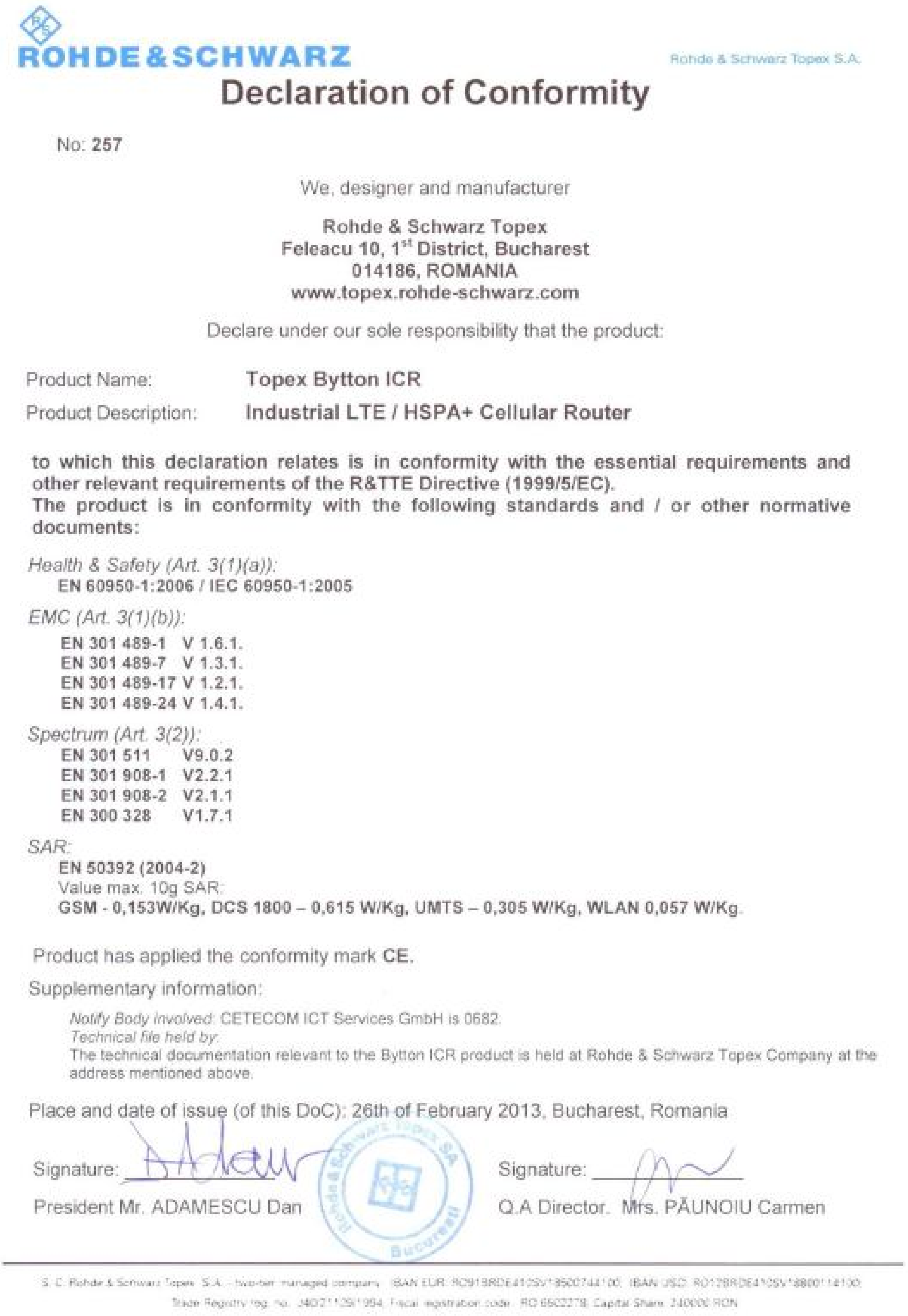
- **SMS Read / Send**

- you can send and receive SMS messages from the Web interface, using the modem module and the one or two SIM cards used on the equipment;

- **Multiple networks and technologies supported**

– different types of mobile modems available, for different frequency bands, mobile technologies and data rates, HSPA+ with speeds of 42 Mbps; the modules for LTE (4G) connections with antenna diversity allow download speeds of 100 Mbps
– can connect to mobile networks in the 850/900/1800/1900 MHz ranges for GSM/GPRS and respectively 850/900/1900/2100 MHz ranges for WCDMA, respectively 2600 MHz for LTE.
– backward compatibility form HSPA+ down to GPRS and GSM.

Conformity!



ROHDE&SCHWARZ

Rohde & Schwarz Topex S.A.

Declaration of Conformity

No: **257**

We, designer and manufacturer

Rohde & Schwarz Topex
Feleacu 10, 1st District, Bucharest
014186, ROMANIA
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Declare under our sole responsibility that the product:

Product Name:	**Topex Bytton ICR**
Product Description:	**Industrial LTE / HSPA+ Cellular Router**

to which this declaration relates is in conformity with the essential requirements and other relevant requirements of the R&TTE Directive (1999/5/EC).
The product is in conformity with the following standards and / or other normative documents:

Health & Safety (Art. 3(1)(a)):
EN 60950-1:2006 / IEC 60950-1:2005

EMC (Art. 3(1)(b)):

EN 301 489-1	**V 1.6.1.**
EN 301 489-7	**V 1.3.1.**
EN 301 489-17	**V 1.2.1.**
EN 301 489-24	**V 1.4.1.**

Spectrum (Art. 3(2)):

EN 301 511	**V9.0.2**
EN 301 908-1	**V2.2.1**
EN 301 908-2	**V2.1.1**
EN 300 328	**V1.7.1**

SAR:
EN 50392 (2004-2)
Value max. 10g SAR:
GSM - 0,153W/Kg, DCS 1800 – 0,615 W/Kg, UMTS – 0,305 W/Kg, WLAN 0,057 W/Kg.

Product has applied the conformity mark **CE.**

Supplementary information:

Notify Body involved: CETECOM ICT Services GmbH is 0682.
Technical file held by:
The technical documentation relevant to the Bytton ICR product is held at Rohde & Schwarz Topex Company at the address mentioned above.

Place and date of issue (of this DoC): 26th of February 2013, Bucharest, Romania

Signature: ____________

President Mr. ADAMESCU Dan

Rohde & Schwarz Topex SA Bucuresti

Signature: ____________

Q.A Director. Mrs. PĂUNOIU Carmen

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Trade Registry reg. no.: J40/2112/1994, Fiscal registration code: RO 6502278, Capital Share: 240000 RON

WEEE Directive Compliance

WEEE Directive

This symbol applied on your product or on its packaging means that this product fulfils the WEEE Directive. The product shall not be recycled as household waste; it will be disposed separately as sorted waste.

Regarding to WEEE Directive the recycling EE equipments must be accomplish separately in purpose of natural resources preserving and to avoid the occurring negative effects about human health and environment. The acquired product shall not be treated like household waste at the end of its life and will be returned to ROHDE & SCHWARZ TOPEX S.A. Company at the address: ROMANIA, Bucharest, Feleacu Street no 10, code 014186 or given to a specialized firm.

! Please do not dispose your ROHDE & SCHWARZ TOPEX S.A. product as unsorted waste (household waste), recycle it to protect the environment. Separate the packages according to waste disposal options and sort it for recycling.

For supplementary information contact us to:
Phone: +4021 408.39.00 or www.topex.rohde-schwarz.com

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RECORD OF CHANGES						MADE BY
ISSUE	**DATE**	**NUMBER OF PARAGRAPH**	**A* M D**	**TITLE OR BRIEF DESCRIPTION**	**Firmware**	**NAME**
A	May 2012	All	A,M,D	First draft	Orange-3.0.0-FA-O-b	C. Malide
B, C	June, July	All	A,M,D	Revision New labels, MIMO –enabled variant, four antennas “Eth x” interfaces renamed, Alias, VRT, QOS	Orange-3.0.0-FA-O	C. Malide
E, F	July	All	A,M,D	Updating firmware form 3.0.1FAS to 3.0.3	topex-3.0.3-FA-S	C. Malide
G	1 Sept	All	A,M,D	Corrections and Feedback from Q.A.	Same firmware	C. Malide
H	3 oct	All	A,M,D	Implemented corrections; feedback form Support, generated index of figures	Same firmware	C. Malide
I	25 oct	All	A,M,D	Documented new and modified features in firmware	Firmware version 3.0.5	C. Malide
J	6 dec	All	A,M,D	Corrections and customer feedback, disabling two Eth ports added	Same firmware	C. Malide
K	11 dec	All	A,M,D	Modifications and corrections requested by the designer	topex-3.0.5-FA-S-g	C. Malide
L	21 Mar 2013	All	A,M,D	Latest firmware, conformity, list of figures	topex-3.0.6-FA-S	C. Malide
M	21 Mar 2013	All	A,M,D	Modifications and corrections form the feedback	topex-3.0.6-FA-S	C. Malide
N	27 Mar 2013	All	A,M,D	Reduce file size, insert examples of MAC filtering	topex-3.0.6-FA-S	C. Malide

1. INTRODUCTION

Embedded Modem

The embedded modem of Bytton ICR may be a 4G (LTE) or 3.5G (HSPA+) or 3G (UMTS/HDSPA) engine multi-mode device, downwards compatible with 2G (GPRS/ EDGE/ GSM) networks.

It measures in real-time the RF signal level strength of the mobile network and lets the user to freely choose the 2G or 3G+ network. Thus it provides access rates up to the maximum possible for each mobile voice/data network. This way you may talk, download files or surf the Web without cabled connections almost anywhere, at any time.

When you are out of the coverage of very high speed networks such as LTE or HSPA/UMTS, you can still get services on the wireless Internet with alternative access via GPRS/EDGE/GSM network in your area.

The embedded multiband modem covers almost all of the frequency bands of the world (multiband for LTE, dual band for UMTS/HSPA+ and tri-band or quad band for GSM/GPRS/EDGE!

Serial interface(s)

For connection to legacy devices, Bytton LTE can feature one or two configurable RS-232 or RS-485 ports on the front panel.

By means of the Web configuration menu you may control the serial interface (RS232) of Bytton LTE and its associated IP services.

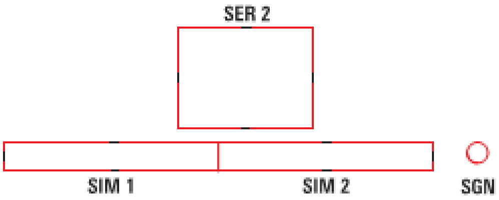


Figure 1-1: Bytton LTE featuring one or two RS-232 ports (SER1, SER2).

Note: *Your actual equipment may not look exactly as described above!*

Available variants

Bytton is a very versatile equipment; it features inside one motherboard that can get several types of plug-in daughter boards, according to the functions requested by the customer. Because of this, your actual equipment may not look identical to the pictures presented in the manual, and may not have all the features described. The main variants / options are:

- several types of mobile modules, for 2G or 3G+ networks (UMTS, HSDPA, HSPA+), and even LTE (assuring up to100 Mbps peak download rate), or for different frequency bands: 850/900/1800/1900 MHz for GSM/GPRS/EDGE, 2100 MHz for HSDPA or HSPA+, 800/900/1800/2100/2600 MHz for LTE and so on. The external aspect of the equipment remains the same for all variants of modules, but the capabilities (and price!) are different. Some type of modules feature antenna diversity (MIMO capabilities): connection of two Mobile antennas, for diversity reception or for achieving higher data rates. Thus, special Bytton equipments may feature four antenna connectors, two for the MOB mobile data network (HSPA+, LTE) and two for the embedded Wi-Fi module. GPS capability is also available, for mobile units, powered form the car battery;
- no voice capabilities and no Wi-Fi, with two data SIMs (not concurrently) for higher availability and with serial interface(s) for legacy devices. It has holders for two data SIMs; the device may be used with one or two SIM cards. It may feature one serial interface (SER2).
- still no voice capabilities but with Wi-Fi for wireless local connection, a single data SIM. The four Ethernet connectors are present In this case the connector for Wi-Fi antenna is present, located near the center of the front panel, together with the corresponding indicator LED for Wi-Fi. No serial interface!
- with **voice** capability (one FXS interface located to the left) and also with Wi-Fi, one voice/data SIM card. The connector for Wi-Fi antenna is present, together with the corresponding LED for Wi-Fi. Since there are not two mobile modules (it cannot perform LTE for two mobile carriers), the variants with telephone port always use a single SIM card.
- BYT_4G_FC1/ BYT_3G_FC1, the variant with one serial interfaces, labeled “SER”, available for connections to legacy equipments. No voice capabilities, no Wi-Fi antenna and hence no Wi-Fi indicator, a single SIM card. The RS-232 interface feature RJ-45 connectors on the front panel.
- the Lite (low cost) variant of the equipment, a Topex Bytton LTE with no voice capabilities and no Wi-Fi, a single data SIM, and no serial interfaces. Out of the four Eth ports, there are two LAN ports, one configurable WAN0/LAN0 port, and the dedicated WAN port;
- There is an even simpler variant, with no SIM and hence mobile data capability, used as an advanced network router. The front panel features **just four ETH ports, one SER.**
- Advanced variants with one or two serial interfaces, and one or two SIM cards besides the Mobile antenna and the four ETH ports. The two serial ports labeled “SER1” and respectively “SER2” are available for connections to legacy equipments. The RS-232 interfaces feature RJ-45 connectors on the front panel. The phone line interface (FXS) is missing, but the Wi-Fi access point can be present, for wireless connection of equipments in the field. The front panel features, from left to right: the circular antenna connector Mob, two SER connectors, the round Wi-Fi connector for wireless antenna, the four Ethernet connectors (WAN, WAN0/LAN0, LAN2, and LAN1), the recessed Reset button and the PWR jack for power supply!

- the most advanced variants, with full complement of features: two serial interfaces, two SIM cards, also FXS interface for analog fixed telephone and USB connection.
  The serial ports labeled “SER1” and respectively “SER2” are available for connections to legacy equipments. The RS-232 interfaces feature RJ-45 connectors on the front panel. To the right of the serial connectors, there is also a slot for USB 2.0.

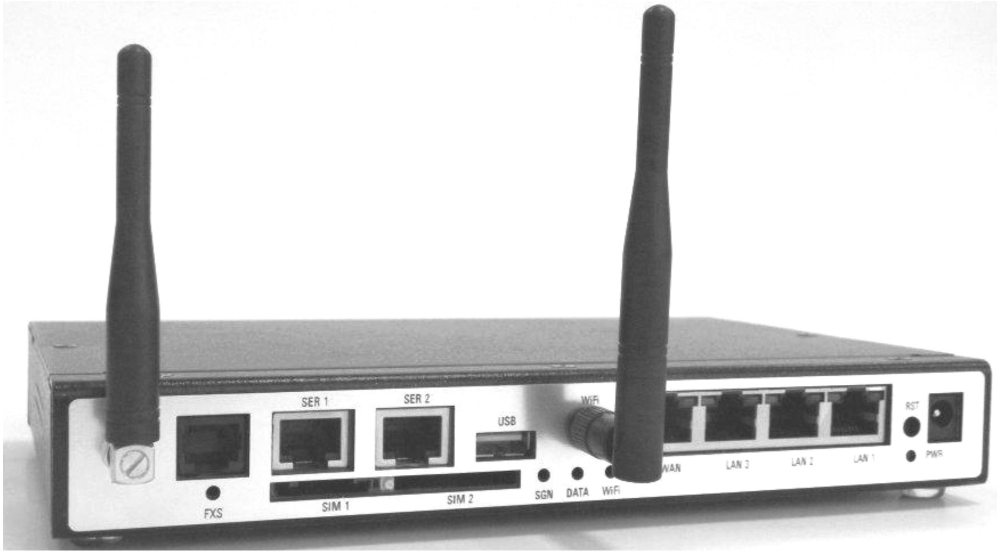
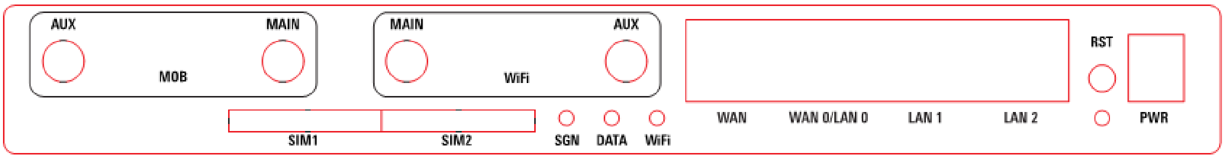


Figure 1-2: Photo of Bytton LTE with two serial ports, FXS phone interface, two SIM cards, Wi-Fi and slot for USB.

Note: *This picture may not be identical to the aspect of your own Bytton router!*

- **Antenna diversity versions.**

These Bytton equipments may feature with two connectors for MOBILE antennas and also two connectors for Wi-Fi. Thus it features up to four antenna connectors, labeled MAIN and respectively AUX both for the mobile data network and for the embedded Wireless Access point:



Both the LTE modem and the embedded Wi-Fi access point of Bytton LTE have MIMO capabilities, meaning they can operate with two antennas for achieving diversity (higher bandwidth or higher tolerance to perturbations, thus achieving increased capacity and / or robustness). There are several sub-variants of MIMO Bytton equipments available, for instance, as you can see in the photo, it may have two antenna connectors for the mobile data network, but only one connector for the Wi-Fi antenna!

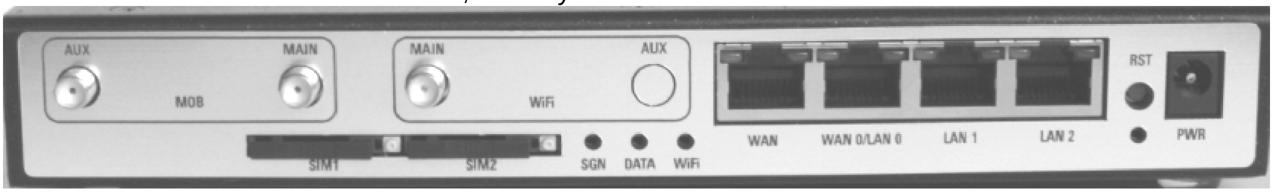


Figure 1-3: Drawing and photo of antenna diversity: up to two antennas for Mobile and Wi-Fi.

The advanced variants with FXS port and respectively with USB slot, and also the special version with up to four antennas, are available only upon special request!

In order to ensure a correct installation / configuration and a good operation of the Bytton LTE equipment, the manufacturer strongly recommends you to study this manual before attempting operation.

2. PACKAGE CONTENT

The component elements that you may identify upon opening the Bytton LTE package are shown below. When you open the equipment package, please ensure, using this list of items, that you have the full content.

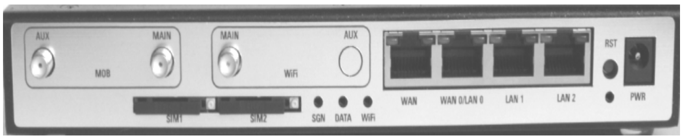
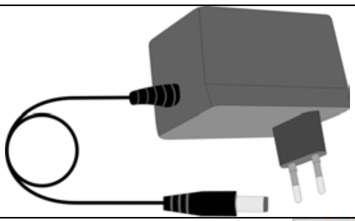
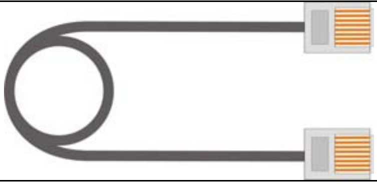
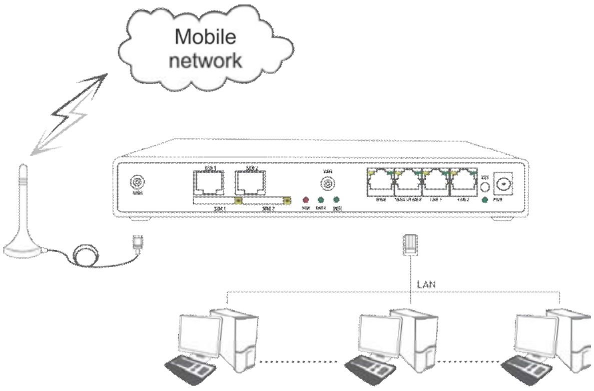
Component Image	Component Description
 AUX MAIN MOB MAIN AUX WiFi SIM1 SIM2 SGN DATA WiFi WAN WAN 0/LAN 0 LAN 1 LAN 2 RST PWR	Bytton LTE unit in its metallic case. It is a 3G/4G router with embedded firewall an tunneling solution for wired and/or wireless local computer networks, which allows secure, mobile, high-speed access to Internet using the 3G+ network or other WAN connections
	Power supply: switching mains adapter Input: 100-240V$_{A.C}$ Output: 12V$_{D.C}$. / 2.1A Power Max. Output : 24 W
	Ethernet cable for local network connection A piece of UTP straight cable, with RJ-45 connectors.
	Stick antenna for Wi-Fi Special antenna for the embedded Access Point, the connector can be bended at 90^{o} or rotated for getting the best signal. The N-type Wi-Fi may use **dual** antennas.
	Antenna, adequate for the mobile module used on the respective Bytton. It may be a **quad band stick** for GSM / HSPA+ with magnetic base and 2,5 m long cable. In case of Bytton LTE fitted with 4G modules, in the package are shipped 1-2 multiband coil antennas especially for LTE networks. LTE technology can use dual antennas for diversity, so **two** antennas will be included in the Bytton LTE package.
-	CD with User's Manual
-	Warranty Certificate

Figure 2-1: Illustrations of the content of the package of Bytton ICR

3. Equipment Functions and Identification

3.1 What is Bytton ICR?



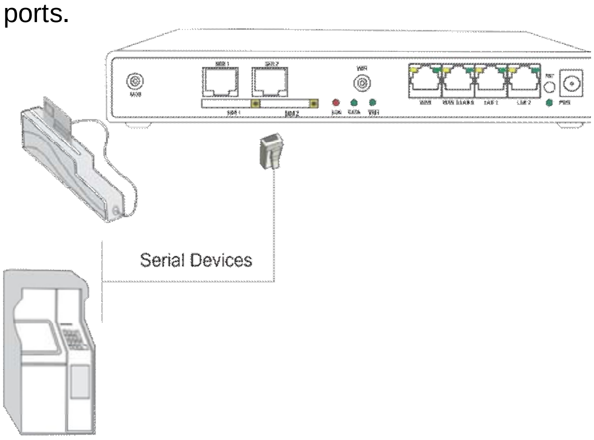
The Bytton ICR equipment from Topex is versatile advanced router for wireless broadband Internet access using 3G+ or 4G technology.
As **data router**, Bytton ICR achieves a direct connection, transparent for the user, between the local networks (Ethernet and/or Wi-Fi) and the GSM/GPRS/EDGE (2G), or UMTS/HSDPA/HSPA+ (3G/3G+) and even 4G up to 100Mbps using LTE mobile communications networks.

For wireless WAN connection, it uses an embedded radio modem for the GSM, GPRS/EDGE, HSPA+ or LTE mobile network. Its 3G/4G capabilities assure high speed Internet access, up to the topmost limit of the respective data network.

Figure 3-1: Connecting the local clients to Internet via broadband mobile data network.

Still, if you are in an area where you have only UMTS or GPRS, or even GSM coverage, you may use Bytton LTE in conjunction with the respective networks.

The Bytton LTE equipment also can feature one or two serial (RS-232 / RS-485) ports, allowing connection to legacy requirements, different devices that feature serial ports.



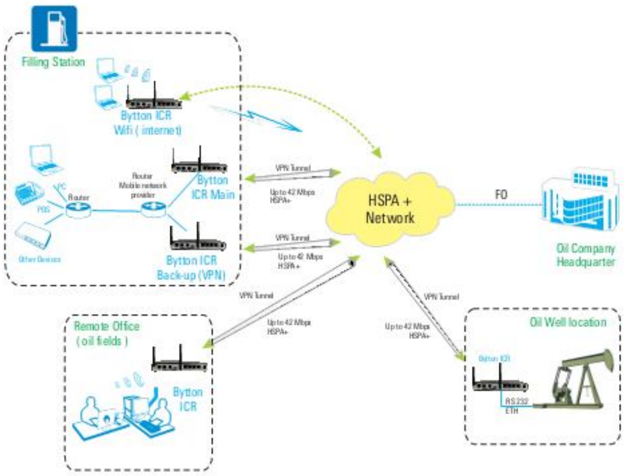


Figure 3-2: General (field) applications of the Bytton ICR wireless router

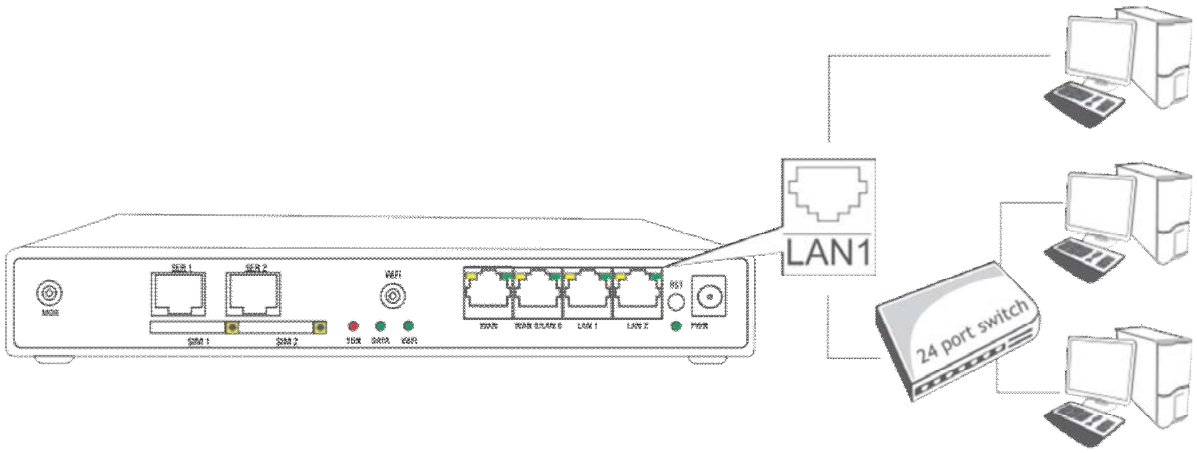


Figure 3-3: Bytton ICR acts as a router for wired and wireless local networks

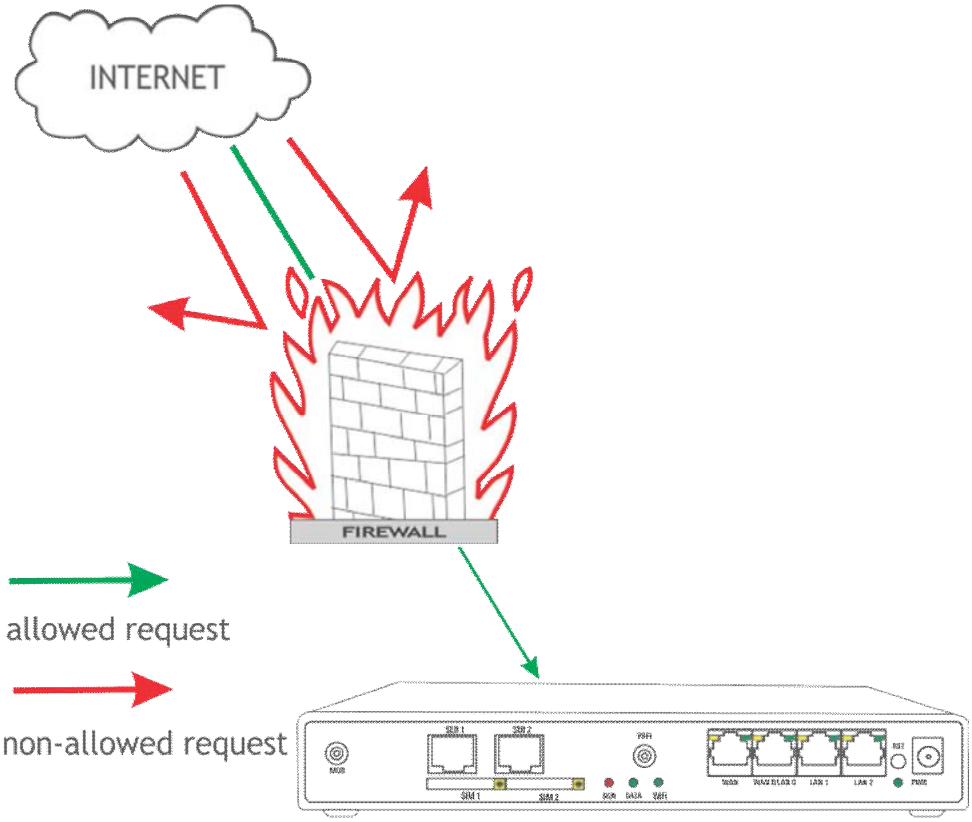


Figure 3-4: Firewall function of Bytton ICR

All computers on the wired local networks can access the Internet or remote VPN networks through the 3G Router from Rohde & Schwarz Topex S.A., using only a single external IP address. One can rest assured that the local area network connected to our product is safe because we have implemented a very powerful firewall and intrusion detection system.

The Bytton LTE Router makes usage of NAT (Network Address Translation) and SPI firewall to ensure protection for your local wired networks.

The features of the firewall are identical to those available to Linux servers throughout the world, which are well renowned for their safety. This firewall is fully configurable, but it is also easy to use for beginning users.

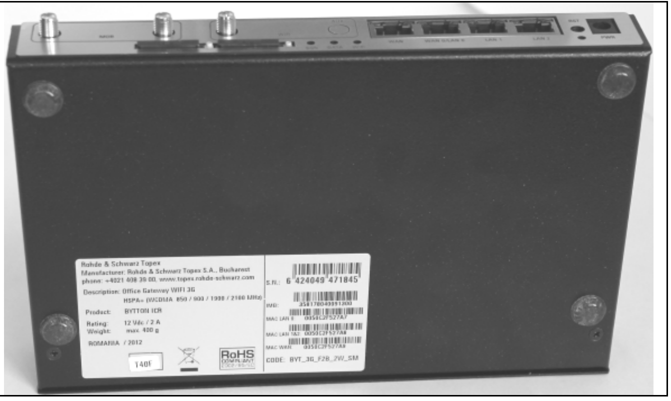
The software of Bytton Router assures secure communication over the public networks, through embedded VPN tunnels – GRE, IPSec, OVPN and PPTP are supported. For instance, you can define up to twenty IPSEC tunnels!

Since this product is Linux based, applications to enhance Bytton ICR or to customize it can be quickly designed by our software developers, according to the special needs of various clients.

Our best technical experts are available for your technical questions around the clock, if you sign up our technical support offer. In addition, the software upgrades can be done remotely via Internet, and are free of charge.

The Bytton family is a highly versatile solution; its embedded firmware can be easily upgraded over the Internet.

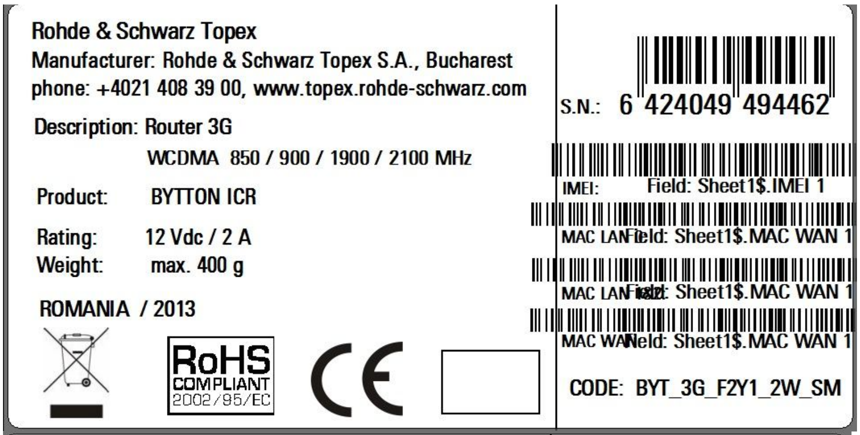
3.2 **Identification of the equipment model/variant**

On the bottom of the case of each Rohde & Schwarz Topex S.A. device there are several labels or tags that indicate the characteristics and compliance, as you can see in this example:	

3.3 Significance of labels

These adhesive labels contain information about the manufacturer, type, model, certification, approval and compliance to UE and international or USA directives such as FCC.

See here the label for a Bytton ICR operating over 3G+ networks:



Rohde & Schwarz Topex
Manufacturer: Rohde & Schwarz Topex S.A., Bucharest
phone: +4021 408 39 00, www.topex.rohde-schwarz.com

Description: Router 3G
WCDMA 850 / 900 / 1900 / 2100 MHz

Product: BYTTON ICR

Rating: 12 Vdc / 2 A
Weight: max. 400 g

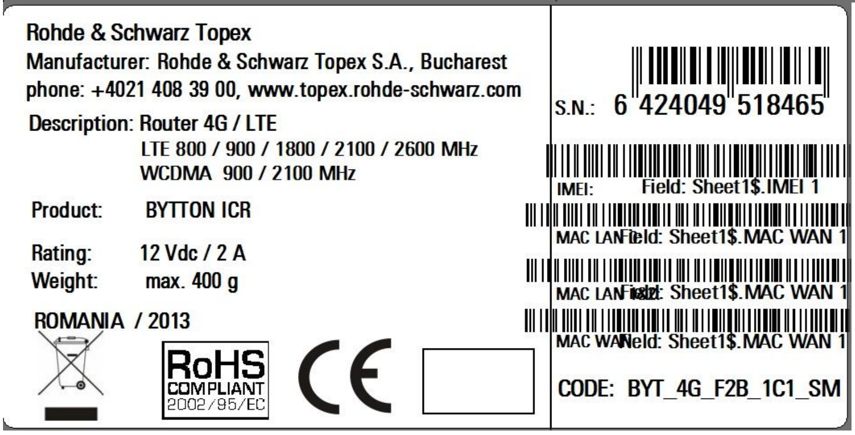
ROMANIA / 2013

S.N.: 6 424049 494462
IMEI: Field: Sheet1$.IMEI 1
MAC LAN Field: Sheet1$.MAC WAN 1
MAC LAN Field: Sheet1$.MAC WAN 1
MAC WAN Field: Sheet1$.MAC WAN 1
CODE: BYT_3G_F2Y1_2W_SM

RoHS COMPLIANT 2002/95/EC

CE

- and respectively for the 4G (LTE) version of Bytton ICR:



Rohde & Schwarz Topex
Manufacturer: Rohde & Schwarz Topex S.A., Bucharest
phone: +4021 408 39 00, www.topex.rohde-schwarz.com

Description: Router 4G / LTE
LTE 800 / 900 / 1800 / 2100 / 2600 MHz
WCDMA 900 / 2100 MHz

Product: BYTTON ICR

Rating: 12 Vdc / 2 A
Weight: max. 400 g

ROMANIA / 2013

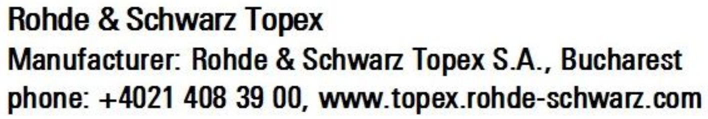
S.N.: 6 424049 518465
IMEI: Field: Sheet1$.IMEI 1
MAC LAN Field: Sheet1$.MAC WAN 1
MAC LAN Field: Sheet1$.MAC WAN 1
MAC WAN Field: Sheet1$.MAC WAN 1
CODE: BYT_4G_F2B_1C1_SM

RoHS COMPLIANT 2002/95/EC

CE

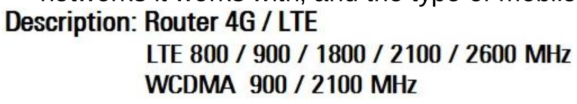
As shown in the example above, the labels include barcodes and refer to the following data:

- Manufacturer identification (name, phone, web site);



Rohde & Schwarz Topex
Manufacturer: Rohde & Schwarz Topex S.A., Bucharest
phone: +4021 408 39 00, www.topex.rohde-schwarz.com

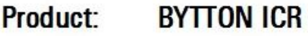
- Model identification, and details of variant, in this case the type and frequencies of mobile networks it works with, and the type of mobile modules:



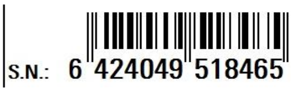
Description: Router 4G / LTE
LTE 800 / 900 / 1800 / 2100 / 2600 MHz
WCDMA 900 / 2100 MHz

This allows the network operator to check the terminal as one of its approved models, so no additional certification or approval is required;

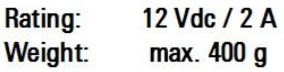
- Product name and / or description:


Product: BYTTON ICR

- Serial number form the manufacturer:


S.N.: 6 424049 518465

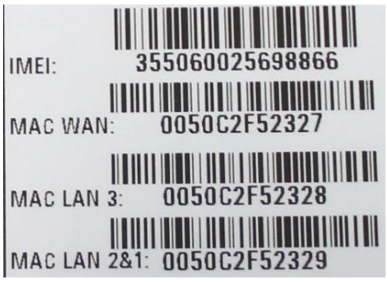
- Rating and Weight: power supply requirements and mass.


Rating: 12 Vdc / 2 A
Weight: max. 400 g

Network identification:

- IMEI code, International Mobile Equipment Identity for SIM based equipments. A unique 15- or 17-digit number such as <<269751923786501>> or <<355060025698866>> that identifies an individual mobile station to a GSM or UMTS network handset.

This IMEI code is on all GSM and UMTS mobile terminals, commonly found in Europe, Asia, Africa and increasingly in America. When the Rohde & Schwarz Topex S.A. device features several mobile modules (there are voice/data routers featuring two, four modules or more) - it will have, correspondingly, more IMEI labels - one for each mobile modem;


IMEI: 355060025698866
MAC WAN: 0050C2F52327
MAC LAN 3: 0050C2F52328
MAC LAN 2&1: 0050C2F52329

- Identification for the Ethernet network can include **MAC** for local and remote side. Bytton ICR features several MACs, for its up to four Ethernet interfaces. Typically these are MAC LAN, the Media Access Control address (unique hardware number) on the local network side and MAC WAN, the Media Access Control address on the side of the external network.
- As can be seen in the example above, Bytton ICR has one MAC for WAN, one for the WAN/LAN port 3, and a single one for the LAN ports 2 and 1, which are joined together in a switch;

Default connect

Default IP address of the Rohde & Schwarz Topex S.A. device in the local LAN and type of connection. For Bytton ICR, the default is **https**, with IP address **192.168.1.1**

Warning!

Please read carefully this label or the manual before attempting connection, since different Rohde & Schwarz Topex S.A.equipments may have different default IP addresses, such as 172.16.173.20. or 10.0.0.1. The Bytton ICR router has, as shown the default address: ***192.168.1.1.*** *Also, the label and the manual clearly specifies the* ***type of connection****, which is HTTPS. Most Rohde & Schwarz Topex S.A. devices such a secure connection, only a few use the ordinary http link. If you try to use the wrong type of connection, even if the IP address is correct, it will not work, so please read the manual or look at the "Default connect" label before establishing a connection to the Rohde & Schwarz Topex S.A. box.*

EMC, Safety, and CE Directive Compliance.

RoHS
COMPLIANT
2002/95/EC

The **WEEE** (Waste Electrical and Electronic Equipment Statement) directive places an obligation on EU-based manufacturers, distributors, retailers, and importers to take back electronics products at the end of their useful life.

The sister Directive, **ROHS** (Restriction of Hazardous Substances) complements the WEEE Directive by banning the presence of specific hazardous substances such as lead in the products at the design phase. The "forbidden waste bin" symbol shown on the label of Rohde & Schwarz Topex S.A. device or on its packaging indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of the device by handing it over to a designated collection point for the recycling of electrical and electronic waste. By means of the **RoHS** (Restriction of the Use of Hazardous Substances) tag, Rohde & Schwarz Topex S.A. SA. confirms that its products comply with the chemical concentration limitations set forth in the directive 2002/95/EC of the European Parliament (Restriction Of the use of certain Hazardous Substances in electrical and electronic equipment - RoHS)

Product version (CODE):

CODE: BYT_4G_F2B_1C1_SM

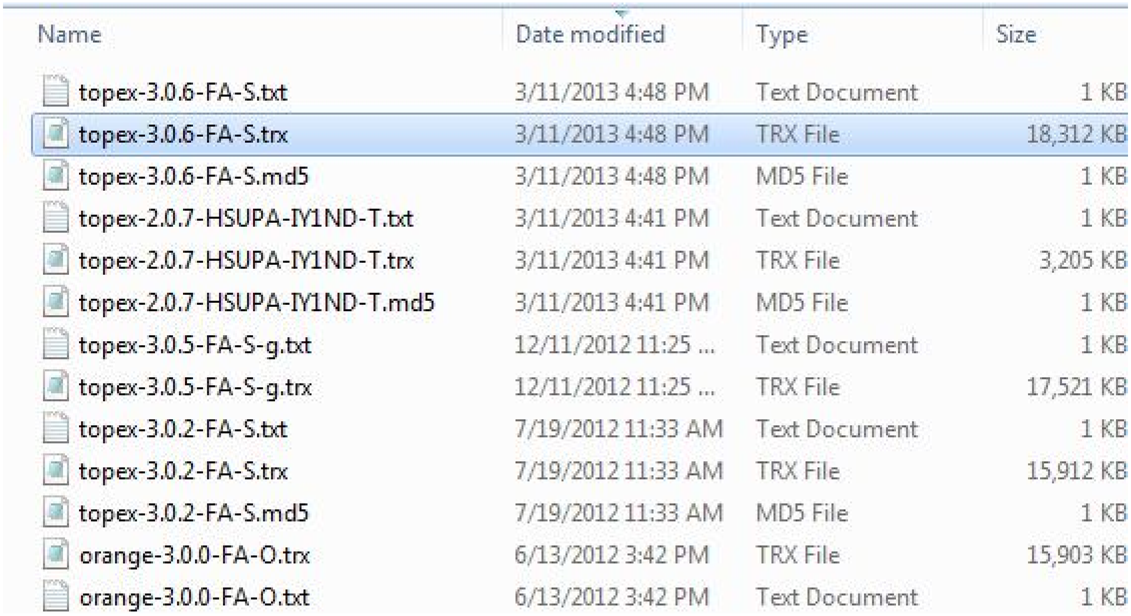
CODE: BYT_3G_F2O_SM

This label indicates exactly what type of product it is.

You must mention this code when you call Support for upgrade and for repairs.

Also, when you perform software upgrade, you must check that the firmware version you want to load is adequate for your model of equipment.

See next a listing of such firmware "images":



Name	Date modified	Type	Size
topex-3.0.6-FA-S.txt	3/11/2013 4:48 PM	Text Document	1 KB
topex-3.0.6-FA-S.trx	3/11/2013 4:48 PM	TRX File	18,312 KB
topex-3.0.6-FA-S.md5	3/11/2013 4:48 PM	MD5 File	1 KB
topex-2.0.7-HSUPA-IY1ND-T.txt	3/11/2013 4:41 PM	Text Document	1 KB
topex-2.0.7-HSUPA-IY1ND-T.trx	3/11/2013 4:41 PM	TRX File	3,205 KB
topex-2.0.7-HSUPA-IY1ND-T.md5	3/11/2013 4:41 PM	MD5 File	1 KB
topex-3.0.5-FA-S-g.txt	12/11/2012 11:25 ...	Text Document	1 KB
topex-3.0.5-FA-S-g.trx	12/11/2012 11:25 ...	TRX File	17,521 KB
topex-3.0.2-FA-S.txt	7/19/2012 11:33 AM	Text Document	1 KB
topex-3.0.2-FA-S.trx	7/19/2012 11:33 AM	TRX File	15,912 KB
topex-3.0.2-FA-S.md5	7/19/2012 11:33 AM	MD5 File	1 KB
orange-3.0.0-FA-O.trx	6/13/2012 3:42 PM	TRX File	15,903 KB
orange-3.0.0-FA-O.txt	6/13/2012 3:42 PM	Text Document	1 KB

When you load a new firmware, remember that this, the first letters, that describe the hardware, must be the same – for instance if you own a Bytton VoIP with the label "BYT_3G_F2Y1_2W_SM" you should look for firmware images with names like "FA-S", and **not** other versions!
The three digits show the firmware revision (such as 2.0.7 or 3.0.6 in the above examples).

Of course you **can** load a firmware image with more features, a customized or a newer / updated version, but the letters describing the hardware model must correspond.

The hardware information is important, however the Code printed on adhesive tab cannot ensure the precise type and version of firmware, because the application software can very easily be updated or upgraded by the user.
After such a firmware update, the application program running on the Rohde & Schwarz Topex S.A. device may no longer be the same that was described by the label on the bottom of the case of the device.

To learn about the current firmware, please use the Web interface of the device, as shown in the next paragraph!

3.4 Software Information

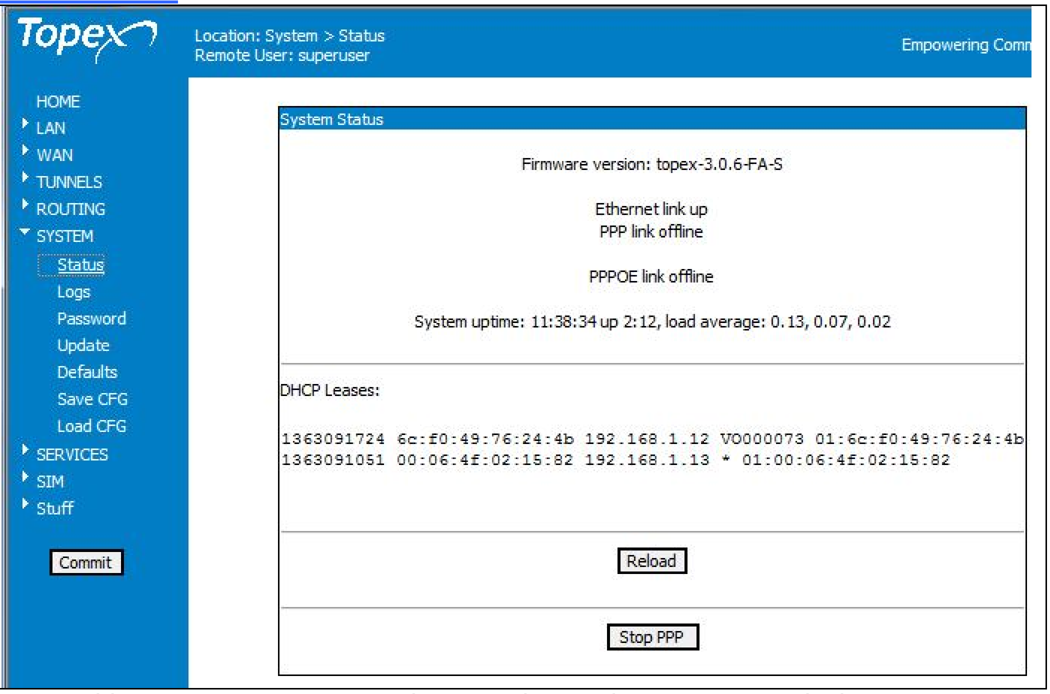
The Web interface displays some of the information described above, but also important additional information, which is NOT available through the adhesive tags.

Such information is related to the serial of the motherboard of the device, or the software version actually running on it.

For this you must access the System> Status page. Just enter into the browser the URL for the page: **https://192.168.1.1**

System Status

The updated information about serial number, hardware version, current firmware, uboot and kernel can be found in the option Status – *System Information* of the menu page SYSTEM, as shown here:



Location: System > Status
Remote User: superuser

System Status

Firmware version: topex-3.0.6-FA-S

Ethernet link up
PPP link offline

PPPOE link offline

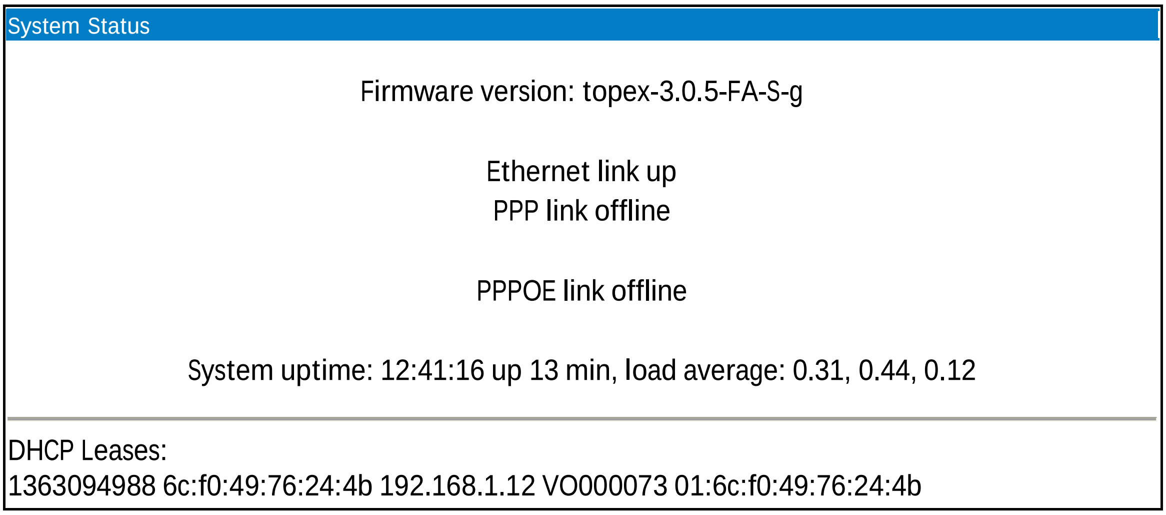
System uptime: 11:38:34 up 2:12, load average: 0.13, 0.07, 0.02

DHCP Leases:

```
1363091724 6c:f0:49:76:24:4b 192.168.1.12 VO000073 01:6c:f0:49:76:24:4b
1363091051 00:06:4f:02:15:82 192.168.1.13 * 01:00:06:4f:02:15:82
```

To be able to see this Status page, one must be logged-on to the Bytton VoIP device.

As can be seen in these examples:



System Status

Firmware version: topex-3.0.5-FA-S-g

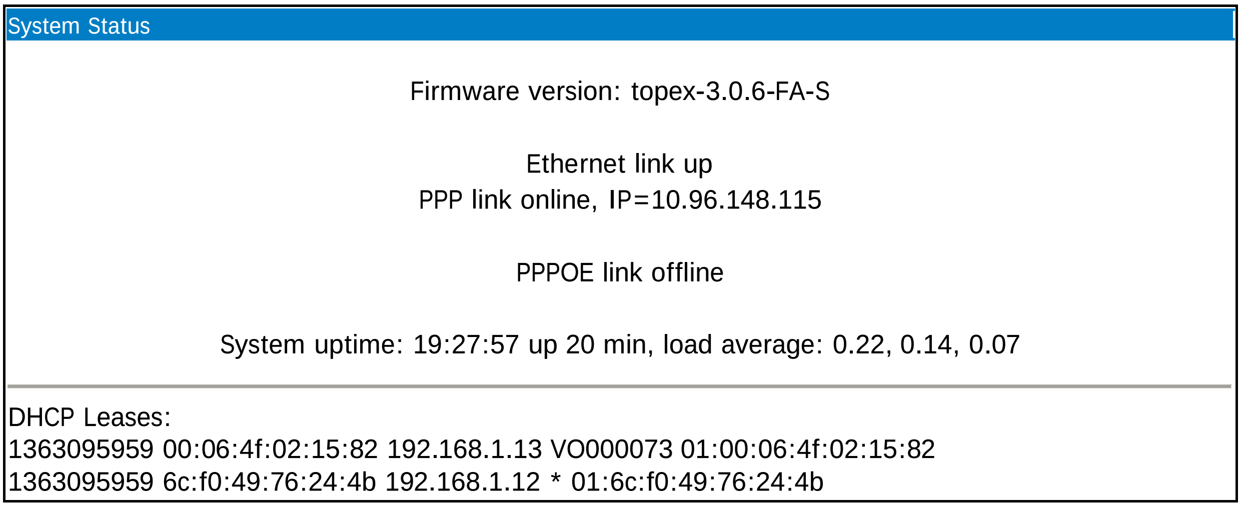
Ethernet link up
PPP link offline

PPPOE link offline

System uptime: 12:41:16 up 13 min, load average: 0.31, 0.44, 0.12

DHCP Leases:
1363094988 6c:f0:49:76:24:4b 192.168.1.12 VO000073 01:6c:f0:49:76:24:4b

Or:



System Status

Firmware version: topex-3.0.6-FA-S

Ethernet link up
PPP link online, IP=10.96.148.115

PPPOE link offline

System uptime: 19:27:57 up 20 min, load average: 0.22, 0.14, 0.07

```
DHCP Leases:
1363095959 00:06:4f:02:15:82 192.168.1.13 VO000073 01:00:06:4f:02:15:82
1363095959 6c:f0:49:76:24:4b 192.168.1.12 * 01:6c:f0:49:76:24:4b
```

two categories of information are displayed in System Status:

- **Equipment info**, permanent data, which is important for this chapter – the exact firmware version;
- **System info**, with temporary (current) data, such as state of different links (ETH, PPP, PPPoE) uptime, load, DHCP leases, etc;

The ***permanent*** identification info shown refers to the Firmware version: topex-3.0.5-FA-S-g, topex-3.0.6-FA-S, orange-3.0.1-FA-O and so on.

Format for the Name of the firmware image file:

[brand]-[version]-[type]-[release]-[package].trx
brand - indicates the brand used for the respective firmware. It may be Topex, Omniacom, Vodafone, Orange , etc.
version – the firmware version, three numbers divided by decimal points, such as 1.2.1 or 2.0.7 or 3.0.6
type - mobile network used for the product (HSPA, CDMA, UMTS, GPRS, EDGE)
release – the “release” field may contain up to three letter:
1 – Type of platform, such as F
2 - Type of mobile modem used, such as A
3 – Standard or special requirements
package - P - plastic, M - metal

Examples:

topex-0.5.9-cdma-nad-p.trx

orange-3.0.1-FA-O.trx

topex-3.0.6-FA-S

4. INSTALLATION

In order to ensure the proper operation of the Bytton ICR equipment you must follow the set-up steps shown below:

- Establish the best location
- Identification of connectors
- Mounting (Hardware installation)
- Connecting the data cables
- Connecting the telephone cables (for the versions with FXS port)
- Configuring and installing the SIM cards
- Connecting the external antennas (for Mobile and respectively for Wi-Fi)
- Power up.

4.1 Establishing the best location

In order to determine the best location for the ROHDE & SCHWARZ TOPEX S.A. router please have in mind these considerations:

• If you use wired connections, the length of the Ethernet cables that connects the Bytton routers the network must not exceed 100 meters.

• Bytton ICR should be placed on a flat, sturdy surface located as far from the ground as possible. A high location, on the wall or on top of a desk or a shelf is best both for the GPRS or HSPA+ connection. Also, Bytton ICR should be kept clear of obstructions and away from heat sources, direct sunlight and heavy-duty electrical equipment.

• To ensure good coverage to all of the wireless mobile devices in your area Bytton ICR should be installed in a central place in the building. Normally the antennas should be in vertical position, but if reflections occur, you may get better results by changing their orientation.

• For power supply, use only the adapter shipped with Bytton ICR. The jacks of different power supplies may fit but the polarity, current, voltage or regulation factor may not be compatible.

• While the device is in operation, the antennas of the Bytton ICR unit should be at least 30 centimeters away from any human being.

4.2 Mounting (hardware installation)

The Bytton ICR router can be mounted horizontally, by means simply placing it on a flat surface, or into a rack, attached to a DIN rail, using the supplied mechanical adapter.

4.2.1 Horizontal Mounting

This kind of mounting is the simplest, you just place the metallic case of Bytton on a flat surface! The respective surface must be level and strong enough to hold the weight of Bytton ICR together with its cables (power supply, antennas, wired LAN or WAN connections, serial and so on).

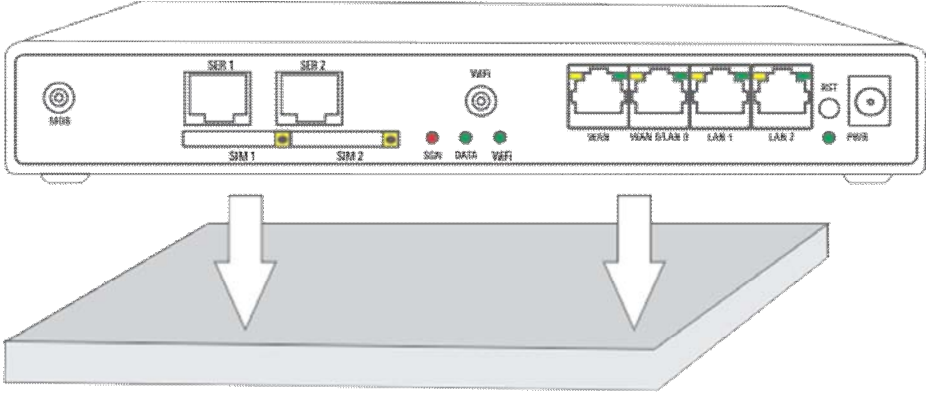


Figure 4-1: Horizontal mounting of Bytton ICR.

A desk, table or shelf is good place for the installation of Bytton ICR wireless router.

Generally, the best location for Bytton ICR is in the middle of the place where you want to have wireless coverage. Installing Bytton LTE on a shelf higher up, with no obstructions around, ensures the best performance for the mobile modem.

Take care to avoid obstructions, in order to ensure adequate cooling of the equipment!

4.2.2 Rail Mounting

For good environmental protection and outdoors usage, the Bytton ICR router must be placed inside a waterproof and dust enclosure.
To this purpose, Bytton LTE was designed to be easily mountable on a standard DIN rail (omega rail, 35 mm wide), by means of a mechanical adapter. The adapter bracket is attached to the corresponding holes at back of the Bytton unit, as shown in the following drawing:

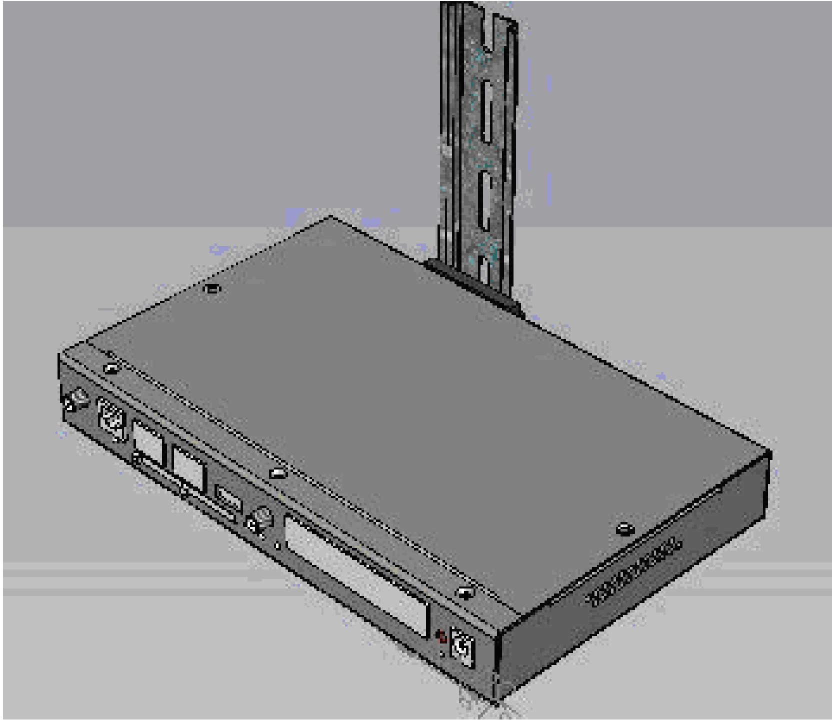


Figure 4-2: Schematic of Bytton ICR attached to a DIN Rail

Mounting of the equipment

Attaching the Bytton box to the rail is done with the help of a mechanical adapter (mounting kit).
This mounting kit includes a mechanical adapter, a bracket with hooks and clamps that allows easy clipping / unclipping of the Bytton case to the Omega DIN rail.

The steps required to mount Bytton LTE on the standard omega DIN Rail are described next:
1. first, attach the mechanical adapter (bracket) to the back of the metallic case of Bytton.
The fastening is done by means of a pair of **M3** mechanical screws – use two M3 x 8 screws.

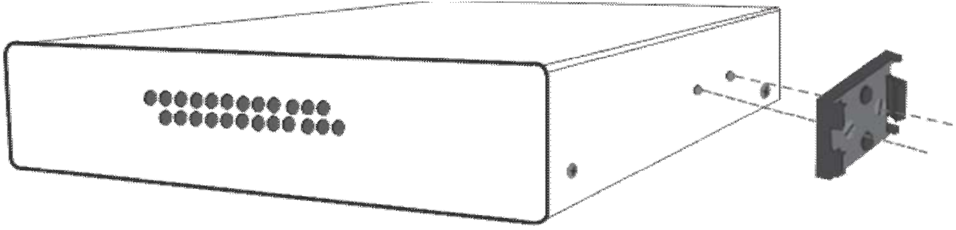


Figure 4-3: Attach the mechanical adapter to the back of the case of Bytton ICR

Correct position for the adapter

The upper part of the adapter (the one with two hooks) must be towards the left of the Bytton case (the edge opposed to the side with the power jack).

2 attach the Bytton ICR equipment to the DIN Rail, as indicated in the schematic drawing (only the adapter is figured):

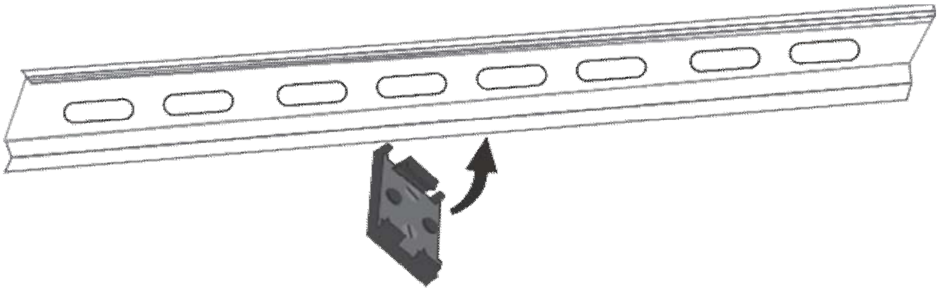


Figure 4-4: Attach the equipment to the DIN rail, by means of the adapter.

To attach it, clip the assembly (Bytton + bracket mounted on it) onto the upper side of the DIN rail with the two upper hooks.
The lower clamp is not yet attached to the rail, allowing you to move the Bytton equipment over the DIN rail, to the left or to the right.

2. **slide the Bytton assembly** on the DIN rail

When Bytton has been moved to the intended location, press it towards the back so that the lower clamps also fastens to the DIN rail.
Now Bytton ICR equipment is locked into place over the DIN rail:DIN rail, up to the position you want.
View from the back, after complete attachment to the rail:

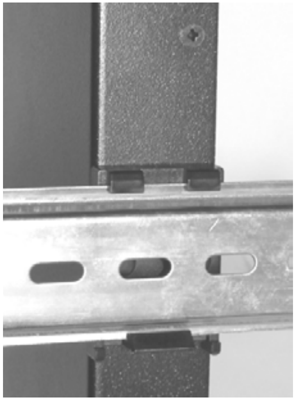


Figure 4-5: Bytton LTE fastened to the DIN rail

Note:
<u>No matter how the equipment is mounted, always take care to ensure adequate cooling of the Bytton ICR mobile terminal.</u>

4.3 Identification of connectors

Bytton ICR features several external connectors and indicators, as described next..

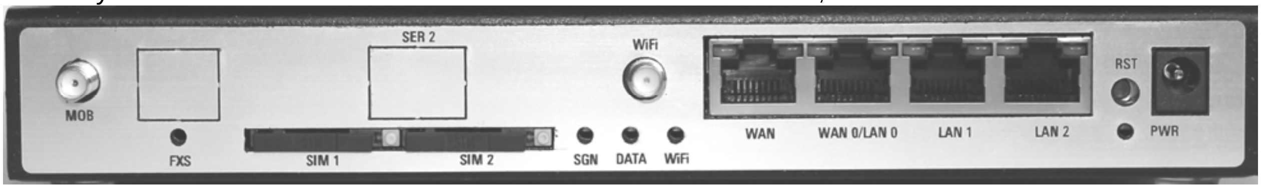


Figure 4-6: Image of indicators and Connectors of Bytton ICR with one serial interface

The concrete appearance depends upon the current equipping of the Bytton LTE, for instance you may have:

- two SIM slots or a single one
- one, two or none serial interfaces
- connector and indicator for Wi-Fi access point
- dual antenna connectors for Mobile and /or for Wi-Fi, and so on – the example above is for a unit with a single serial interface, two SIM holders, and Wi-Fi capabilities!

Typically, on the front panel of the Bytton LTE equipment there are, from left to right:

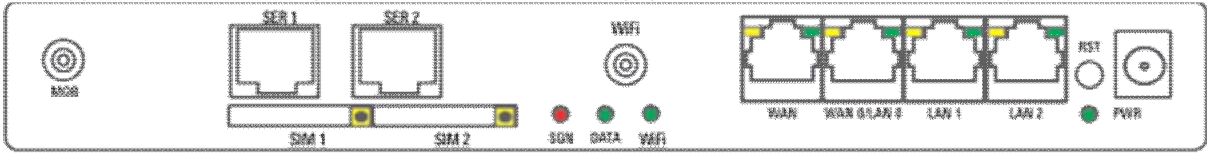
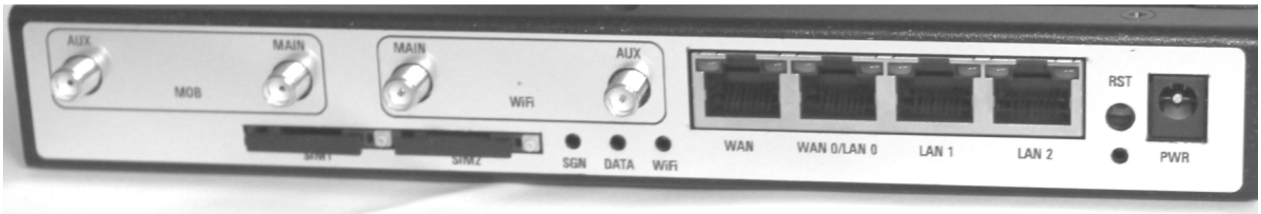


Figure 4-7: Drawing of indicators and connectors of an "advanced" Bytton LTE, fully equipped.

- a first circular RF connector (female), for the Mobile antenna **(labeled MOB)**
- in case of antenna diversity modules for LTE, there are two MOB connectors, labeled "AUX" and respectively "MAIN". Always thread the connector for Main first!



- one, two or none RJ45 connector for serial data link (**labeled SER1, SER2)**
- near the center, a second circular RF connector (male, with protruding pin), for the wireless local network (**labeled Wi-Fi**)

- in case of wireless AP type N, that use antenna diversity, instead of one Wi-Fi there are again two antenna connectors for Wi-Fi. They are also labeled "AUX" and respectively "MAIN".
  The connectors for multiple antennas replace the SER connectors, thus the Bytton LTE equipments featuring three or four antenna connectors cannot have also connectors for serial connections;
- under these, the one or two slot (tray holder) for the SIM card(s), each with its small yellow pushbutton (**labeled respectively SIM1 and SIM2**)
- near the center, three optical indicators: LEDs for RF Signal, Data and respectively Wi-Fi access point (**labeled SGN, DATA, Wi-Fi**).

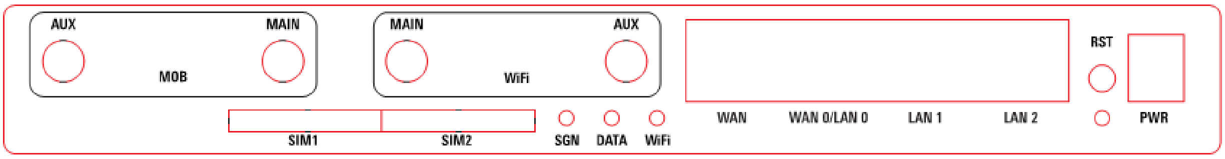
Note: for equipments that are not fitted with the Wi-Fi module, both the Wi-Fi connector and the associated Wi-Fi indicator will be missing!

A group of four female metallic RJ45 connectors for Ethernet network connections, with different assignments:

- The first (rightmost) female metallic RJ45 connector (**labeled WAN)** is for the external network
- The two leftmost ones **(labeled LAN1, LAN2)** are in a physical switch, and logically they are in a bridge with the wireless local network (Wi-Fi). These two ports can be also assigned individual IP addresses.
- The middle connector **(labeled respectively WAN 0/LAN 0)** may be configured from the Web configuration pages, according to your requirements. As its name suggests, the either to a second external, Wide Area Network, or to the switch for the local network (LAN);
- All four ETH connectors include yellow and green indicator LEDs.
- the black Reset button, recessed (**labeled RST**)
- below it, the Power LED, of green color
- Towards the right edge, the round connector for the power supply jack, (labeled **PWR)** (12V_{DC}) .

Antenna Diversity Variants

The versions of Bytton LTE equipment for antenna diversity or MIMO (multiple input/output) feature two antenna connectors (labeled MAIN and respectively AUX) for the Mobile network and / or for the Wi-Fi access point.



As can be seen, these multiple-antenna variants have no room on the front panel for SER, USB or FXS connectors!

4.4. Connecting the data cables

To ensure a proper functioning of the Bytton ICR unit, you must make the right cable connections, as described below.

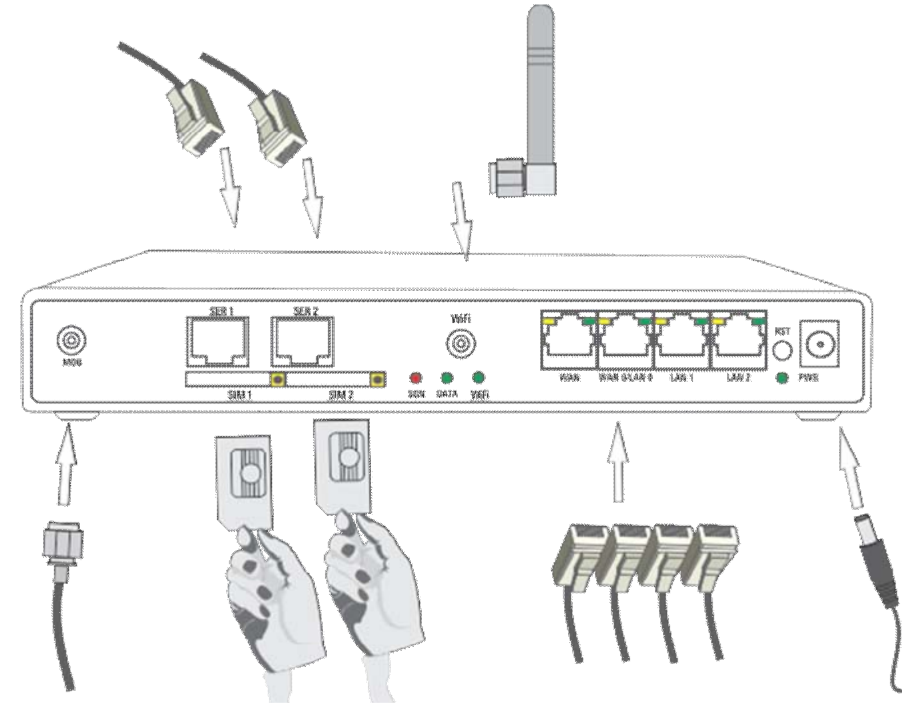


Figure 4-8: Connecting all the cables and accessories to Bytton

For local network connection:

Use standard UTP network cables (CUT 5) fitted with RJ45 connectors at both ends. The cables can be either straight-through or crossover, since the three-port switch of Bytton ICR is auto-crossover.

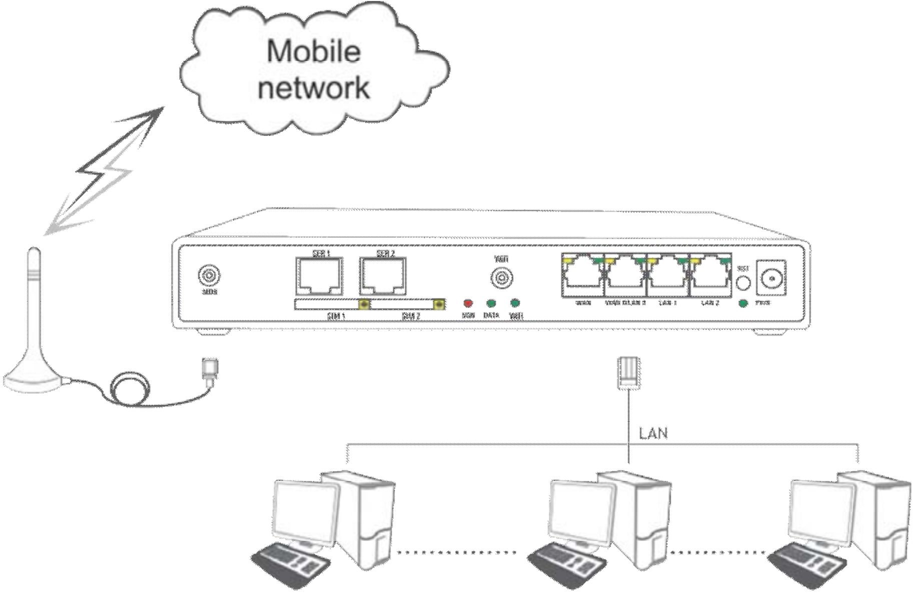


Figure 4-9: Connecting the LAN cables

One short length of RJ-45 cable is supplied with the BYTTON Router. You may use either 10Base-T or 100Base-T connection, and both types of Ethernet connections maybe used on the same time.

The network cables are to be inserted with one end into the RJ-45 sockets of the Bytton LTE equipment labeled **LAN1** or **LAN2, also LAN0** **<u>when it is configured as local port</u>**.

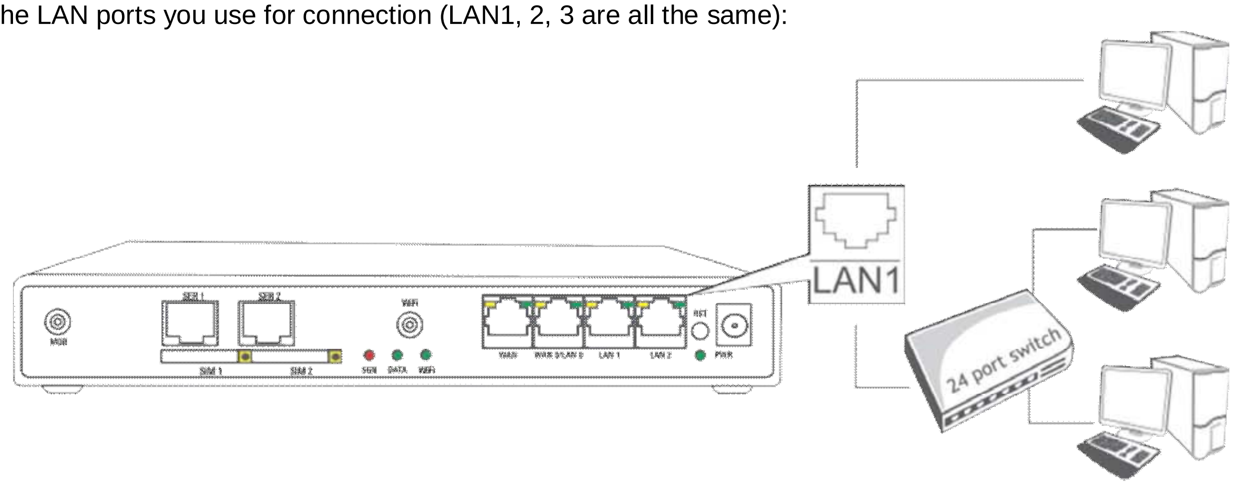
Take care, when each of the LAN ports gets an individual IP address, the connections must be performed accordingly, the ports are no longer identical!

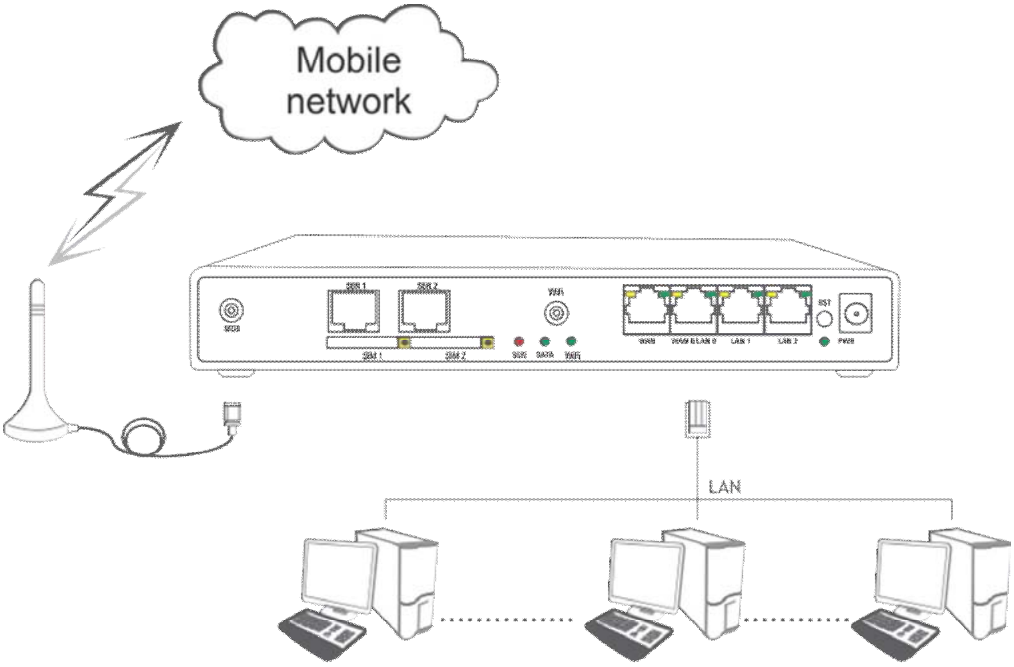
The same applies for the situation when you disable two of the local ports so only one LAN port is usable – you must insert the Ethernet cable into the right port!
The opposite end of the UTP cable can be inserted in switches or hubs or directly into PCs or specific equipment with the respective IP configured.

The corresponding LED indicators embedded into each of the connectors on the front panel should light up, showing at first physical connection (the green LED) then also data traffic on the respective Ethernet interface (the yellow LED).

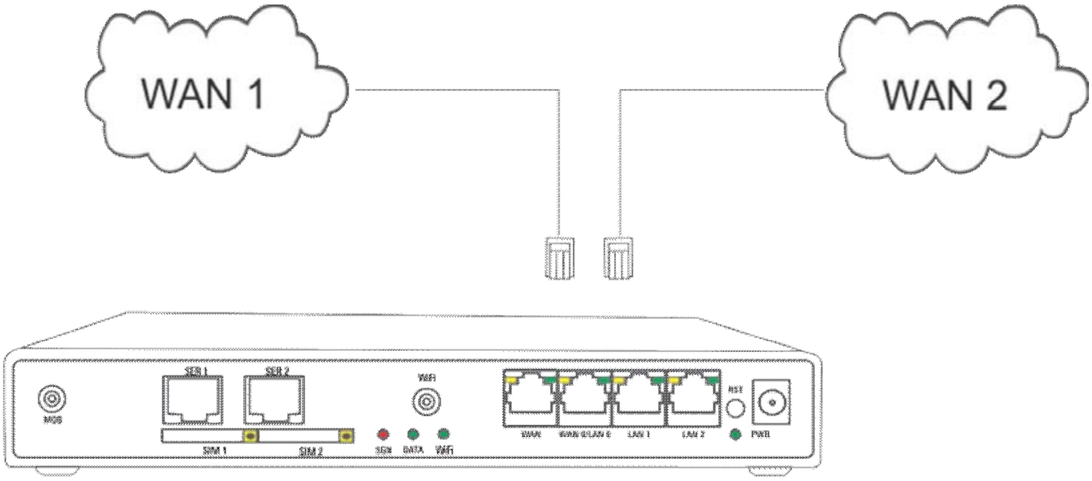
<u>WAN0/LAN0 connection:</u>

Take care when the configurable ETH connector labeled “WAN0/LAN0” is set to secondary WAN instead of LAN.
By default, all three LAN ports are connected in the same switch, so it does not matter at all which of the LAN ports you use for connection (LAN1, 2, 3 are all the same):





But when you set an IP for the WAN0/LAN0 port, it will be taken off from the switch and treated as a WAN port, leaving only the two rightmost ETH connectors in a switch for the Local cabled network:



In this case, you must take care where you connect the LAN cable(s) and where the one or two WAN cable(s)!

For WAN connection:

Plug one end of the cable into the RJ45 port labeled “WAN” on the front panel of the Bytton LTE device and the other end into the Ethernet port of the DSL,
Cable modem or other equipment that achieves a connection to the external network.

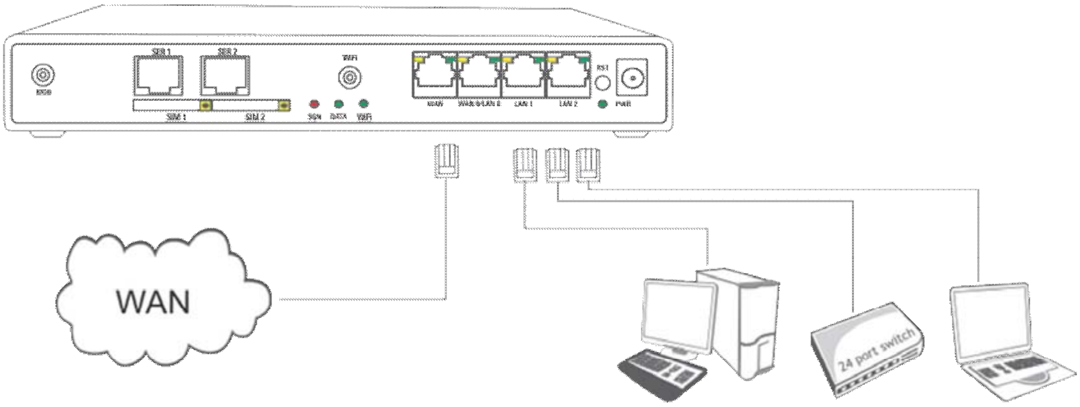
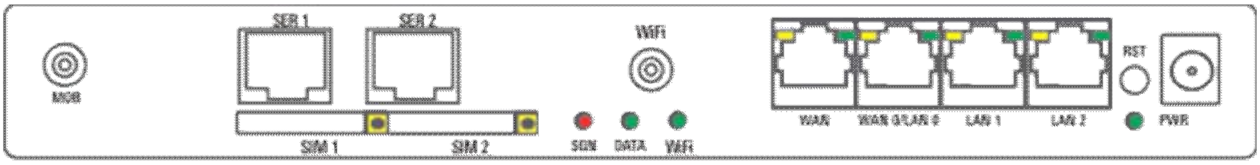


Figure 4-10: Connecting the WAN cable

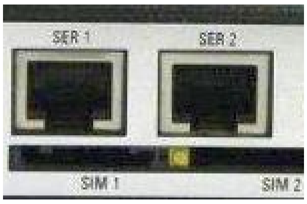


The leftmost ETH connector is always the WAN port.
But you may set from the Web configuration pages the WAN0/LAN0 connector also as WAN port, and then connect the WAN cable accordingly!

Connecting the serial cable(s) :

In case of R&S Topex equipments fitted with serial interfaces, you may connect legacy devices fitted with serial interfaces to the Bytton rICR outer, using special serial cables.

Serial connectors



Bytton features on the front panel one or two RJ-45 connectors for the serial interfaces. These connector don’t have embedded LED indicators, and the metallic casing is tied to the electrical ground.
This is why special connection cables must be used, which feature a RJ-45 male connector towards the Bytton LTE and a DB-9 female or DB-25 male or female connector towards the legacy equipment (type DTE or DCE).

Software configuration

You can establish from the Web configuration interface how your data packet will be is sent over the serial interfaces: with 7 or 8 bit words, with or without start, stop, and parity bits, what kind of flow control shall be used (X-On/X-Off, none or hardware), and of course the transfer speed. But you cannot select from the Web interface if the serial link is RS-232 or EIA-485, this is established at the factory!

Type of serial link

When you order the Bytton LTE equipment with serial interfaces, you must specify, whether the serial interface shall be RS-232 or RS-485. *The selection is done in the manufacturing process, the type cannot be changed via Web interface for configuration or by means of jumpers*.
This choice determines the voltage level and the pin assignment on the RJ-45 connectors.

RS-232

RS-232 connection in not of the minimal "3-wire" type, consisting only of transmit data, receive data, and ground, but includes also hardware flow control: it also uses the RTS and CTS lines (5-wire version). RTS is “ Request To Send”, issued from the DTE towards the DCE, telling it to be prepared, while CTS is “Clear To Send”, issued by the DCE to show that it is ready to accept data.

RS-485

When you specify the variant with serial interfaces implementing the EIA-485 standard, you get an interface with multi-drop capability, which may be used effectively over long distances and in electrically noisy environments. The RS-485 variant is often used in industrial environments and similar field applications.
Bytton LTE implements the full-duplex, four wires mode of operation. The signal ground is also available on the connector, although it is not absolutely required.
The connector has a termination resistor connected across the two wires of each pair, to eliminate reflections and two powered resistors to bias the lines apart when the lines are not being driven.

RJ-45 Serial Connector Pinout

PIN Number	RS-232	RS-485
1	RTS	TX
2		-TX
3	TX	RX
4		-RX
5	GND	GND
6	RX	
7		
8	CTS	

The other pins of the serial connectors are not currently used. The metallic casing of the connectors is tied to the signal ground.

Connection

Just insert the RJ-45 connector into the corresponding receptacle (SER1 or SER2) on the front panel of Bytton LTE, as shown:

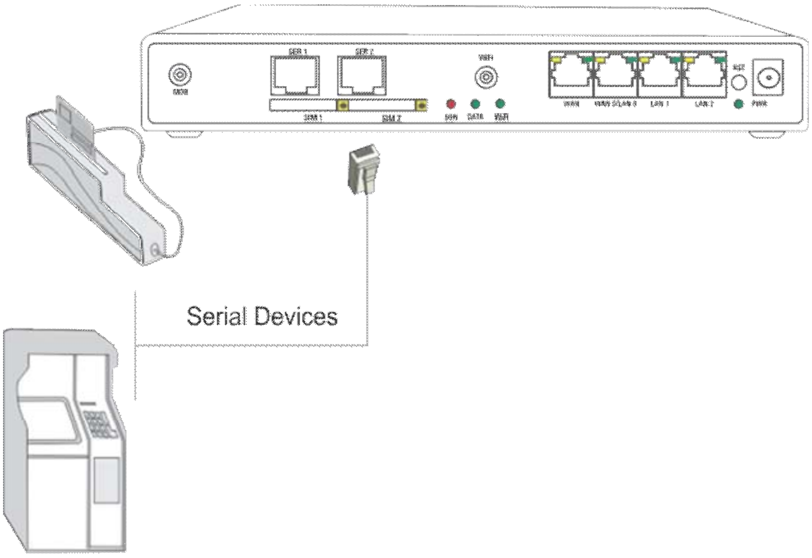


Figure 4-11: Connecting the serial cables to Bytton LTE

<u>For power supply:</u>

To power the Bytton LTE unit, just insert the jack of the power supply adapter into the supply connector. Do **not** yet plug the adapter into the 230V$_{A.C.}$ mains outlet on the wall.

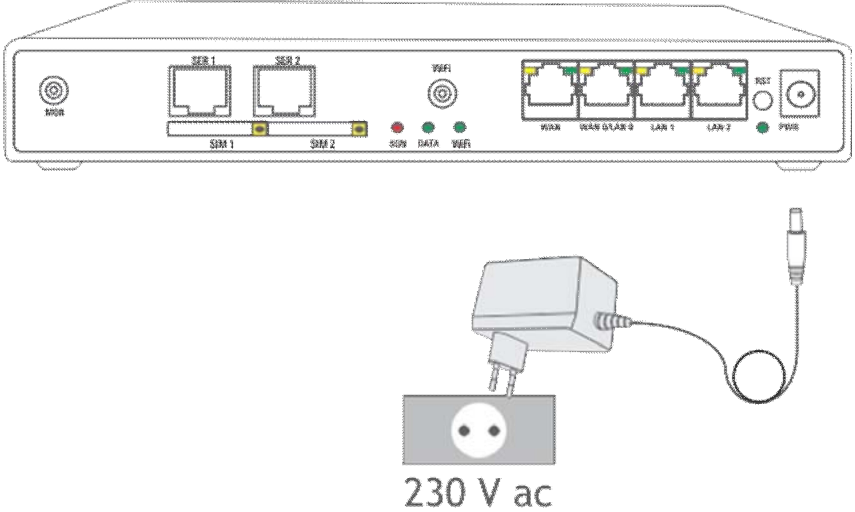


Figure 4-12: Connecting the power supply to Bytton

The special adapter from Rohde & Schwarz Topex S.A., which is part of the Bytton LTE package, supplies the voltage required to power the equipment. It is an external power supply adapter (Input 100-240VAC, 50 or 60 Hz, output +12VDC@2.1A, power output max. 24W).

Note: *The adapter is the disconnection device (there is no POWER switch), so the 230 V$_{AC}$ socket-outlet shall be installed near the equipment and shall be easily accessible.*

Warning !

- Use only the power supply adapter shipped in the equipment package. Using of other kinds of power supplies may cause damage to the equipment.
- To avoid accidents or damage to the equipment, follow the steps described earlier. First, connect the antenna, and then the power supply adapter.
- You should avoid connecting or removing the antennas while the Bytton LTE equipment is powered, shut it down before handling the antennas.

4.5. Configuring and installing the SIM card (s)

Your Bytton equipment may feature a single slot of two slots (dual SIM version) for SIM cards.
In order for the Bytton LTE router to work, it must have at least one valid SIM card with subscription to the GSM/GPRS/EDGE, UMTS/HSPA or LTE mobile data carrier where you want to connect to.

Configuring the SIM card

The SIM card(s) that is used must be active.

- Each SIM card must be configured **before** it is inserted into the slot of Bytton LTE.
- For configuring the SIM card you may use an **ordinary GSM cell phone**.

The required configurations are:

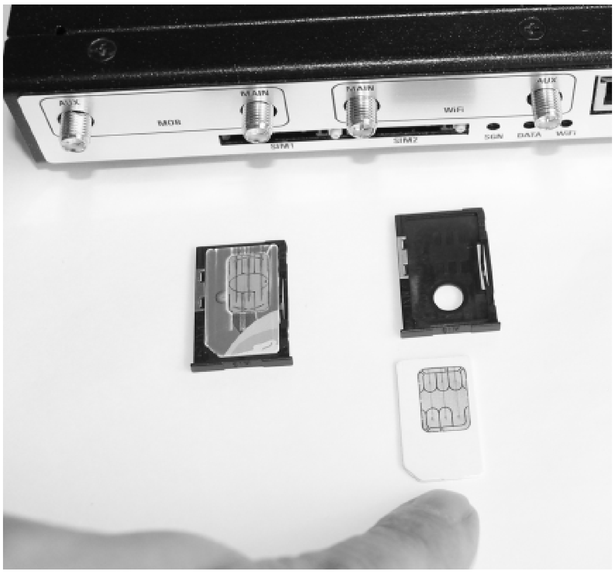
⏩ *PIN CODE REQUEST* – if you disable (from the menu of the mobile phone) *PIN CODE REQUEST* security option, then you will not be asked to enter it.

⏩ Alternatively, the PIN code can be enabled and you may enter it form the Web page used for configuration. *In this case, take care to enter the correct PIN code* ***before*** *inserting the SIM card, to avoid PUK locking!*

⏩ *Disable GSM services* – Mobile operators offers you different supplementary services for calls.

⏩ When you use the Bytton LTE mobile data interface is recommended that these options to be disable, because they are available only with additional costs.

Inserting the SIM card(s)



The SIM card(s) must be inserted into the special slot(s) of the Bytton LTE equipment as shown here.

The slots for SIM card are located on the front panel (the one with the indicators and connectors), to the left of the one or two MOB antennas, towards the bottom (under the SER connectors, if these are present).

In case of dual-SIM equipments, the two slots for SIM trays are side by side, as shown in the illustration.

For inserting or extracting the SIM card use the mobile holder (removable tray) for the respective SIM card.

To actuate the holder, press the little yellow button that is located to the right of each SIM slot.

Handle with care when inserting or extracting SIM cards.

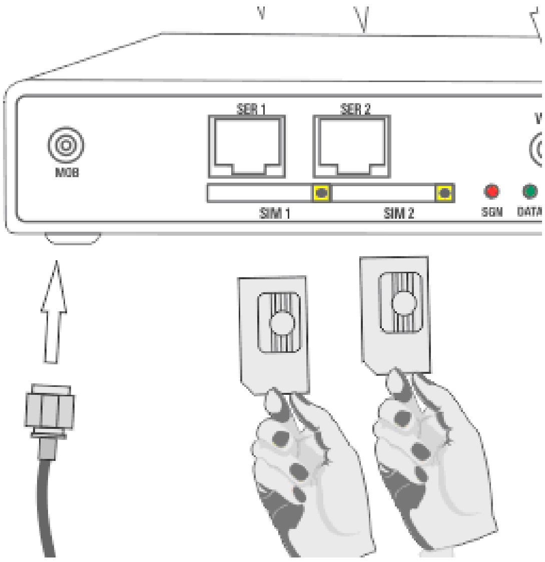
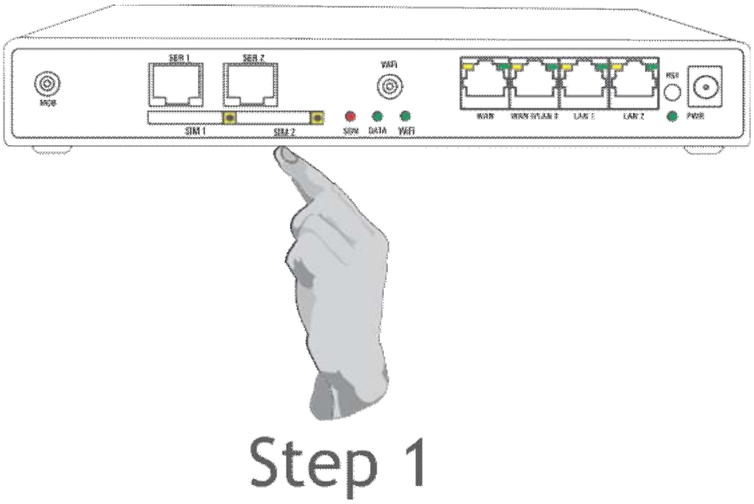


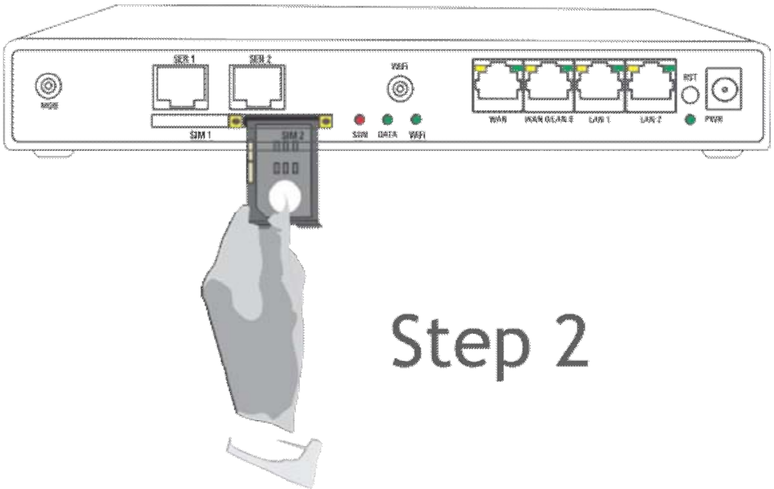
Figure 4-13: Location of the one or two slots for SIM cards

! When inserting or changing the SIM card, the equipment must be powered off.

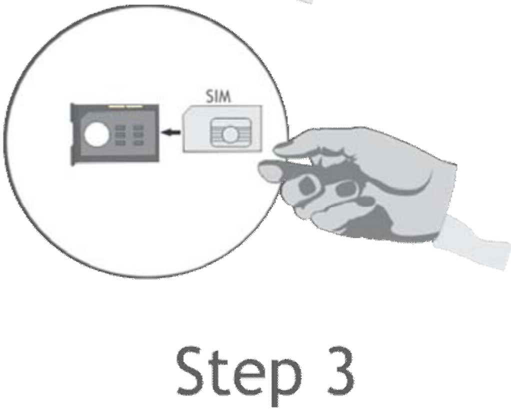
For inserting the SIM card(s) follow the next steps:



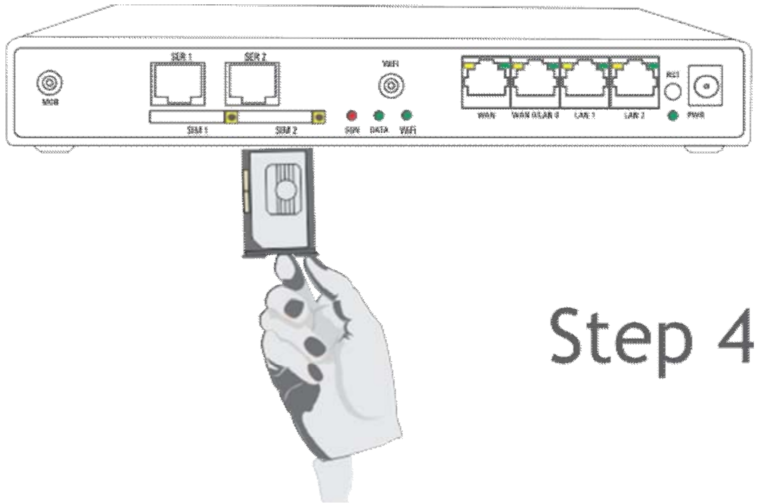
1. Push the little yellow button to eject the SIM carrier.



2. Pull out the holder (tray) for the SIM card.



3. Insert the SIM card into the holder, with the cut (notched) corner orientated upwards and the side with contacts toward you.



4. Push the holder with the SIM card back into the slot and push to close.
Be careful not to drop the SIM out of the tray and to insert the holder properly into the slot!

Figure 4-14: Illustration of the four steps sequence of inserting the SIM card into Bytton LTE.

This procedure must also be followed when you replace the SIM card of the Bytton LTE equipment.

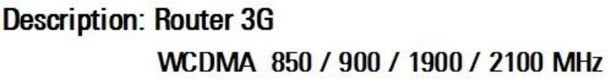
4.6. Connecting the external antennas

To ensure a good quality of transmission and reduce radio interference, always use the antennas shipped in the Bytton ICR package.
These antennas are specially designed for the respective frequency bands:
- 800/850/900/1800 MHz for the GSM / GPRS / EDGE
- in the 900 and 2100 MHz range for UMTS / HSPA+ networks,
- 800/900/1800/2100 MHz and 2600 MHz for LTE
- and respectively 2100 MHz for Wi-Fi.

The antennas must be connected to Bytton LTE via the respective RF circular connector(s) located on the front panel of the metallic case, starting from the left.
There are some differences, according to the type of mobile module and wireless access point that is fitted in your Bytton LTE: different types of antennas shall be used, corresponding to the respective frequency bands, and one or two antennas may be required (there are dual connectors for the antenna diversity – enabled modules).

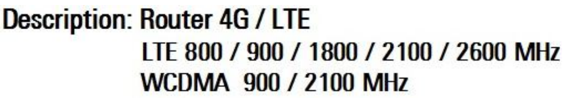
Mobile Antenna

There are two possible cases: the mobile module of Bytton may be either for GSM/3G networks, or for 4G (LTE). This is clearly specified on the product label:



Description: Router 3G
WCDMA 850 / 900 / 1900 / 2100 MHz

Or:



Description: Router 4G / LTE
LTE 800 / 900 / 1800 / 2100 / 2600 MHz
WCDMA 900 / 2100 MHz

This choice dictates the number and type of mobile antennas to be used:

1.GSM/HSPA

For 2G/3G+ modules, a single antenna is used, the small multi-band stick antenna for 2G/3G+ is provided in the package.
The cable for this antenna must be threaded into the circular connector of Bytton LTE labeled “MOB”, located to the left of the metallic case (the first connector to the left), as shown in the illustration:

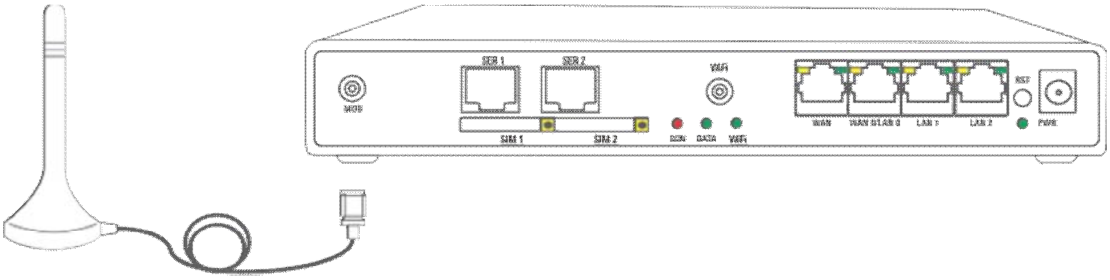


Figure 4-15: Inserting the connector of the GSM/3G Mobile Antenna

2. LTE

The 4G networks use a different type of antenna, and generally **two** antennas are required, to achieve the higher bandwidth specific to LTE (it operates in diversity or MIMI mode).
The one or two antennas for LTE must be threaded to the corresponding Mobile connectors, located to the left of the front panel, and labeled “AUX” and respectively “MAIN”:

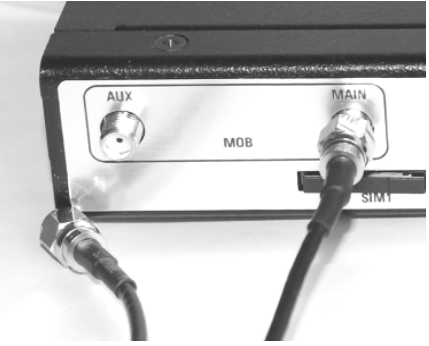


Figure 4-16: Inserting the connectors for the LTE Mobile Antennas (one or two pcs.)

Note:
In case of dual MOB connectors for diversity antennas, don’t forget to connect <u>first</u> the antenna for Main , and only then the second antenna for the Aux connector!
If only the Main antenna is connected, diversity will not operate the performances will be lower, but if you connect only the Aux antenna, the system may not work at all!

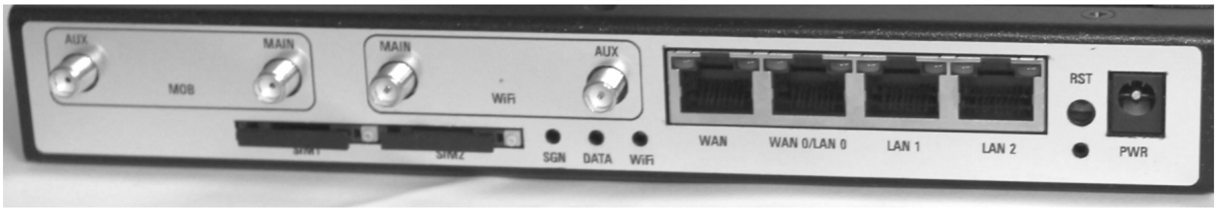


Figure 4-17: Bytton LTE with four antenna connectors, two for LTE (4G Mobile) and two for N-type WiFi access point.

Warning!
When your site has low level of Mobile signal, it may not be possible to use the full UMTS, HSPA+ or LTE technology without a special, high gain antenna (type Yagi, high directivity).
You should get such an antenna and install it in a higher position (the roof of the building), directed towards the base station of the mobile network carrier, in order to get best results.

For further information about the different Mobile antennas available for Bytton ICR, please see Annex 1.

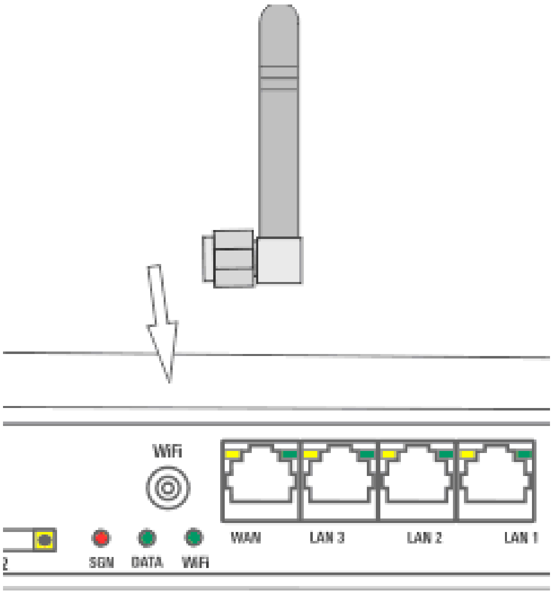
3. WiFi Antenna

The antennas for the WiFi Access Point of Bytton ICR are stick-type, with an articulation near the connector.

In case of Bytton LTE units equipped with WiFi b/g module, a single WiFi stick antenna must be inserted.

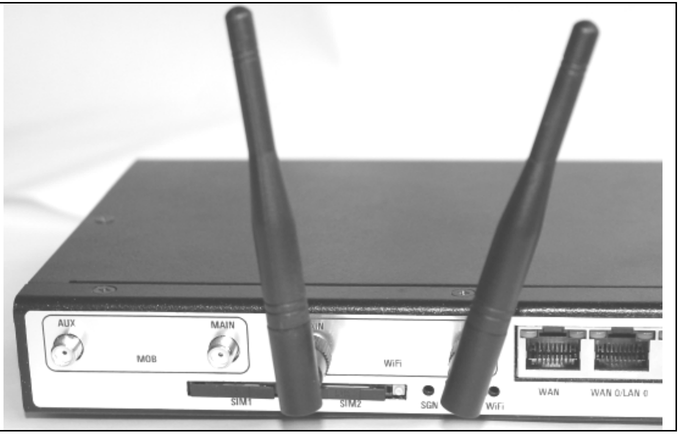
Use the sleeve of the 90 degree bent to thread the stick antenna into the circular male connector on the front panel (marked "WiFi), which is located in the middle, above the three indicator LEDs, as shown in the following drawing.

Figure 4-17: Attachment of a single WiFi Stick Antenna



Dual WiFi connectors

Bytton LTE equipments fitted with "N" type access point may feature dual connectors for WiFi, to achieve better coverage and higher bandwidth.
Thus you shall thread two stick antennas for WiFi!

Here also, you must observe the "Main" and "Aux" indications written under the antenna connectors: Figure 4-18: Attachment of the two WiFi Antenna for N-type wireless AP	 AUX MAIN MOB WiFi SIM1 SIM2 SGN WiFi WAN WAN 0/LAN 0

Note that the connector for the Mobile network is female, while the connector for the WiFi antenna is male, there is no risk of inserting the incorrect antenna.

Warning!
Don't use excessive force when threading the antennas.
Make sure the antennas are securely screwed into the respective RF connectors, but do NOT use a spanner or screw key, which could damage the antenna connector!
Tighten the flange lightly, by hand.

The different types of stick antennas are omnidirectional and have vertical polarization, they should be placed in vertical or horizontal position, depending of the local RF field condition for the respective frequencies bands.

In case of antenna diversity (MIMO) versions of the Bytton LTE equipment, the dual antennas shall be connected in the same way, only taking into account that there are two of them, and the Main antenna must always be connected first, and then the Aux antenna:

Notice:

- The Bytton LTE unit and its antennas should be placed such as to be as far as possible from appliances or office equipment that is sensitive to radio interference (microwave ovens, copiers, TV sets, PC displays, and multimedia systems).
- For best results, try to find for the WiFi and respectively HSPA+ or LTE antennas a place of maximum signal reception.
- In addition, the antenna must NOT be located near heavy-duty equipment that may generate electromagnetic interferences, such as electric motors or heaters.

4.7. Power Up

Power up Bytton ICR by simply inserting the adapter into the wall outlet and the router will start working.
You should see the green PWR indicator LED lighting up immediately. The other optical indicators may be active after all firmware components are loaded and running, and this takes some time – up to two minutes – but the green PWR indicator should ON as soon as you connect the power supply jack.

Warning*: Remember that the adapter is the disconnection device (there is no POWER switch on Bytton LTE), so the 230 V_{AC} socket-outlet shall be installed near the equipment and must be easily accessible.*

4.8. Status indicators

Bytton LTE has several optical indicators (different color LEDs) that shows the status of the device.

These indicators may light up continuously or flash to show activation, type of network, signal strength or data traffic.

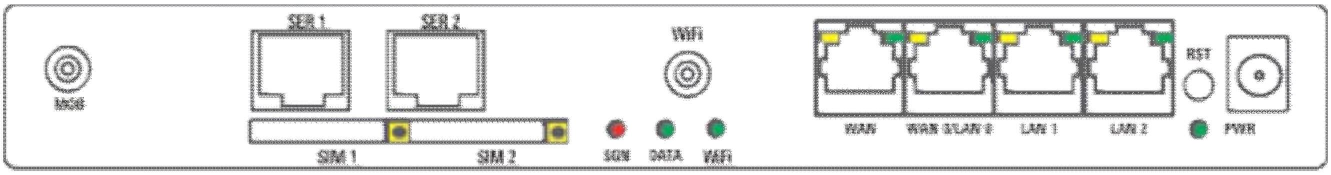


Figure 4-19: Location of indicator LEDs

- Group of indicators in the center

SGN – Red LED, shows for the intensity of the RF signal.
Off indicates no mobile network connection, or no registration.
Blinking show activity, when the signal is stronger, the blinking becomes faster. For instance, when you insert a wrong SIM, at startup the indicator will blink, since the equipment tries to register to the mobile network, but then it will turn off, when the equipment finds out that registration is not possible.
Note: *In case of Bytton LTE devices that are not equipped with Mobile modules, the SGN led will be also missing!*

DATA – green LED. Indicates active connection to the mobile data network, and its type. If it lights up steadily, the network is 2G technology, when it blinks, it means the network is 3G.

WiFi – green LED, lights up to indicate that the WiFi function is active (enabled). This one also, together with the WiFi antenna, may be missing in care of equipments not fitted with wireless access point!

Note:

1. When the Bytton device is not equipped with WiFi mobile Access Point, the corresponding indicator will also be missing!

2.Also, when the WiFi of Bytton is set to “Station” instead of the default “Access Point” function, the green indicator LED will be turned OFF – even if the wireless module is active, it acts as a client, not as server.

- Power LED, under the recessed Reset button

PWR – Green LED. Off = no power, On indicates that Bytton LTE is powered. Of course, if the power supply voltage is off, no indicator LED will light!

RST – Reset button. Its actual function is established from software (in the web interface, SERVICES>Reset). It can also perform a hardware reset to defaults, when you execute the prescribed procedure.

- Pair of yellow/green rectangular LEDs embedded into each ETH connector

WAN – Green LED. Off = no cable connected to the WAN, On = physical connection to Ethernet network (an UTP cable was connected to the respective input). Yellow LED: blinking = shows data traffic (send or receive) through that connector.

LAN 1, LAN2 and **LAN0/WAN0** – Green LED. Off = no cable connected to the respective LAN input, On = physical connection to Ethernet network (an UTP cable was connected to the respective input). Yellow LED: On shows data connection, blinking = shows data traffic (send or receive) through that connector. The rate of blinking is always proportional to the data transfers, so when Bytton LTE is used as an Ethernet router, the difference between the WAN and LAN sides is clearly visible to the naked eye!

5. CONFIGURATION

Bytton LTE can properly perform its functions of wireless high-speed router with the default settings. However, it can be easily configured to meet various usage scenarios. “Configuring” or programming the equipment means adequate setting of all the parameters. The embedded Linux firmware allows you to configure Bytton LTE without the need of additional software on the computer used for programming. You just need a web browser as configuration terminal.

This means that Bytton LTE may be used on **any computer platform** and is not restricted to a certain operating system!

Using the web browser, the configuration can be performed remotely: the desktop PC or notebook may be connected to the Bytton LTE Router either directly or through a switch by means of the wired (Ethernet) connection.

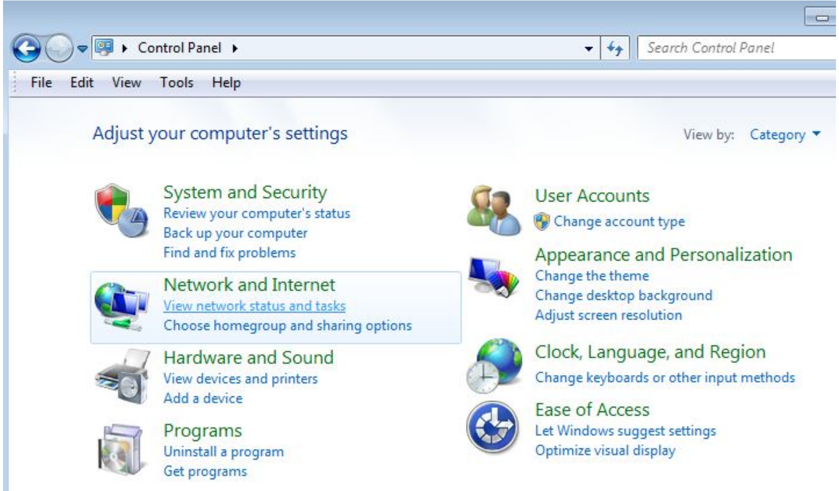
Prior to using this Bytton LTE equipment you should check the basic settings to guarantee it will work in your environment (for instance, it may be required to change the default IP address).

5.1 Using the Web Interface

The default address of the webpage of the Bytton LTE device from Rohde & Schwarz Topex S.A. is **192.168.1.1.** It is recommended that you use this address, provided that the configuration of your local network allows this. And, of course, if there is a single Bytton device in that network! When you install several Bytton LTE in the same LAN, you must change their respective IP addresses.

5.1.1 Set up a connection

First, you should establish an Ethernet connection to the Bytton LTE unit you want to configure.


Control Panel
Search Control Panel
File Edit View Tools Help
Adjust your computer's settings
View by: Category
System and Security
Review your computer's status
Back up your computer
Find and fix problems
Network and Internet
View network status and tasks
Choose homegroup and sharing options
Hardware and Sound
View devices and printers
Add a device
Programs
Uninstall a program
Get programs
User Accounts
Change account type
Appearance and Personalization
Change the theme
Change desktop background
Adjust screen resolution
Clock, Language, and Region
Change keyboards or other input methods
Ease of Access
Let Windows suggest settings
Optimize visual display

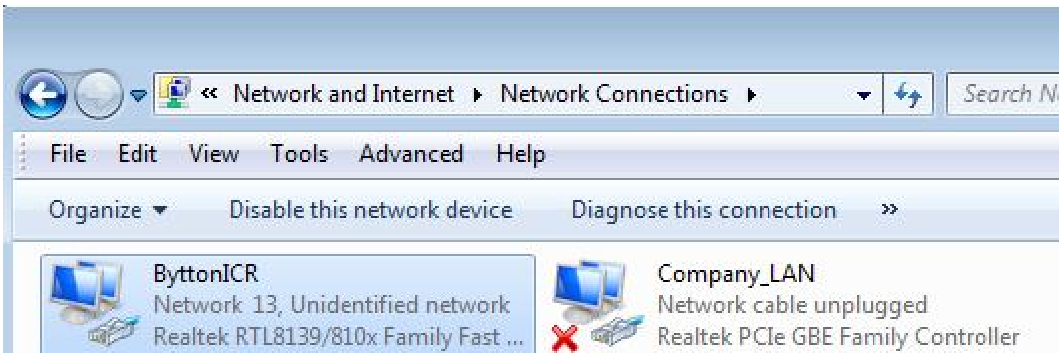
Go to “Network Connections” on your computer and define a connection to be used for the Bytton LTE router.

For instance, under Windows 7 Professional, In Control Panel you must choose “Network and Internet”

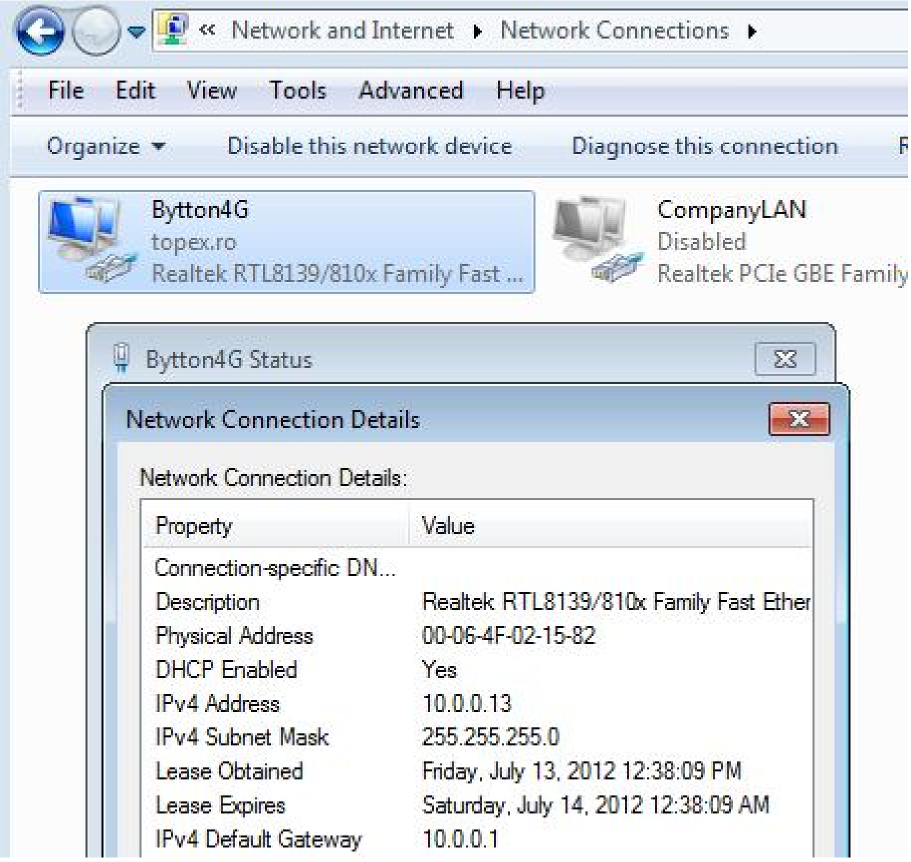
Figure 5-1: Go to “network and Internet” in the Control Panel

You should use for the ETH connection a significant name, such as “Bytton_LTE” or ”Bytton4G”.

See below examples of configuration on a computer with two network adapters, the PICe GBE Controller being used for the connection to the company’s network, while Realtek RTL8139 is used for connection to the Bytton router:


« Network and Internet ▸ Network Connections ▸
Search N
File Edit View Tools Advanced Help
Organize ▾ Disable this network device Diagnose this connection »
ByttonICR
Network 13, Unidentified network
Realtek RTL8139/810x Family Fast ...
Company_LAN
Network cable unplugged
Realtek PCIe GBE Family Controller

Or:


« Network and Internet ▸ Network Connections ▸
File Edit View Tools Advanced Help
Organize ▾ Disable this network device Diagnose this connection F
Bytton4G
topex.ro
Realtek RTL8139/810x Family Fast ...
CompanyLAN
Disabled
Realtek PCIe GBE Family
Bytton4G Status
Network Connection Details

Network Connection Details:

Property	Value
Connection-specific DN...	
Description	Realtek RTL8139/810x Family Fast Ether
Physical Address	00-06-4F-02-15-82
DHCP Enabled	Yes
IPv4 Address	10.0.0.13
IPv4 Subnet Mask	255.255.255.0
Lease Obtained	Friday, July 13, 2012 12:38:09 PM
Lease Expires	Saturday, July 14, 2012 12:38:09 AM
IPv4 Default Gateway	10.0.0.1

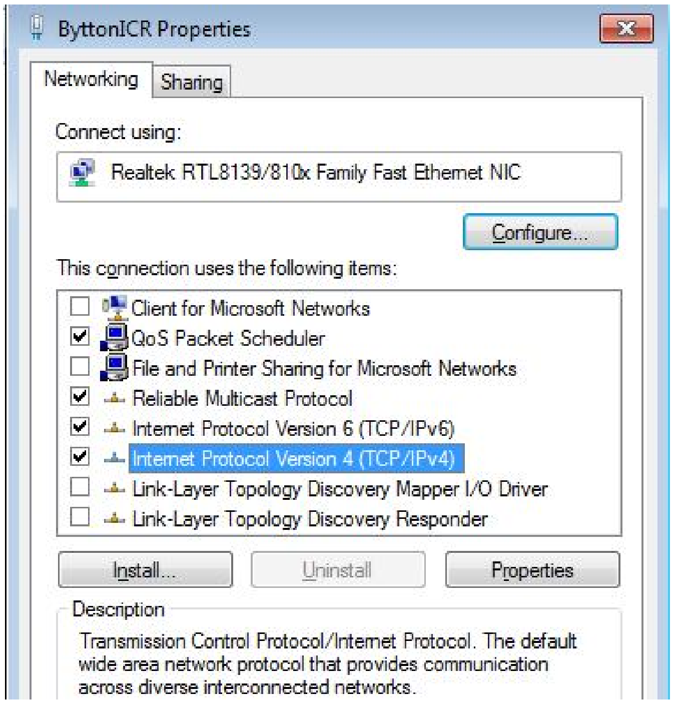
Figure 5-2: Go to “Network and Internet” to create a network connection for Bytton LTE.

From the network adapters (network cards) of your computer, select the one which is connected via Ethernet cable to the Bytton equipment.

In this example, it is the network board type:
”Realtek RTL8139/810x Family”.

Check the box “Internet Protocol (TCP/IP) and click the button “Properties” to configure your PC.

You may configure the connection to Topex Bytton LTE either manually or automatically.



ByttonICR Properties

Connect using:

Realtek RTL8139/810x Family Fast Ethernet NIC

This connection uses the following items:

☐ Client for Microsoft Networks
☑ QoS Packet Scheduler
☐ File and Printer Sharing for Microsoft Networks
☑ Reliable Multicast Protocol
☑ Internet Protocol Version 6 (TCP/IPv6)
☑ Internet Protocol Version 4 (TCP/IPv4)
☐ Link-Layer Topology Discovery Mapper I/O Driver
☐ Link-Layer Topology Discovery Responder

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

Figure 5-3: Setting the network properties for the ETH connection to Bytton

5.1.2 Automatic IP Address

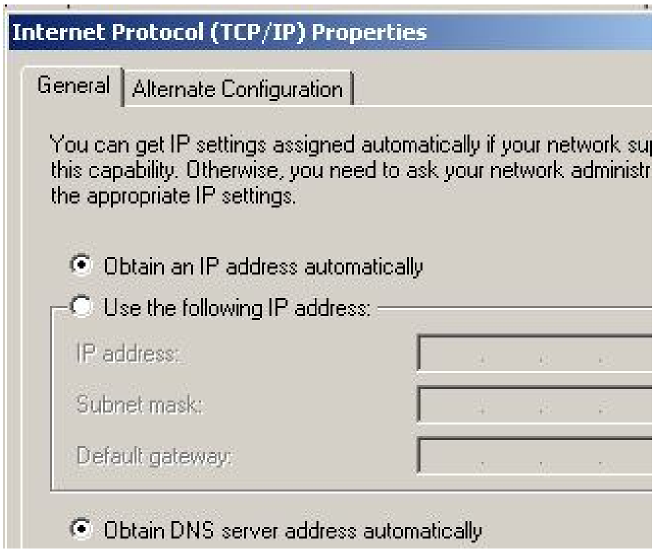
The simplest way is to set your network adapter to get its IP address automatically from Bytton LTE. The Rohde & Schwarz Topex S.A. mobile router features a DHCP server, so it can provide your PC with the correct IP address, DNS and Gateway.

In this case, in “Internet Protocol Properties” you should check the boxes:

- “Obtain an IP address automatically”
- and respectively “Obtain DNS server address automatically”.

Reset (reboot) your PC to be sure these network settings become valid.

This way, you won’t have to worry anymore about your settings, the Bytton LTE equipment will take care of providing your computer with adequate IP address and DNS.



Internet Protocol (TCP/IP) Properties

You can get IP settings assigned automatically if your network su this capability. Otherwise, you need to ask your network administr the appropriate IP settings.

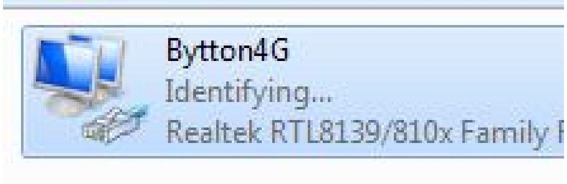
● Obtain an IP address automatically
○ Use the following IP address:

IP address: . . .
Subnet mask: . . .
Default gateway: . . .

● Obtain DNS server address automatically

Figure 5-4: Setting automatically IP for the connection to Bytton

In the status bar at the bottom of the screen you should see the icon of the Bytton link blinking, and a first message will show up:



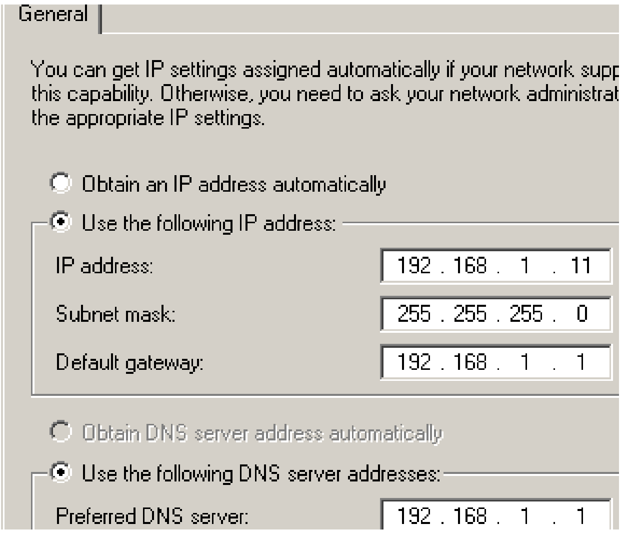
Bytton4G
Identifying...
Realtek RTL8139/810x Family F

“Bytton LTE acquiring network address” or “Identifying” while the network adapter gets a local IP address from the DHCP server of the Bytton equipment.

5.1.3 Manual IP Settings

As an alternative, you can set the network parameters manually. By default, Bytton LTE has the IP address **192.168.1.1** and the standard Netmask 255.255.255.0, and these settings are used in the example below. However, it does not make sense to use manual settings for the *default configuration*, rather you should use manual settings if your local network has some special requirements, which the automatic configuration cannot satisfy.

In case of manual settings, in “Internet Protocol Properties” you must fill in the corresponding values:
- the IP address could be from 192.168.1.2 up to 192.168.1.254; to be sure you don’t fall over the address of another device of your LAN, a value of 11 is suggested, instead of 2 which is the absolute minimum available value
- the Subnet mask must be the standard one, 255.255.255.0
- the Default gateway must be 192.168.1.1
- the same address 192.168.1.1 is to be used for the “Preferred DNS server” .



General

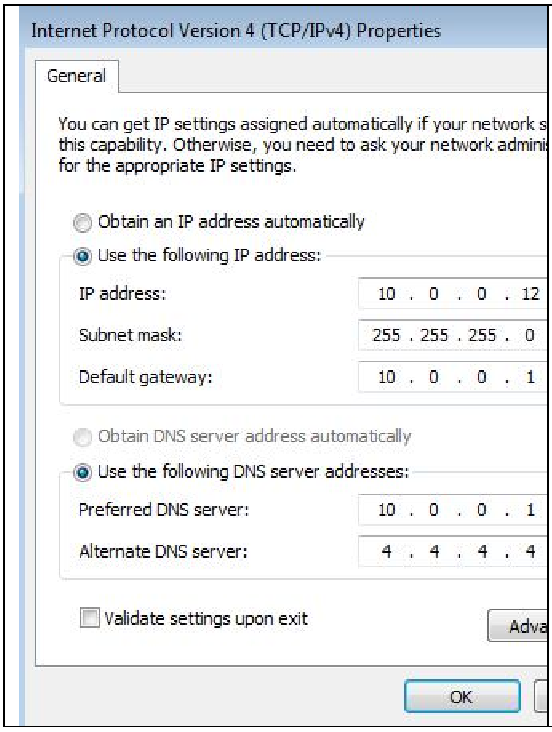
You can get IP settings assigned automatically if your network supp
this capability. Otherwise, you need to ask your network administrat
the appropriate IP settings.

○ Obtain an IP address automatically
● Use the following IP address:
IP address: 192 . 168 . 1 . 11
Subnet mask: 255 . 255 . 255 . 0
Default gateway: 192 . 168 . 1 . 1

○ Obtain DNS server address automatically
● Use the following DNS server addresses:
Preferred DNS server: 192 . 168 . 1 . 1

Figure 5-5: Manually establishing IP parameters for the connection to Bytton

In the status bar at the bottom of the screen you should see the link icon blinking, and a message will show up: “Bytton LTE is now connected”.



Internet Protocol Version 4 (TCP/IPv4) Properties

General

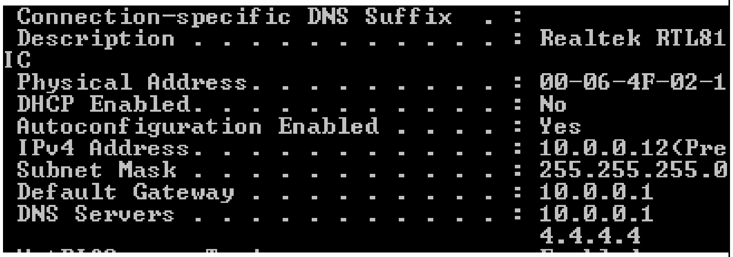
You can get IP settings assigned automatically if your network s
this capability. Otherwise, you need to ask your network admini
for the appropriate IP settings.

○ Obtain an IP address automatically
● Use the following IP address:
IP address: 10 . 0 . 0 . 12
Subnet mask: 255 . 255 . 255 . 0
Default gateway: 10 . 0 . 0 . 1

○ Obtain DNS server address automatically
● Use the following DNS server addresses:
Preferred DNS server: 10 . 0 . 0 . 1
Alternate DNS server: 4 . 4 . 4 . 4

□ Validate settings upon exit

An alternate example of manual settings, when the IP address of Bytton LTE is 10.0.0.1:



```
 Connection-specific DNS Suffix  . :
 Description . . . . . . . . . . . : Realtek RTL81
IC
 Physical Address. . . . . . . . . : 00-06-4F-02-1
 DHCP Enabled. . . . . . . . . . . : No
 Autoconfiguration Enabled . . . . : Yes
 IPv4 Address. . . . . . . . . . . : 10.0.0.12(Pre
 Subnet Mask . . . . . . . . . . . : 255.255.255.0
 Default Gateway . . . . . . . . . : 10.0.0.1
 DNS Servers . . . . . . . . . . . : 10.0.0.1
                                     4.4.4.4
```

Note:
When you use for your local network a Proxy Server, you must set an exception for Bytton ICR wireless router, because otherwise you won’t be able to access the Bytton LTE ***equipment!***

You should enter the IP address of the Bytton LTE device (by default 192.168.1.1) in the list of exceptions for the Proxy server: “Do not use proxy server for addresses beginning with …”

5.1.4 First Connection

To configure the Bytton LTE product using the web interface, just open your favorite web browser and type the default IP address as the URL: https://192.168.1.1/ as shown:

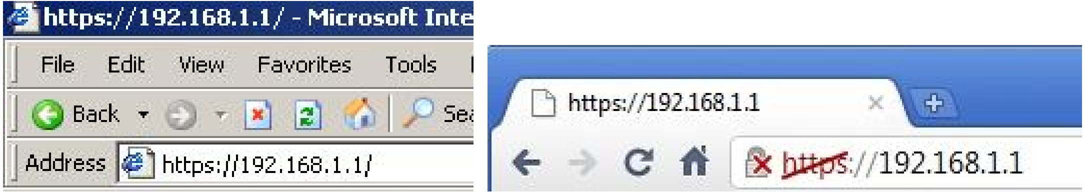


Figure 5-6: Enter the default IP address of the Web page into your browser.

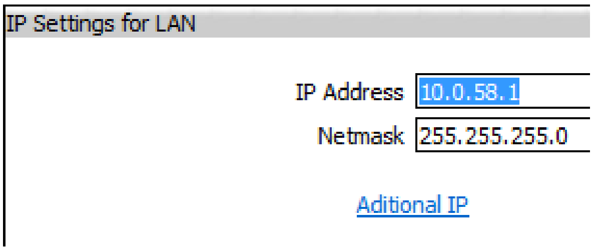
If you cannot connect to the Bytton LTE *router because of problems in the settings of the IP address, you must go back to the factory default settings. Press the "RESET" button for at least three seconds. The equipment reboots and starts operating with the* ***factory default settings****.*

These include the IP address 192.168.1.1, allowing you to connect to the Rohde & Schwarz Topex S.A. wireless router in order to configure it.

After reaching the configuration web pages at the default IP address, you may change the IP address of the device according to your requirements!

For instance, you can use addresses in the range https://172.27.168.xxx/ or https://10.0.58.1, as shown in this example:

Figure 5-7: Changing the default IP address of Bytton LTE.



IP Settings for LAN

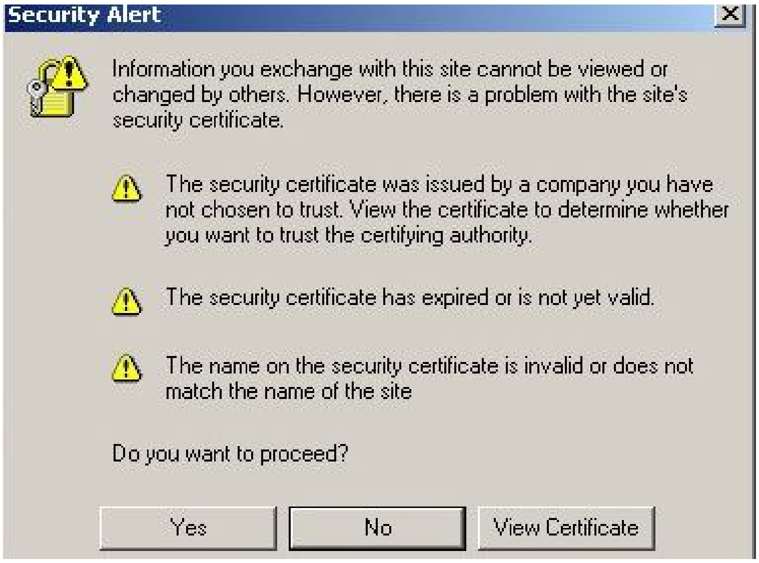
IP Address: 10.0.58.1

Netmask: 255.255.255.0

5.1.5 Secure Connection HTTPS

Note that Bytton LTE uses a **secure web connection** (https) so you may get several warning messages like this one:

Figure 5-8: Security Alert for the https connection.



Security Alert

Information you exchange with this site cannot be viewed or changed by others. However, there is a problem with the site's security certificate.

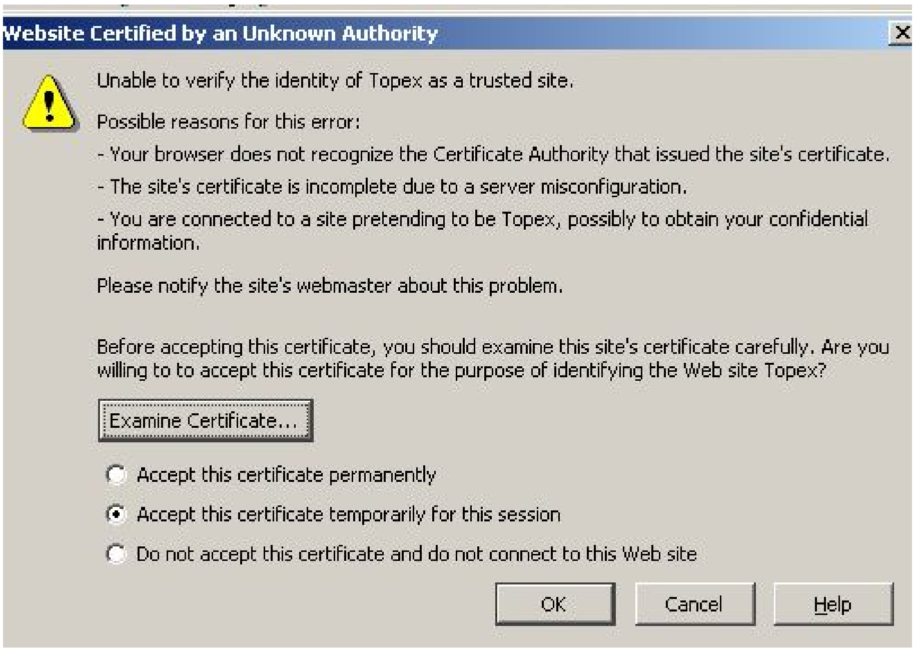
⚠ The security certificate was issued by a company you have not chosen to trust. View the certificate to determine whether you want to trust the certifying authority.

⚠ The security certificate has expired or is not yet valid.

⚠ The name on the security certificate is invalid or does not match the name of the site

Do you want to proceed?

or similar warnings mentioning "Website Certified by an Unknown Authority":



Website Certified by an Unknown Authority

Unable to verify the identity of Topex as a trusted site.

Possible reasons for this error:

- Your browser does not recognize the Certificate Authority that issued the site's certificate.
- The site's certificate is incomplete due to a server misconfiguration.
- You are connected to a site pretending to be Topex, possibly to obtain your confidential information.

Please notify the site's webmaster about this problem.

Before accepting this certificate, you should examine this site's certificate carefully. Are you willing to to accept this certificate for the purpose of identifying the Web site Topex?

○ Accept this certificate permanently

● Accept this certificate temporarily for this session

○ Do not accept this certificate and do not connect to this Web site

Figure 5-9: Warning about the certificate of a trusted website.

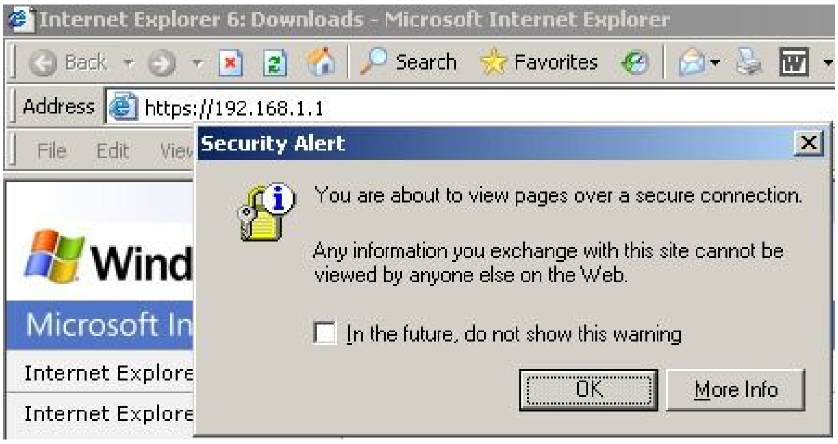
You should click „Yes”, „OK” or „Accept” to go on.

Type “OK” to accept the certificate for the Bytton LTE website.

Other “Security Error” messages may warn you about “Domain Name Mismatch”, referring to the security certificate.   Again click “OK” to continue.

You may receive the warning “You have requested an encrypted page” or “You are about to view pages over a secure connection”.

This is normal, it shows that you are connected to Bytton LTE over a secure, encrypted link.



Address: https://192.168.1.1

Security Alert

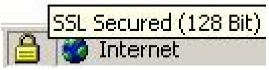
You are about to view pages over a secure connection.

Any information you exchange with this site cannot be viewed by anyone else on the Web.

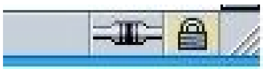
□ In the future, do not show this warning

Figure 5-10: Security Alert from Internet Explorer about the secure connection (encrypted page).

The secure connection is confirmed by the “padlock” symbol that shows up in the status bar at the bottom of the screen, indicating a secure (encrypted) connection. Bytton LTE uses 128-bit SSL encryption to prevent hackers from capturing passwords and sensitive data. The same security is used by banks and the military. Internet Explorer shows the padlock icon only when everything on the entire webpage is encrypted. But even when the browser doesn't show a padlock, the "https://" address means your data is still encrypted.



Or

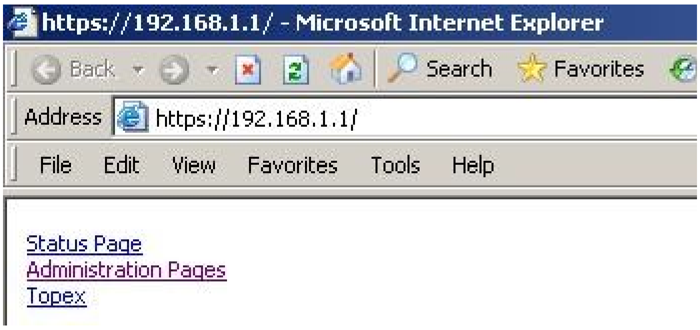


5.1.6 Log-in to Bytton LTE

From the fist configuration screen you may select either:

- status display
- configuration pages
- Rohde & Schwarz Topex S.A. webpage

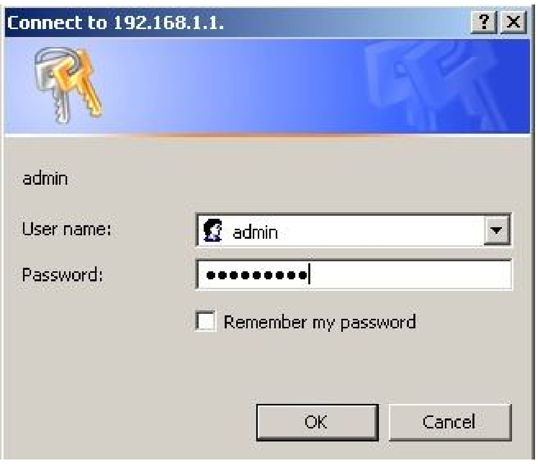
Click the link of interest to you!



Status Page
Administration Pages
Topex

Figure 5-11: Connecting to the configuration Web page of Bytton LTE.

Now you will be asked to enter a user name and a password to access the configuration page of Rohde & Schwarz Topex S.A. Bytton LTE equipment.



admin

User name: admin

Password: ••••••••••

□ Remember my password

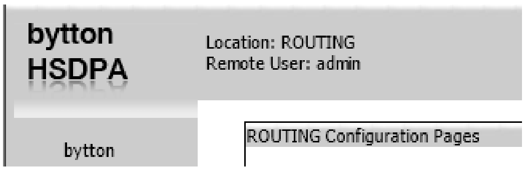
For the administrator of the system network, the default user name is **admin** and the password is **99admin11**. Later, you may change this password using the web configuration page, as described in the paragraph about Password.

For security reasons, it is strongly recommended to change as soon as possible the default password with one of your own choice. Also, you should NOT mark in your browser the checkbox "Remember my password".

Figure 5-12: Authentication required - enter user name (admin) and password.

The log-in name is shown in the "Remote User" field, below the "Location" information:

Figure 5-13: Indication of remote user and location.



Location: ROUTING
Remote User: admin

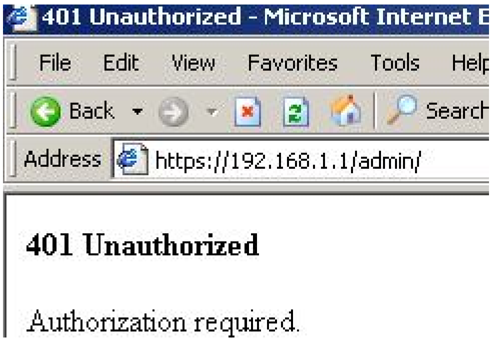
The Administrator "admin" has more rights, access to additional settings, which a normal user does not require (advanced routing configurations and settings for drivers).

If you type a different user name, or if you enter an incorrect password more than three times in a row, you will get the error message:

"**401 Unauthorized**" !

Connect again and be careful to enter the correct name and password.

Figure 5-14: Login error message – Unauthorized!


401 Unauthorized - Microsoft Internet E
File
Edit
View
Favorites
Tools
Help
Back
Search
Address
https://192.168.1.1/admin/

401 Unauthorized

Authorization required.

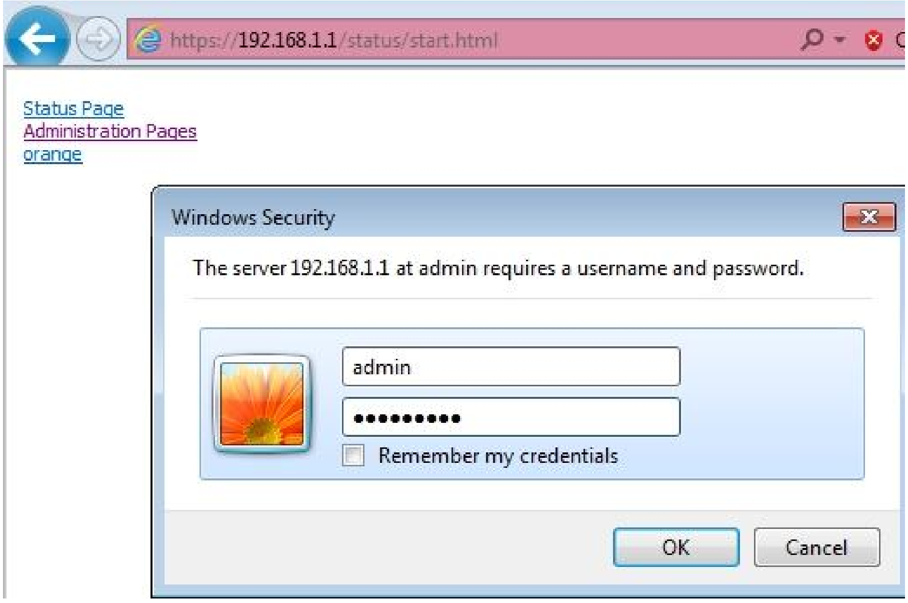
5.1.7 Multiple Log-in to the Web-interface of Bytton

Generally, a complex system has several log-in types: different username and passwords, allowing correspondingly more or les management rights. These various users are allowed access to different sets of configurable parameters.
When someone logs in as user, administrator or super-user, he will have accordingly different management rights, access to some functions only or to all of the functions of the system.

For Bytton ICR, two types of log-in are currently implemented, as **Admin** and respectively as **Super-Use**r.

Admin

The username is **admin** and the corresponding default password (that you should replace afterwards with one of your own) is **99admin11**, as illustrated below:



The server 192.168.1.1 at admin requires a username and password.

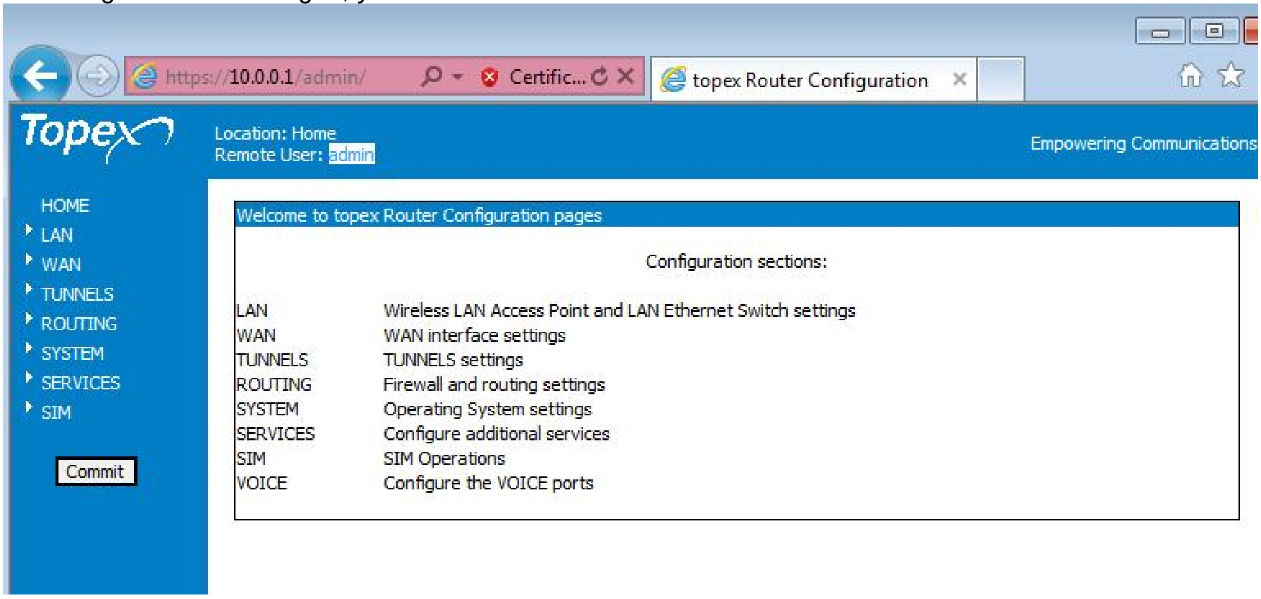
admin

●●●●●●●●●●

□ Remember my credentials

Figure 5-15a: Log-in as “admin”.

Following a successful log-in, you will see the Menu available for the user “admin”:



Location: Home
Remote User: admin

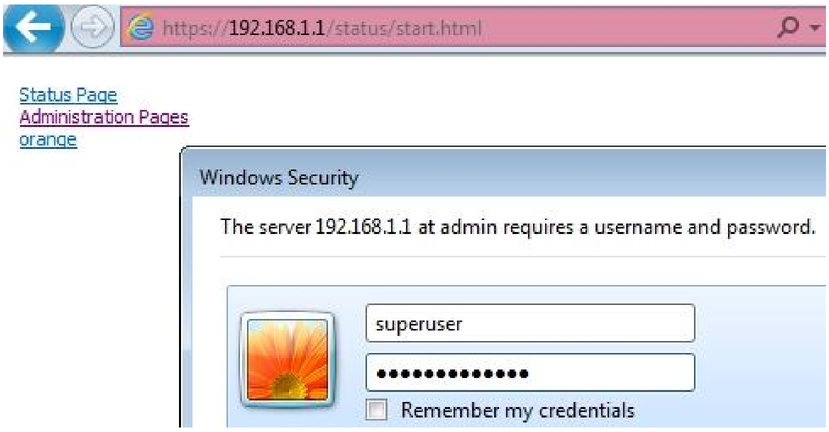
Welcome to topex Router Configuration pages

Configuration sections:

LAN	Wireless LAN Access Point and LAN Ethernet Switch settings
WAN	WAN interface settings
TUNNELS	TUNNELS settings
ROUTING	Firewall and routing settings
SYSTEM	Operating System settings
SERVICES	Configure additional services
SIM	SIM Operations
VOICE	Configure the VOICE ports

Superuser

The privileged user authenticates as "superuser", with corresponding default password of "98superuser12". Here also one should change as soon as possible this generic password with a specific one, known only by him and authorized persons!



The server 192.168.1.1 at admin requires a username and password.

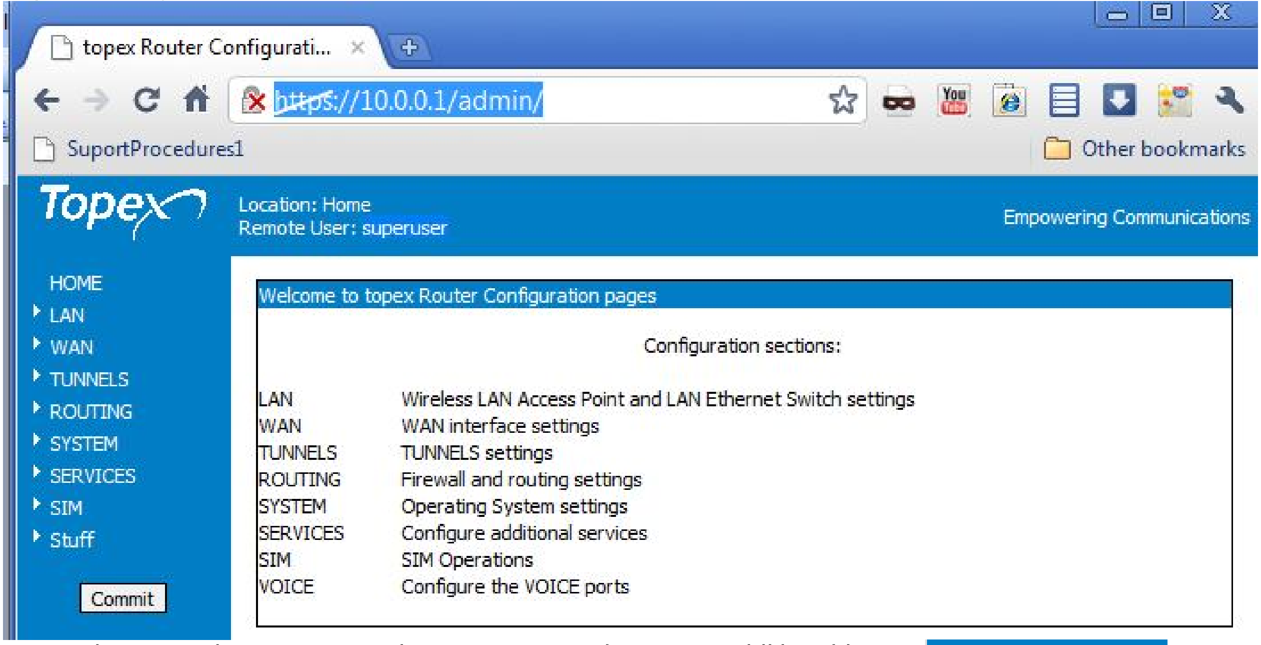
superuser

••••••••••••••

☐ Remember my credentials

Figure 5-15b: Log-in as "superuser".

Following successful log-in as "superuser", the corresponding main page Menu for the Rohde & Schwarz Topex S.A. Bytton LTE router should be shown on screen:.



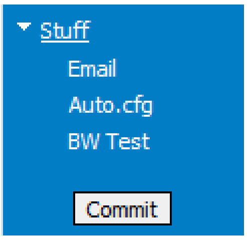
Location: Home
Remote User: superuser

Welcome to topex Router Configuration pages

Configuration sections:

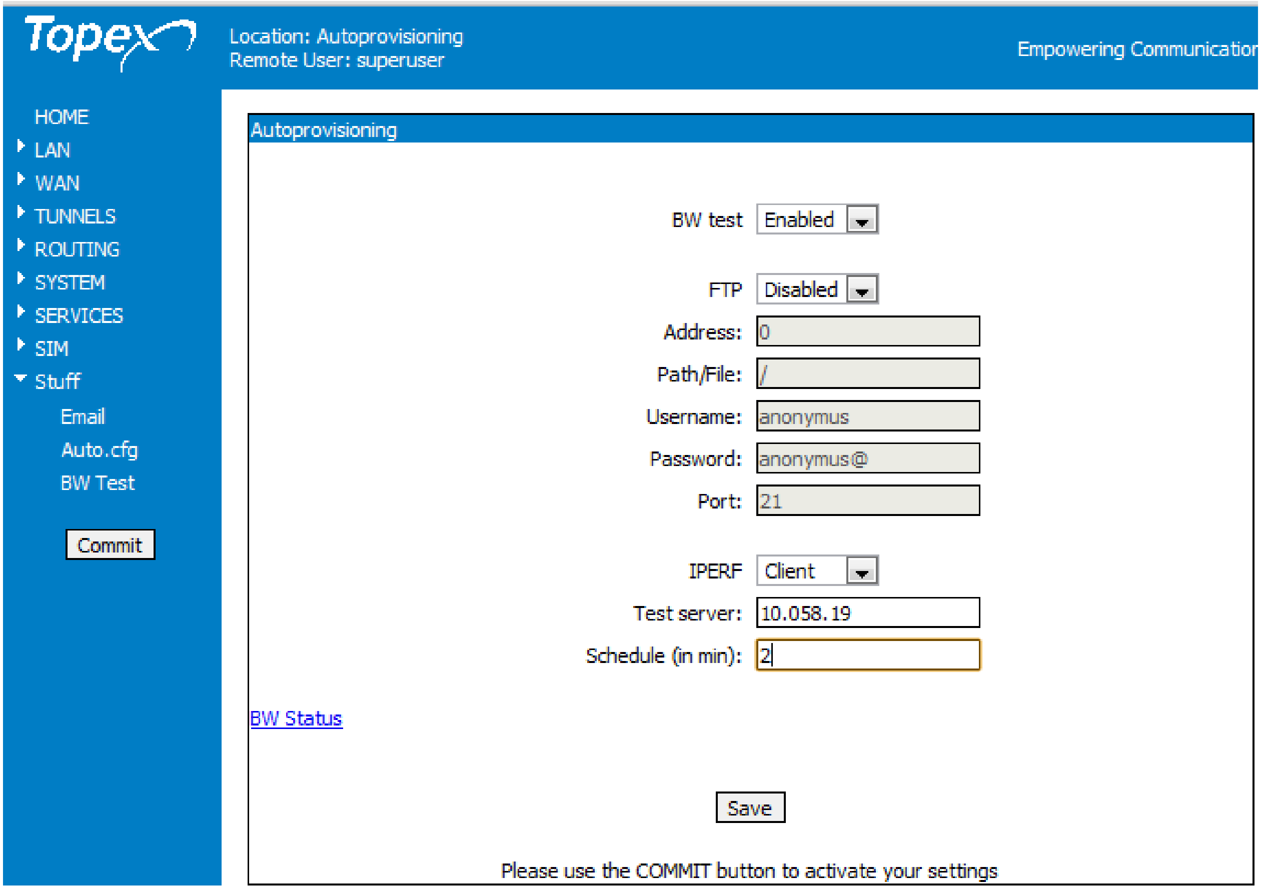
LAN	Wireless LAN Access Point and LAN Ethernet Switch settings
WAN	WAN interface settings
TUNNELS	TUNNELS settings
ROUTING	Firewall and routing settings
SYSTEM	Operating System settings
SERVICES	Configure additional services
SIM	SIM Operations
VOICE	Configure the VOICE ports

As can be seen, the "superuser" has access to at least one additional item of Menu, in this case than last menu element, called "Stuff", which holds sub-pages for configuration of advanced features such as Email reporting, Auto-configuration and Bandwidth testing.



Also, some of the sub-pages that both "admin" and "superuser" can see are more populated (have several features accessible) when you log-in as super-user instead of administrator. This will be detailed further on, with actual examples!

After the configuration page of interest to you is loaded (BW test in the example below), you can change any setting you need, and then click the **Save** button at the bottom of the screen to save it in the current page:



Autoprovisioning

BW test Enabled

FTP Disabled

Address: 0

Path/File: /

Username: anonymus

Password: anonymus@

Port: 21

IPERF Client

Test server: 10.058.19

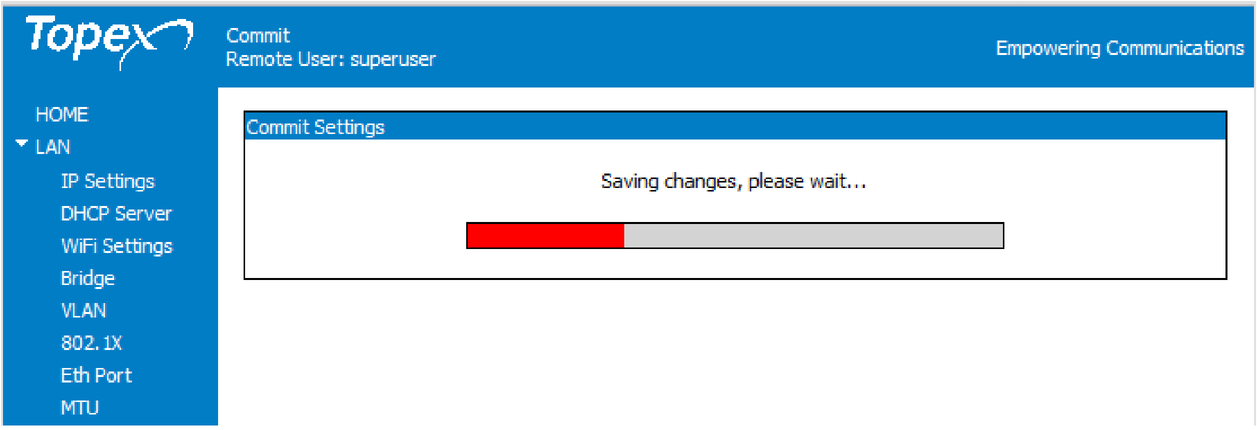
Schedule (in min): 2

BW Status

Save

Please use the COMMIT button to activate your settings

Finally use the **Commit** button at the bottom of the Menu, to make these changes permanent after the restarting of the Bytton LTE equipment:



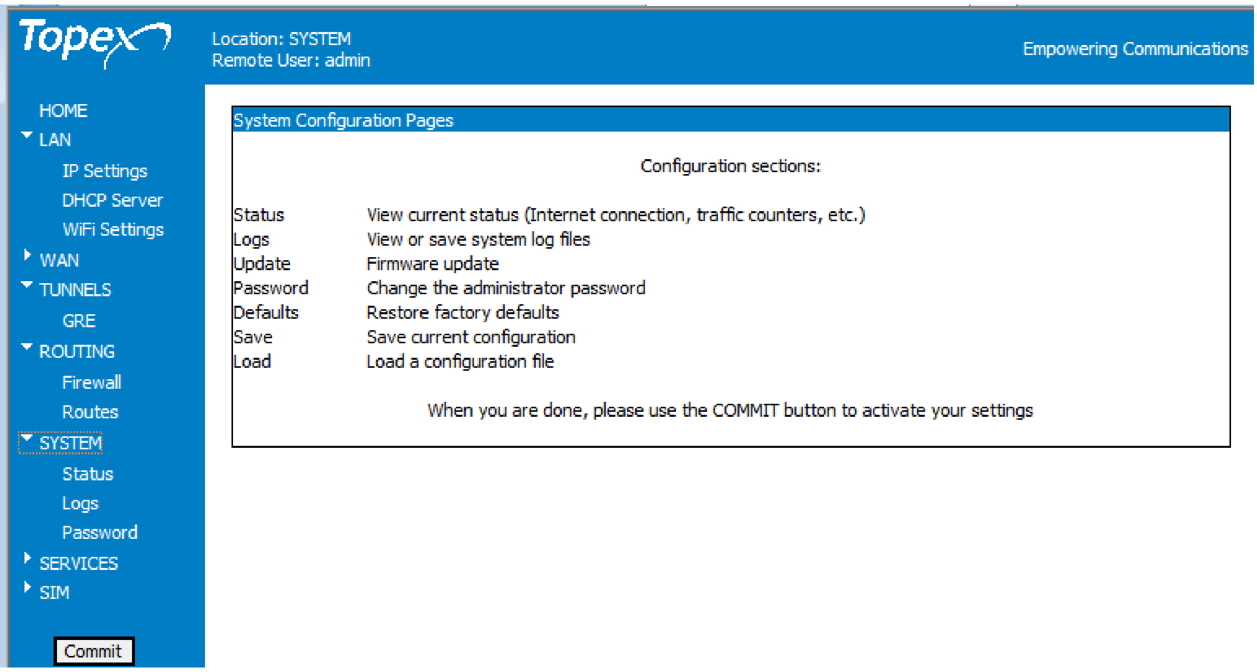
Commit Settings

Saving changes, please wait...

5.1.8 MENU Items

There are several sections (Menu items) on the configuration page of Bytton LTE device, as shown in the images below.

Defending upon the type of authorization, you may have access to all the features, or only to some of them:



System Configuration Pages

Configuration sections:

Status	View current status (Internet connection, traffic counters, etc.)
Logs	View or save system log files
Update	Firmware update
Password	Change the administrator password
Defaults	Restore factory defaults
Save	Save current configuration
Load	Load a configuration file

When you are done, please use the COMMIT button to activate your settings

Figure 5-16a: Web configuration page, listing sub-menu items for “admin”.

When you log in as **superuser**, you will see (and thus be able to configure) additional sub-pages, as shown in the full menu to the right.

These supplementary items are, respectively:

- LAN >Bridge
- LAN> VLAN
- LAN> 802.1X
- LAN> Eth Port
- LAN> MTU.

- TUNNELS> IPSEC
- TUNNELS> OVPN
- TUNNELS> PPTP.

- ROUTING> Dynamic
- ROUTING> Virtual RT
- ROUTING> QOS.

- SYSTEM> Update
- SYSTEM> Defaults
- SYSTEM> Save CFG
- SYSTEM> Load CFG.

- SERVICES> VRRP.

- Stuff> Email
- Stuff> Auto.cfg
- Stuff> BW test.

The menu items “WAN” and “SIM“ have Not been detailed here, since they remain identical in both cases, they provide the same features for both kinds of users.
So for these sub-pages the menu elements remain the same, no matter how you log-in to the Web configuration interface of Bytton LTE.

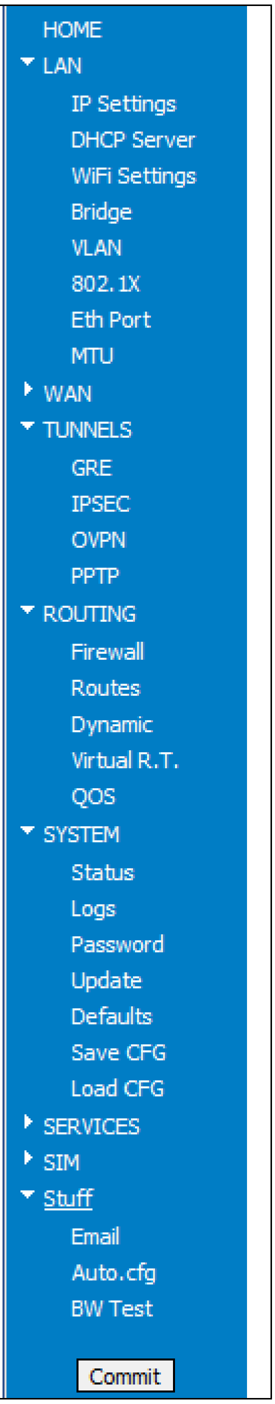


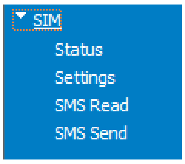
Figure 5-16b: Web configuration page, listing all sub-menu items for “superuser”.

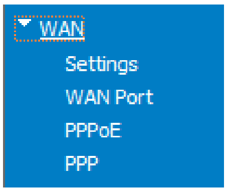
These menu items (sub-pages for configuration) allow you to modify the settings for:

1. **HOME**: this home page for configuration of the equipment.
2. **LAN**: settings for the local wired (Ethernet) network, for the wireless LAN (Wi-Fi - embedded Access Point, when present), additional IPs, advanced configuration of each LAN/WAN port of the switch, parameters for 802.1x authorization, configuring bridges, defining Virtual LANs and establishing MTU for each interface;
3. **WAN:** parameters for remote network - Ethernet, PPP including AT commands, switching from primary to secondary WAN interface, etc ;
4. **TUNNELS:** settings for the tunnels used for VPN (type GRE, IPSEC, Open VPN, PPTP etc.)
5. **ROUTING:** firewall, routing**,** NAT (network address translation), dynamic routes, virtual routing tables, settings for the Quality of Service traffic shaping and prioritization;
6. **SYSTEM:** Shows current status and performs operating system functions (logs, firmware update, save/load configuration, change of password, return to defaults);
7. **SERVICES:** Allows you to configure additional services (such as Dynamic DND, NTP, serial interface for equipments fitted with SER ports, SMS service, VRRP, configuration of Reset button and so on);
8. **SIM:** Shows info and change settings for the SIM card(s) and mobile module, allows viewing, sending out and receiving SMS messages;
9. **VOICE:** In case of equipments that have voice capabilities (FXS telephone interface), this page shows info and allows you to modify parameters for the voice calls performed via Bytton LTE
10. **Stuff:** advanced “stuff”, such as status reporting via email, self-configuration by importing a .cfg file from a specified address, and bandwidth testing by timing file transfers.

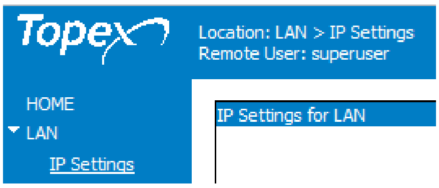
Depending upon the actual firmware version running on your Bytton 3G+ router, you may or may not have access to all these configuration sections. Also the number of accessible sub-sections depends upon the level of authorization, for instance for the same firmware, when you log in as a simple user or as admin you will see fewer sub-pages as one who authenticates to the system as “superuser”.

Only the “WAN” and “SIM” configuration sub-page is always the same, no matter if you are a simple user, Admin or super-user.
This happens since the configuration of mode of connecting to the remote network and information about the state of the SIM card and mobile module, its settings, and sending and receiving text messages are features available for all the users of Bytton LTE, no matter what level of authorization they have!





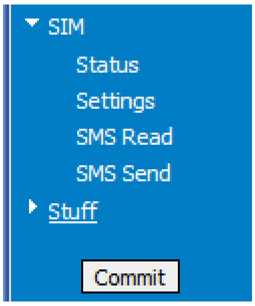
The Menu bar is located to the left, and features the button Commit at its bottom.
On top of the web page, after the Rohde & Schwarz Topex S.A. logo, you will see a “Location” indication, which reminds you where you are on the Web interface.
In this example, the section is LAN and the subsection IP Settings for LAN.



Location: LAN > IP Settings
Remote User: superuser

Under the Location information you can see “Remote User”, which shows you the name that was used for log-in, Admin or respectively Superuser as shown in the above example.

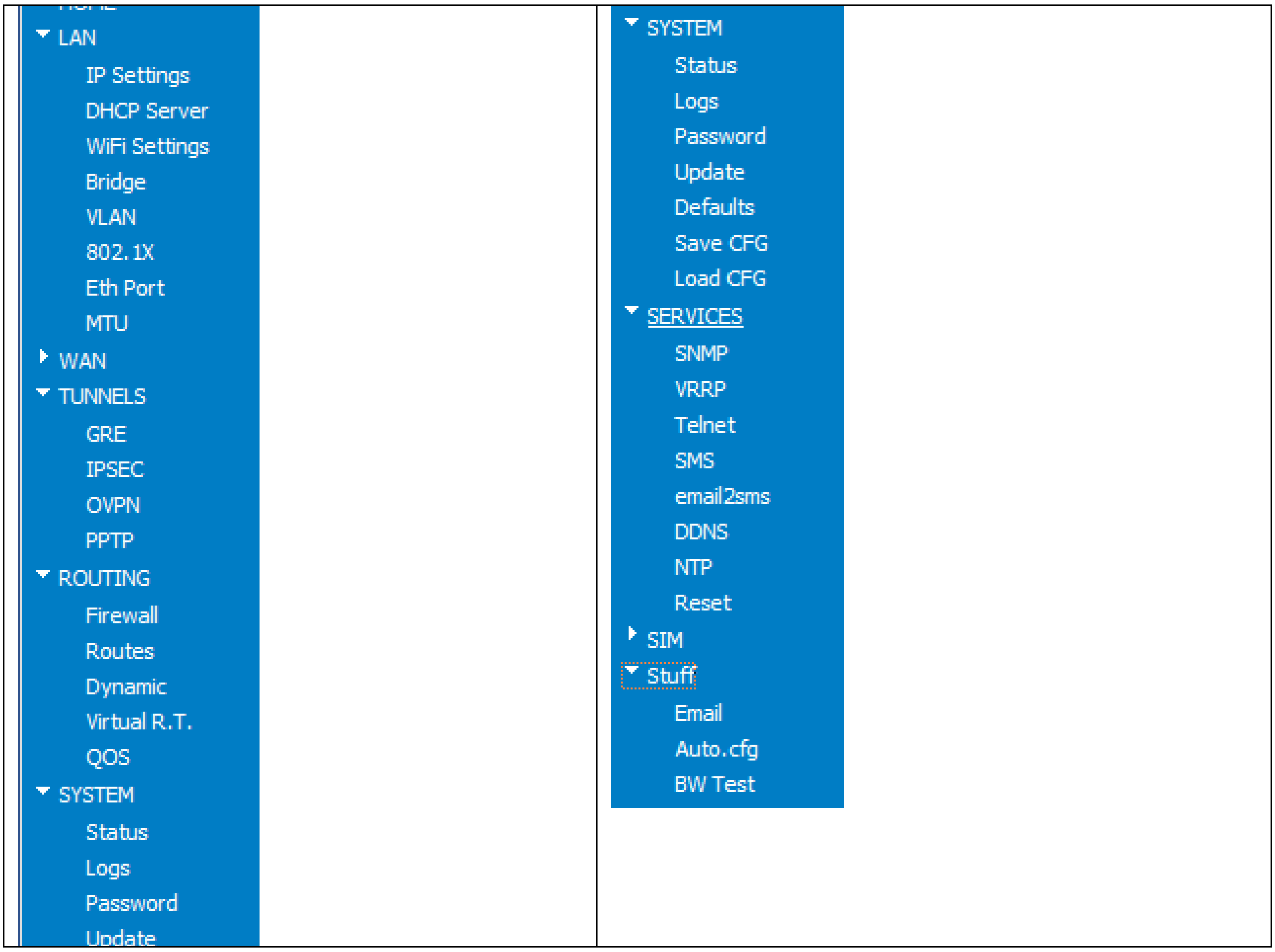
Note:
After you change the settings in any page, if you want to use the new settings, don’t forget to press the “Save” button if you want to keep these settings.
Otherwise, if you click any other link, you will reach another configuration page, and the new settings will be lost.



To make these new parameter permanent, i.e. available even after restarting or resetting the equipment, you need to use the Commit button located at the bottom of the Menu list.

This will save the new settings into the permanent memory of the Bytton LTE router.

Additional menu items available for Superuser:



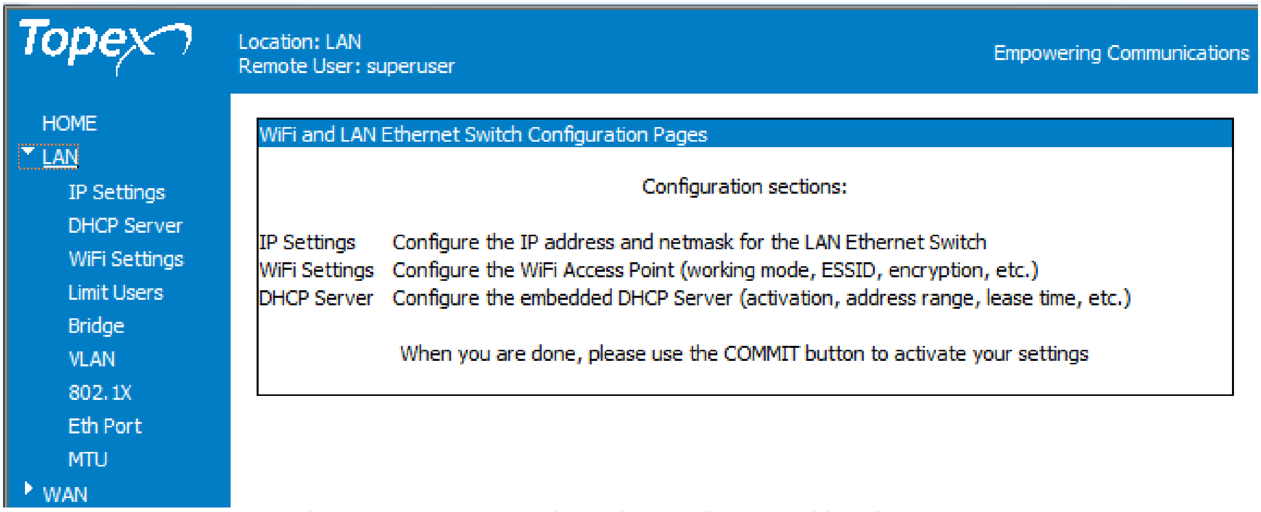
As you can see, the sub-pages are the same, but several of them now include more items than in case of logging-in as Admin.

The explanation in the manual are for the full version of the Web pages, respectively for logging-in as “superuser”.

When you log-in as “admin” or as a simple user, some of the sub-pages described will not be available!

5.2 LAN

This first group features several pages of settings related to the local wired network: for primary and secondary IP and net mask, switch assignment, configuration of the second LAN/WAN port, parameters for the DHCP servers and MAC filterin, for the WiFi Access Point when your Bytton equipment has this feature, for bridging between different networks, for Virtual LANs, for 802.1X authentication and respectively detailed information, configuration for each of the ETH interfaces of the equipment and MTU values:



WiFi and LAN Ethernet Switch Configuration Pages

Configuration sections:

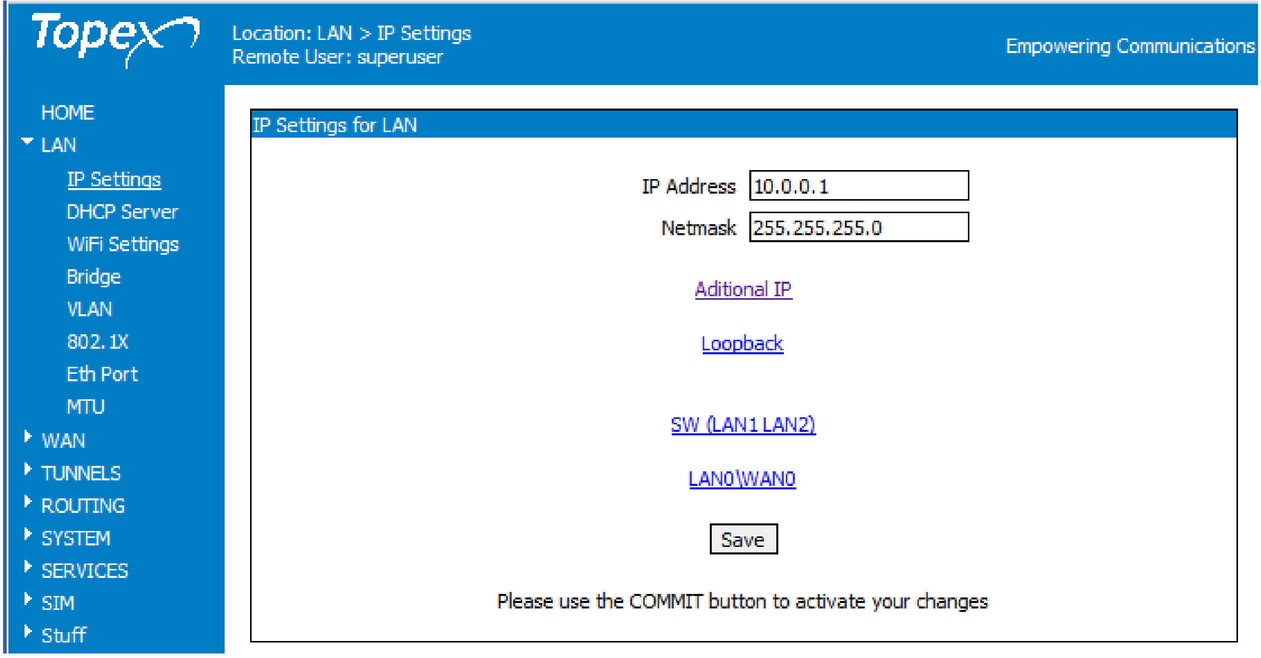
IP Settings	Configure the IP address and netmask for the LAN Ethernet Switch
WiFi Settings	Configure the WiFi Access Point (working mode, ESSID, encryption, etc.)
DHCP Server	Configure the embedded DHCP Server (activation, address range, lease time, etc.)

When you are done, please use the COMMIT button to activate your settings

Figure 5-17: LAN configuration Webpage, with subpages.

5.2.1 IP Settings

On the LAN side, settings include primary and additional IP addresses, Loopback, switch configuration and LAN0/WAN0 assignment:



IP Settings for LAN

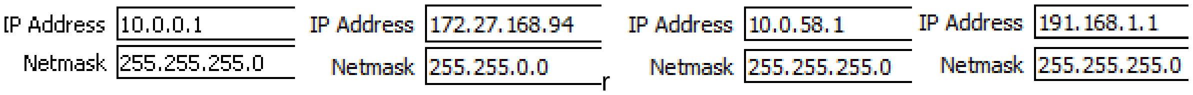
IP Address: 10.0.0.1
Netmask: 255.255.255.0

Please use the COMMIT button to activate your changes

Figure 5-18: LAN configuration page, IP Settings

Settings for the IP LAN address of the Bytton LTE 3G+ router are the standard ones: IP Address and Netmask. These settings control how the Rohde & Schwarz Topex S.A. equipment connects into your local wired (Ethernet) computer network.

The default address value is **192.168.1.1** and the associated net mask is 255.255.255.0. But you may change these default settings, if the configuration of your network requires this, for instance 10.0.0.1. as shown in the image above.
See below other examples:



IP Address	10.0.0.1	IP Address	172.27.168.94	IP Address	10.0.58.1	IP Address	191.168.1.1
Netmask	255.255.255.0	Netmask	255.255.0.0	Netmask	255.255.255.0	Netmask	255.255.255.0

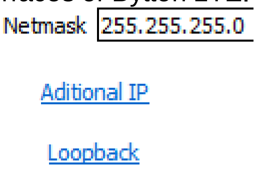
Figure 5-19: Changing the default IP address of Bytton on the LAN – several examples

Use the "Save" button to save the settings, then "Commit" (down on the column to the left of the screen) to make permanent the IP settings.
Usually the IP address allocated for Bytton LTE on the LAN side is a **non-routable** (internal) address. After you change this IP address, you will need to reload the configuration page by typing the new IP address in your browser, if not redirected automatically.

Additional IP

The firmware allows you to set up supplementary IP addresses for the Bytton LTE (Aliases).

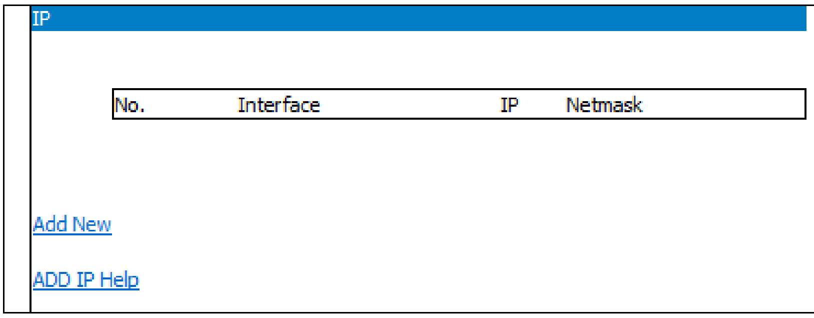
"IP Aliasing" refers to the possibility of setting up multiple network addresses on the same low-level network device driver, in this case multiple IP addresses for the Ethernet or PPP interfaces of Bytton LTE.
Use the blue link to go to the configuration page for the alternate IP addresses and net mask:



Netmask 255.255.255.0

Aditional IP

Loopback



IP

No.	Interface	IP	Netmask

Add New

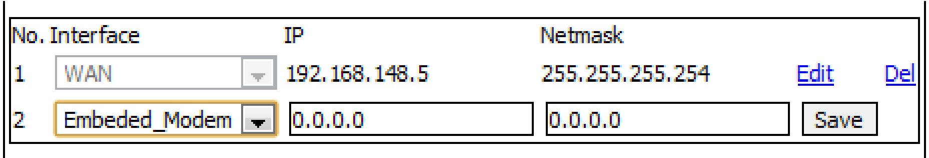
ADD IP Help

At fist, the table with additional IP's is empty, as shown:

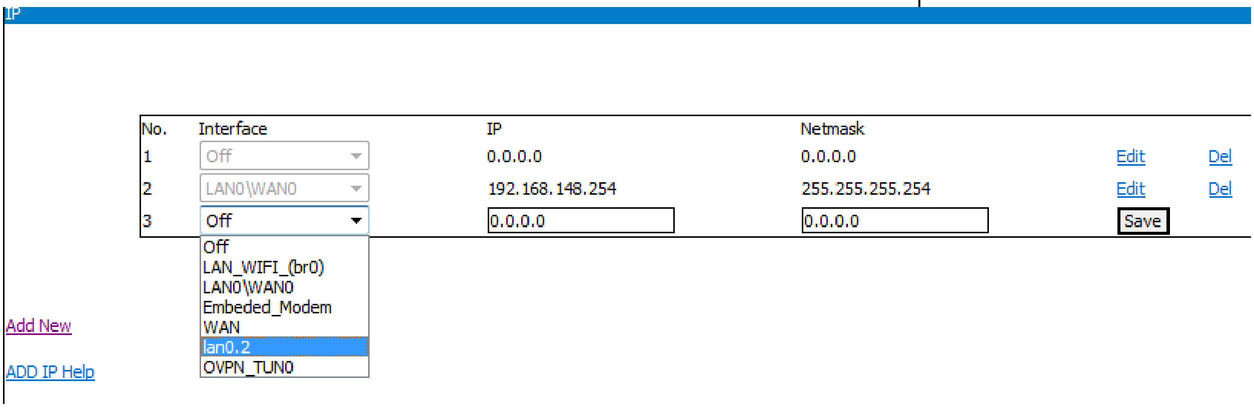
Figure 5-20: LAN configuration page, Additional IP Address Tables

Use the link Add New to create a new entry, the button **Edit** to enter / select parameters:

For each of the Interfaces available from the drop list, you can set one or several IP addresses with the corresponding subnet masks:



No.	Interface	IP	Netmask		
1	WAN	192.168.148.5	255.255.255.254	Edit	Del
2	Embeded_Modem	0.0.0.0	0.0.0.0	Save	



IP

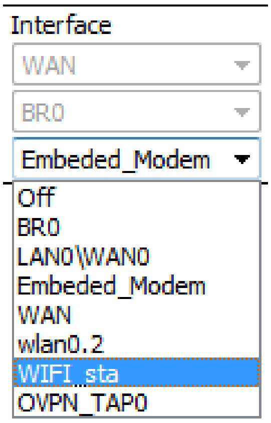
No.	Interface	IP	Netmask		
1	Off	0.0.0.0	0.0.0.0	Edit	Del
2	LAN0\WAN0	192.168.148.254	255.255.255.254	Edit	Del
3	Off	0.0.0.0	0.0.0.0	Save	

Add New

ADD IP Help

You may assign to the equipment as many alternate IP addresses as you wish, for each of the interfaces of the Bytton equipment.

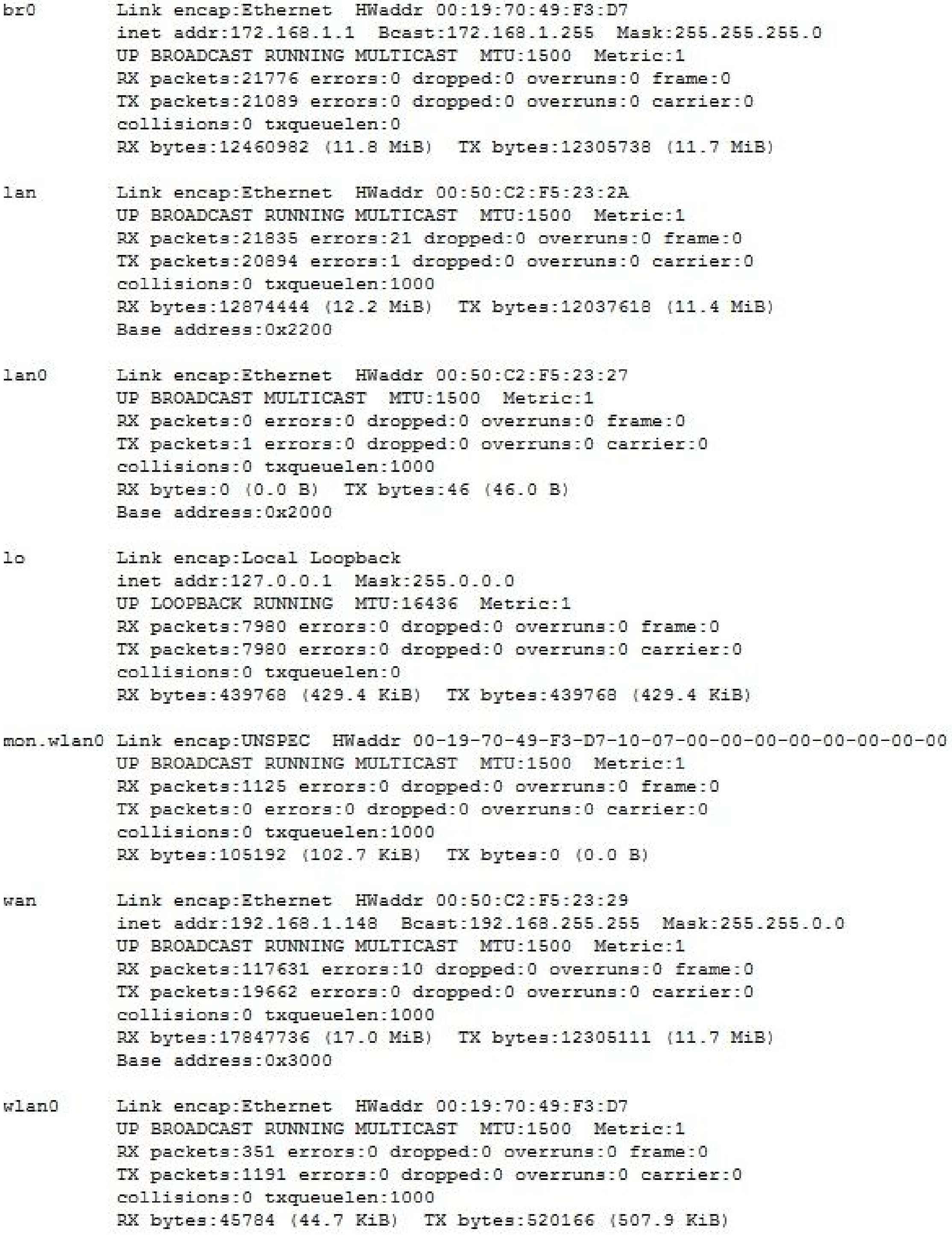
Note that in this case also the “Interface” drop list will show, besides the usual physical interfaces: BR0, WAN, Embedded Modem, WiFi station (when WiFi is set to Station and Ad Hoc instead of access point) , it will show also as options the logical interfaces: bridges, Virtual LANs, GRE, IPSEC or OPEN VPN tunnels, and so on:



Use individual **Save** buttons to the right to save the settings for each supplementary IP addresses, then the big “Save and Reload” button at the bottom of the page. When you want to go back to the IP Settings page, click the link BACK.

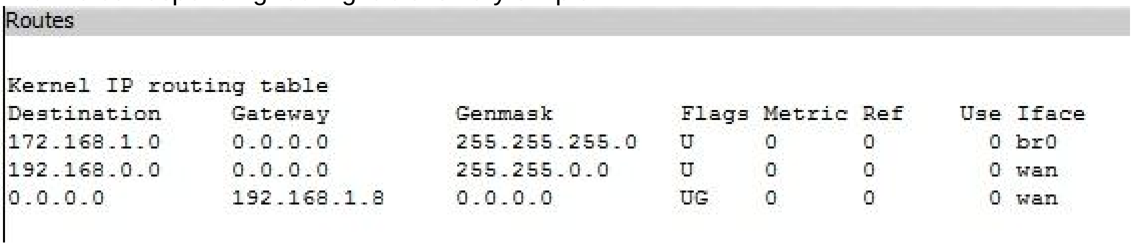
Examples:

When Bytton has a single IP in the local network and a fixed IP for the Ethernet WAN, the Interfaces will be:



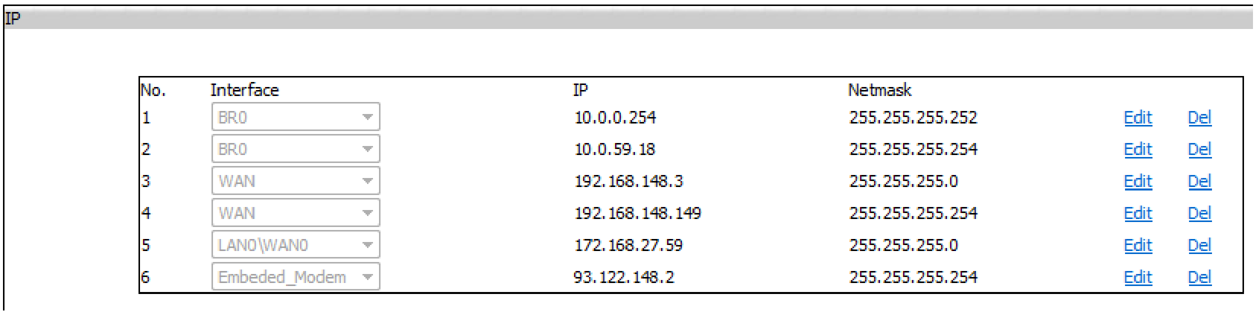
```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:172.168.1.1  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:21776 errors:0 dropped:0 overruns:0 frame:0
          TX packets:21089 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:12460982 (11.8 MiB)  TX bytes:12305738 (11.7 MiB)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:21835 errors:21 dropped:0 overruns:0 frame:0
          TX packets:20894 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:12874444 (12.2 MiB)  TX bytes:12037618 (11.4 MiB)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
          Base address:0x2000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:7980 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7980 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:439768 (429.4 KiB)  TX bytes:439768 (429.4 KiB)

mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-10-07-00-00-00-00-00-00-00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1125 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:105192 (102.7 KiB)  TX bytes:0 (0.0 B)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:117631 errors:10 dropped:0 overruns:0 frame:0
          TX packets:19662 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:17847736 (17.0 MiB)  TX bytes:12305111 (11.7 MiB)
          Base address:0x3000

wlan0     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:351 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1191 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:45784 (44.7 KiB)  TX bytes:520166 (507.9 KiB)
```

And the corresponding routing table is very simple:



```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
172.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

After you set the additional IP’s over the available interfaces of Bytton:



IP

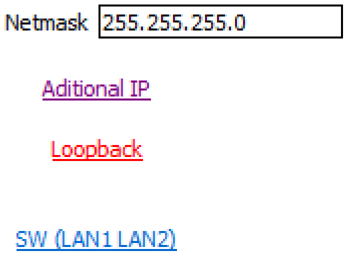
No.	Interface	IP	Netmask		
1	BR0	10.0.0.254	255.255.255.252	Edit	Del
2	BR0	10.0.59.18	255.255.255.254	Edit	Del
3	WAN	192.168.148.3	255.255.255.0	Edit	Del
4	WAN	192.168.148.149	255.255.255.254	Edit	Del
5	LAN0\WAN0	172.168.27.59	255.255.255.0	Edit	Del
6	Embeded_Modem	93.122.148.2	255.255.255.254	Edit	Del

The **Iface status** changes accordingly:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:309 errors:0 dropped:0 overruns:0 frame:0
          TX packets:403 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:35375 (34.5 KiB)  TX bytes:114640 (111.9 KiB)

br0:0     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.0.254  Bcast:10.0.0.255  Mask:255.255.255.252
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1

br0:1     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.59.18  Bcast:10.255.255.255  Mask:255.255.255.254
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:373 errors:0 dropped:0 overruns:0 frame:0
          TX packets:394 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:54536 (53.2 KiB)  TX bytes:114226 (111.5 KiB)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:192.168.148.148  Bcast:192.168.148.151  Mask:255.255.255.252
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
          Base address:0x2000

lan0:4    Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:172.168.27.59  Bcast:172.168.27.255  Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          Base address:0x2000


wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:28186 errors:16 dropped:0 overruns:0 frame:0
          TX packets:135 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1745238 (1.6 MiB)  TX bytes:17015 (16.6 KiB)
          Base address:0x3000

wan:2     Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.148.3  Bcast:192.168.148.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          Base address:0x3000

wan:3     Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.148.149  Bcast:192.168.148.255  Mask:255.255.255.254
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          Base address:0x3000

wlan0     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:135 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:13640 (13.3 KiB)
```

The respective additional addresses show up also in the Routing Table of Bytton:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.59.18      0.0.0.0         255.255.255.254 U     0      0        0 br0
192.168.148.148 0.0.0.0         255.255.255.254 U     0      0        0 wan
10.0.0.252      0.0.0.0         255.255.255.252 U     0      0        0 br0
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
172.168.27.0    0.0.0.0         255.255.255.0   U     0      0        0 lan0
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```



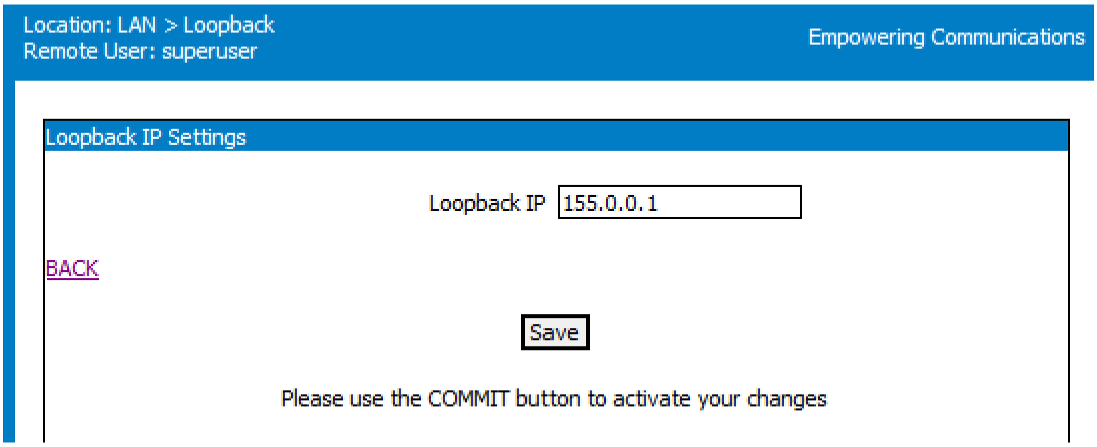
Netmask 255.255.255.0

Loopback

This is a virtual local interface, used for test purposes.

Figure 5-21: LAN configuration page, access the link Loopback.

Click the blue link "Loopback" to enter its configuration page, as shown next:



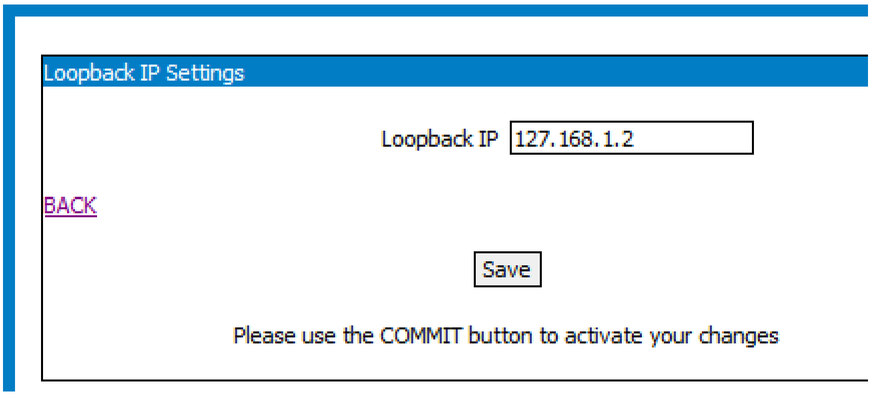
Location: LAN > Loopback
Remote User: superuser

Loopback IP 155.0.0.1

Please use the COMMIT button to activate your changes

Figure 5-22: LAN configuration page, set IP for the Loopback test link.

Here you can set up the IP address to be used for loopback.
Or



Loopback IP 127.168.1.2

Please use the COMMIT button to activate your changes

Or:

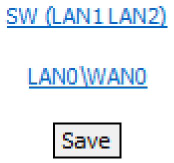
Click the button Save to save the new value, then the link BACK to go back to the LAN>IP settings to configure other parameters.

After reboot, the Loopback IP answers to PING at the respective address:

```
PING 127.168.1.2 (127.168.1.2): 56 data bytes
64 bytes from 127.168.1.2: seq=0 ttl=64 time=0.595 ms
64 bytes from 127.168.1.2: seq=1 ttl=64 time=0.394 ms
64 bytes from 127.168.1.2: seq=2 ttl=64 time=0.460 ms
64 bytes from 127.168.1.2: seq=3 ttl=64 time=0.466 ms
64 bytes from 127.168.1.2: seq=4 ttl=64 time=0.395 ms
64 bytes from 127.168.1.2: seq=5 ttl=64 time=0.395 ms
64 bytes from 127.168.1.2: seq=6 ttl=64 time=0.397 ms
64 bytes from 127.168.1.2: seq=7 ttl=64 time=0.391 ms
64 bytes from 127.168.1.2: seq=8 ttl=64 time=0.397 ms
64 bytes from 127.168.1.2: seq=9 ttl=64 time=0.395 ms
```

5.2.2 Software configuration of the ETH switch

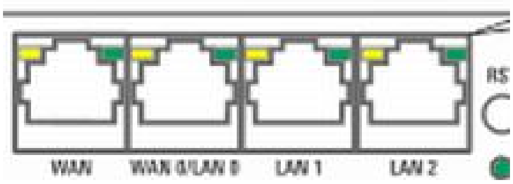
This is a feature of **LAN>IP** settings, but it allows versatile, detailed configuration, thus it is described in a full sub-chapter.



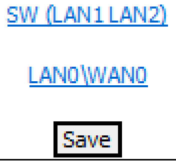
The four-port switch/router of Bytton LTE is fully configurable via software, through the Web interface. You can leave three ETH ports in the LAN switch, or set configuration for each one.
For this purpose, there are two clickable links located at the bottom of the page "IP Settings for LAN" as shown:

Structure or Ethernet Ports

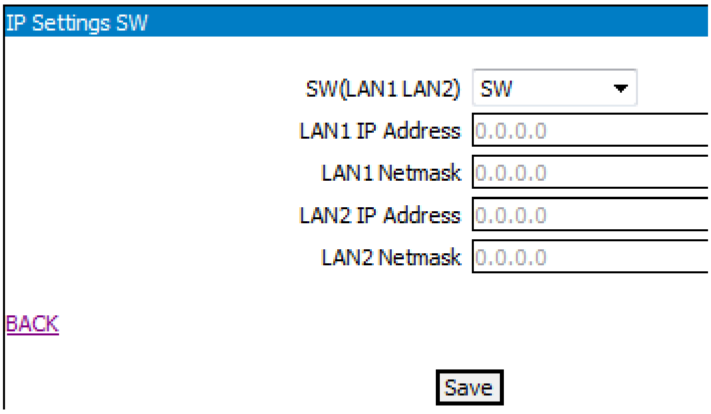
Bytton features a bank of four ETH connectors, which may be finely configured via software. The two leftmost ones, LAN1 and LAN2, are in a physical switch, while the other two are connected to a hardware router, so they may be individually configured.
The hardware switch is also configurable via Web interface. *Thus, each of the four Ethernet ports can be finely tuned, individually or joined together with other ports,* according to the actual requirements:



The leftmost ETH connectors, LAN1 and LAN2, are in a switch for the local LAN, while the rightmost ETH connector, WAN, is for the remote network. But the WAN0/LAN0 connector, as its name suggests, is fully **configurable**, you can assign it either to the switch of the local network, or to the wide area network!

Click the blue link "SW (LAN1 LAN2)" located at the bottom:	

to enter the configuration sub-page for the dual-port ETH switch of Bytton, as shown here:



IP Settings SW

SW(LAN1 LAN2) SW

LAN1 IP Address 0.0.0.0

LAN1 Netmask 0.0.0.0

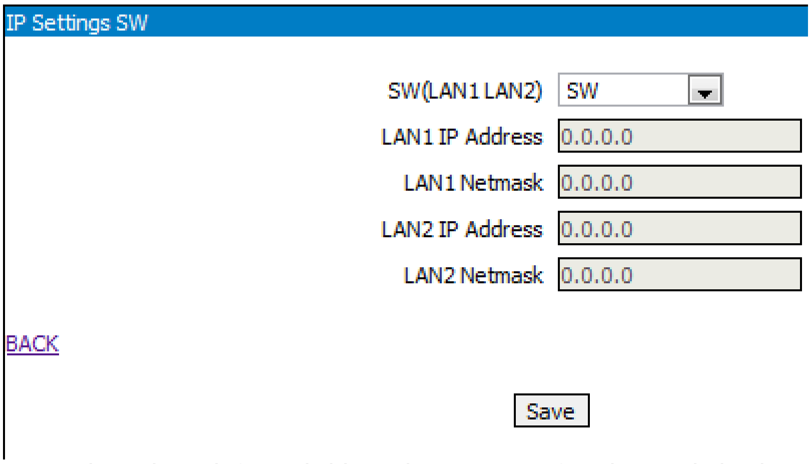
LAN2 IP Address 0.0.0.0

LAN2 Netmask 0.0.0.0

When left to the default SW (switch) option, as shown above, both ETH ports are in a hardware switch and thus share the same IP.

By default, the third ETH port also in this switch.

In this default situation, the fields below are colored in gray, showing that they are inactive (you cannot edit these IP addresses and associated netmasks):



IP Settings SW

SW(LAN1 LAN2) SW

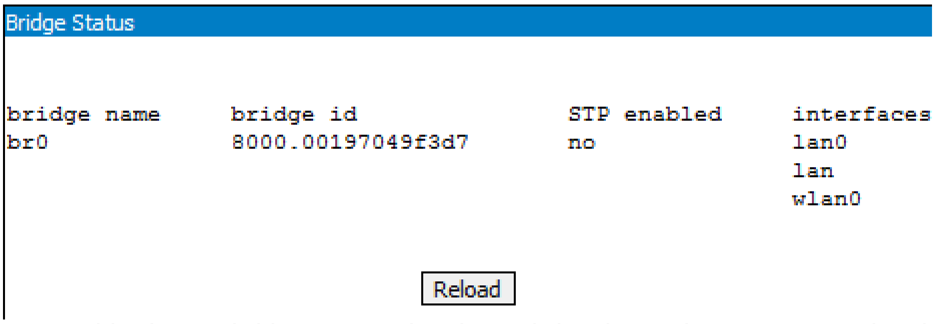
LAN1 IP Address 0.0.0.0

LAN1 Netmask 0.0.0.0

LAN2 IP Address 0.0.0.0

LAN2 Netmask 0.0.0.0

There is a default “bridge”, br0, a sort of logical switch, that connects **lan**, **lan0** and the port for WiFi, **wlan0.** **I**n this case, “**lan**” is the generic name for the two-ports switch holding Ethernet interfaces lan1 and lan2:

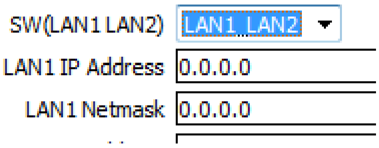


Bridge Status

```
bridge name     bridge id               STP enabled     interfaces
br0             8000.00197049f3d7       no              lan0
                                                        lan
                                                        wlan0
```

This default bridge cannot be deleted, but it can be programmed to join more or less wired or wireless ports.

You can set the two-port switch it to **LAN 1_LAN2** instead of the default SW. Now the fields under SW are no longer gray, now they can be edited – you are allowed to enter the corresponding IP addresses:

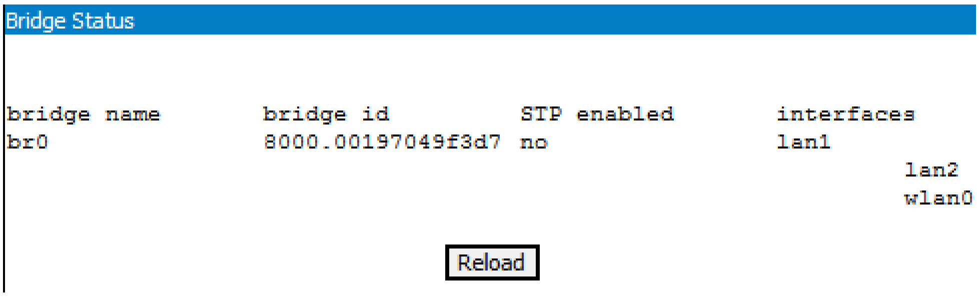


SW(LAN1 LAN2) LAN1_LAN2

LAN1 IP Address 0.0.0.0

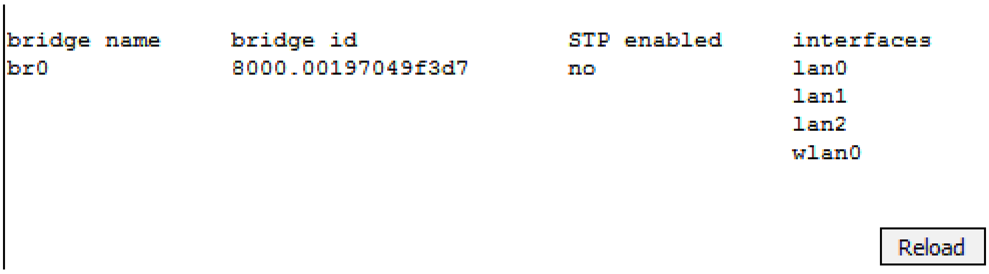
LAN1 Netmask 0.0.0.0

The Bridge Status indication changes accordingly:



```
bridge name      bridge id          STP enabled      interfaces
br0              8000.00197049f3d7  no               lan1
                                                               lan2
                                                               wlan0
```

Also, you can see now that the default bridge **br0**, joins together, besides wlan0, **three** wired ETH ports, lan0, lan1 and lan2, which after being individually configured, are now distinct ports, as shown:



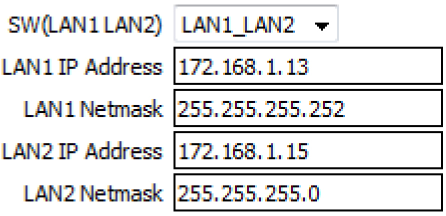
```
bridge name     bridge id               STP enabled     interfaces
br0             8000.00197049f3d7       no              lan0
                                                        lan1
                                                        lan2
                                                        wlan0
```

This arrangement shows up also in **Iface status**:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:172.168.1.1  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:11 errors:3 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:546 (546.0 B)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
          Base address:0x2000

lan1      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:5 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:250 (250.0 B)

lan2      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:5 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:250 (250.0 B)

mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-10-07-00-00-00-00-00-00-00-00
```

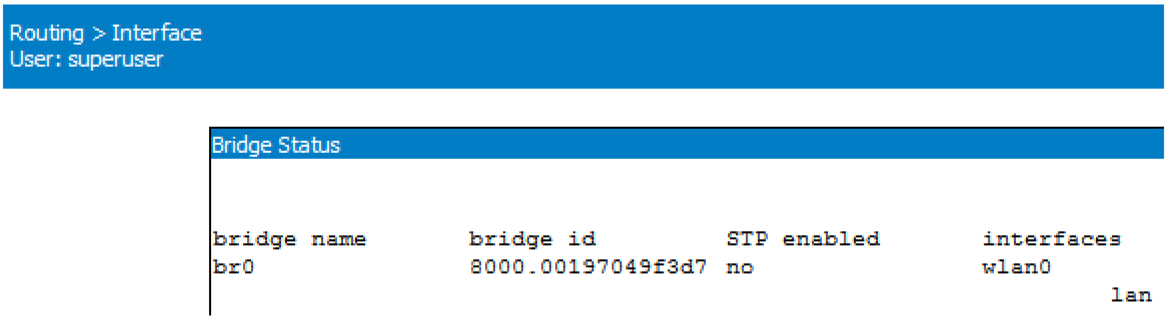
```
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:70 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:6113 (5.9 KiB)  TX bytes:0 (0.0 B)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:12495 errors:0 dropped:0 overruns:0 frame:0
          TX packets:233 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:785556 (767.1 KiB)  TX bytes:69700 (68.0 KiB)
          Base address:0x3000

wlan0     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:5 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:320 (320.0 B)
```

Should you set different IPs for the two interfaces, lan1 and lan2, as shown:



SW(LAN1 LAN2): LAN1_LAN2
LAN1 IP Address: 172.168.1.13
LAN1 Netmask: 255.255.255.252
LAN2 IP Address: 172.168.1.15
LAN2 Netmask: 255.255.255.0

Now a single ETH, **lan0**, is left in the “logical switch for local connections” bridge br0, together with the WiFi interface **wlan0**:



Routing > Interface
User: superuser

Bridge Status

```
bridge name     bridge id               STP enabled     interfaces
br0             8000.00197049f3d7       no              wlan0
                                                                lan
```

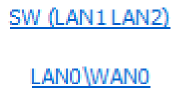
Correspondingly, **Ifaces** will show:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:172.168.1.1  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:61 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:7654 (7.4 KiB)  TX bytes:46 (46.0 B)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
          Base address:0x2000

lan1      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:172.168.1.13  Bcast:172.168.1.15  Mask:255.255.255.252
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan2      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:172.168.1.15  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-10-07-00-00-00-00-00-00-00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:88 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:7665 (7.4 KiB)  TX bytes:0 (0.0 B)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:14449 errors:0 dropped:0 overruns:0 frame:0
          TX packets:417 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:923597 (901.9 KiB)  TX bytes:141158 (137.8 KiB)
          Base address:0x3000
```

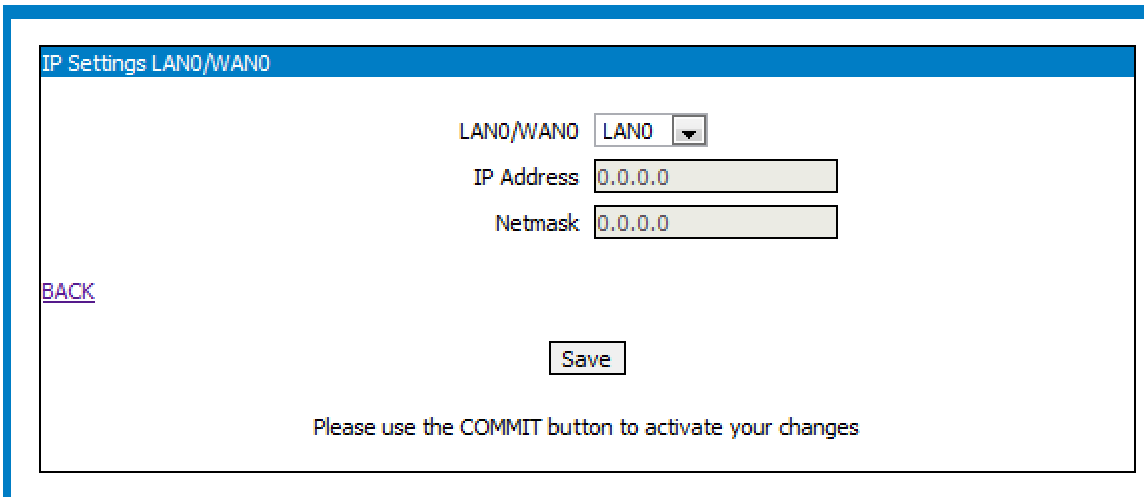
The Routing table in this case will be:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
172.168.1.12    0.0.0.0         255.255.255.252 U     0      0        0 lan1
172.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

Second WAN

To configure the second Eth Wan port of Bytton IC, click the other blue link, "LAN0/WAN0" , located at the bottom of "IP Settings for LAN" configuration page:	

to enter the configuration sub-page for the LAN0/WAN0 ETH interface of Bytton, as shown:



IP Settings LAN0/WAN0

LAN0/WAN0 LAN0

IP Address 0.0.0.0

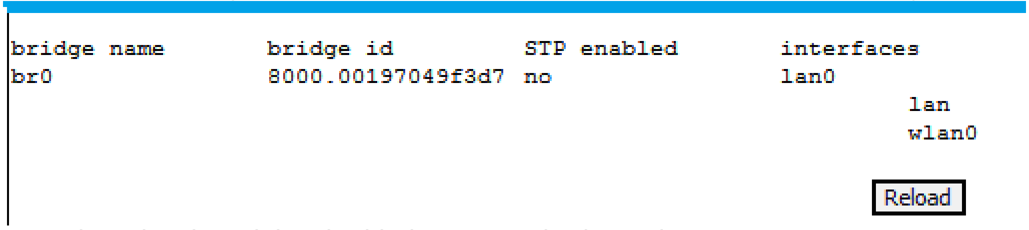
Netmask 0.0.0.0

BACK

Save

Please use the COMMIT button to activate your changes

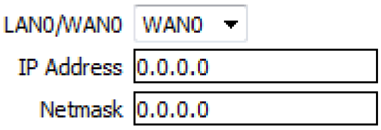
Thus, when you leave it to the default “LAN0”, the port labeled LAN0/WAN0 (**eth0**) will remain bridged in the LAN switch, together with the other two interfaces that are unconditionally for LAN:



```
bridge name     bridge id               STP enabled     interfaces
br0             8000.00197049f3d7       no              lan0
                                                                  lan
                                                                  wlan0
```

The bridge also includes the WiFi embedded access point (**wlan0**).

But, should you set it to **WAN0** instead of the default LAN0, without IP, it will be taken out of the LAN switch and act as a secondary WAN port, with or (as in this example) without specific IP:

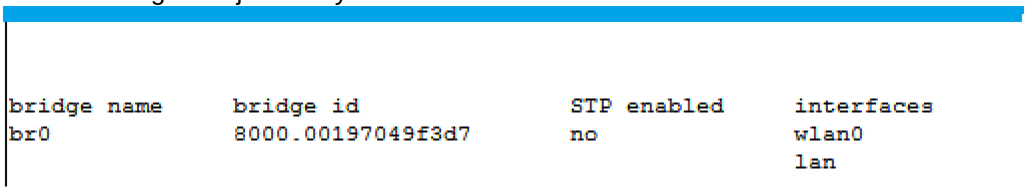


LAN0/WAN0 WAN0

IP Address 0.0.0.0

Netmask 0.0.0.0

Now the bridge **br0** joins only **lan** and **wlan0**:

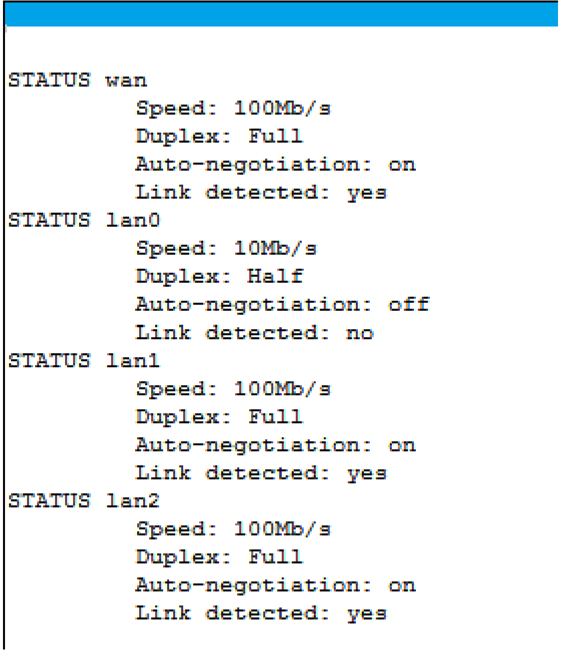


```
bridge name     bridge id               STP enabled     interfaces
br0             8000.00197049f3d7       no              wlan0
                                                        lan
```

The new settings can also be seen in **Iface status**:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1488  Metric:1
          RX packets:453 errors:0 dropped:0 overruns:0 frame:0
          TX packets:971 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:49026 (47.8 KiB)  TX bytes:187994 (183.5 KiB)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:920 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1095 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:88417 (86.3 KiB)  TX bytes:89562 (87.4 KiB)
          Base address:0x2200

lan1      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:172.168.1.13  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:547 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:44758 (43.7 KiB)

lan2      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:172.168.1.15  Bcast:172.168.255.255  Mask:255.255.255.254
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:547 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:44758 (43.7 KiB)

mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-10-07-00-00-00-00-00-00-00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:17878 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1671613 (1.5 MiB)  TX bytes:0 (0.0 B)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:408697 errors:4 dropped:0 overruns:0 frame:0
          TX packets:1712 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:25637960 (24.4 MiB)  TX bytes:355713 (347.3 KiB)
          Base address:0x3000
```

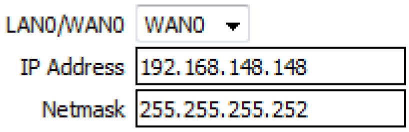
The new configuration is also seen in the **ETH Port>Port Status** pane:



```
STATUS wan
         Speed: 100Mb/s
         Duplex: Full
         Auto-negotiation: on
         Link detected: yes
STATUS lan0
         Speed: 10Mb/s
         Duplex: Half
         Auto-negotiation: off
         Link detected: no
STATUS lan1
         Speed: 100Mb/s
         Duplex: Full
         Auto-negotiation: on
         Link detected: yes
STATUS lan2
         Speed: 100Mb/s
         Duplex: Full
         Auto-negotiation: on
         Link detected: yes
```

<u>Wan0</u> <u>usage</u>

When you specify a certain IP and corresponding netmask for the second WAN port, **wan0**:



LAN0/WAN0: WAN0

IP Address: 192.168.148.148

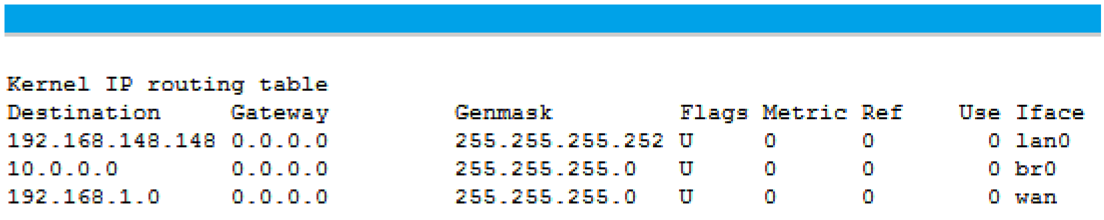
Netmask: 255.255.255.252

This new address will be visible in Ifaces as “lan0” :

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:172.168.1.1  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:142 errors:0 dropped:0 overruns:0 frame:0
          TX packets:60 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:22825 (22.2 KiB)  TX bytes:11603 (11.3 KiB)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:204 errors:0 dropped:0 overruns:0 frame:0
          TX packets:63 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:39576 (38.6 KiB)  TX bytes:11741 (11.4 KiB)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:192.168.148.148  Bcast:192.168.148.151  Mask:255.255.255.252
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
          Base address:0x2000
```

The second WAN IP that you have defined shows up and also in the Routing Table:

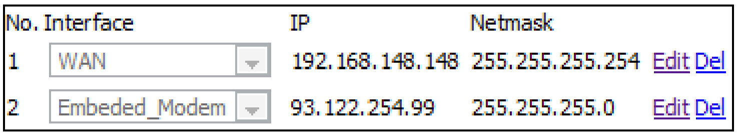
```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
172.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```



```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 wan
```

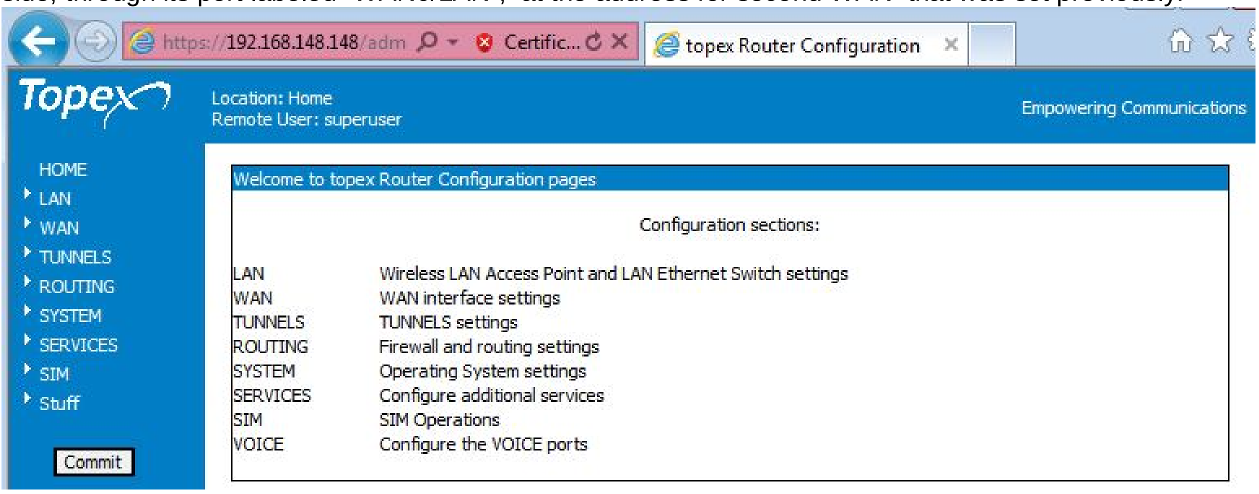
<u>Access on WAN side over alternate IP – example;</u>

Suppose you set up “**192.168.148.148**” as alternate IP address over the WAN interface:



No.	Interface	IP	Netmask	
1	WAN	192.168.148.148	255.255.255.254	Edit Del
2	Embeded_Modem	93.122.254.99	255.255.255.0	Edit Del

Following a **Commit** command and restart, the Bytton LTE equipment will be now accessible on the WAN side, through its port labeled “WAN0/LAN”, at the address for second WAN that was set previously:



Location: Home
Remote User: superuser

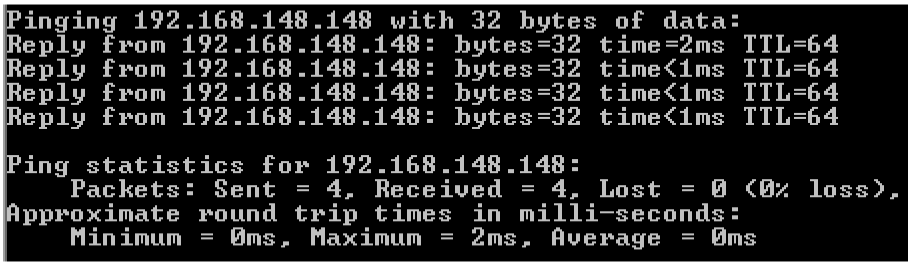
Empowering Communications

Welcome to topex Router Configuration pages

Configuration sections:

LAN	Wireless LAN Access Point and LAN Ethernet Switch settings
WAN	WAN interface settings
TUNNELS	TUNNELS settings
ROUTING	Firewall and routing settings
SYSTEM	Operating System settings
SERVICES	Configure additional services
SIM	SIM Operations
VOICE	Configure the VOICE ports

It also does answer to PING command in the 192.168.xxx.yyy network where Bytton LTE is now connected via its WAN0 interface:

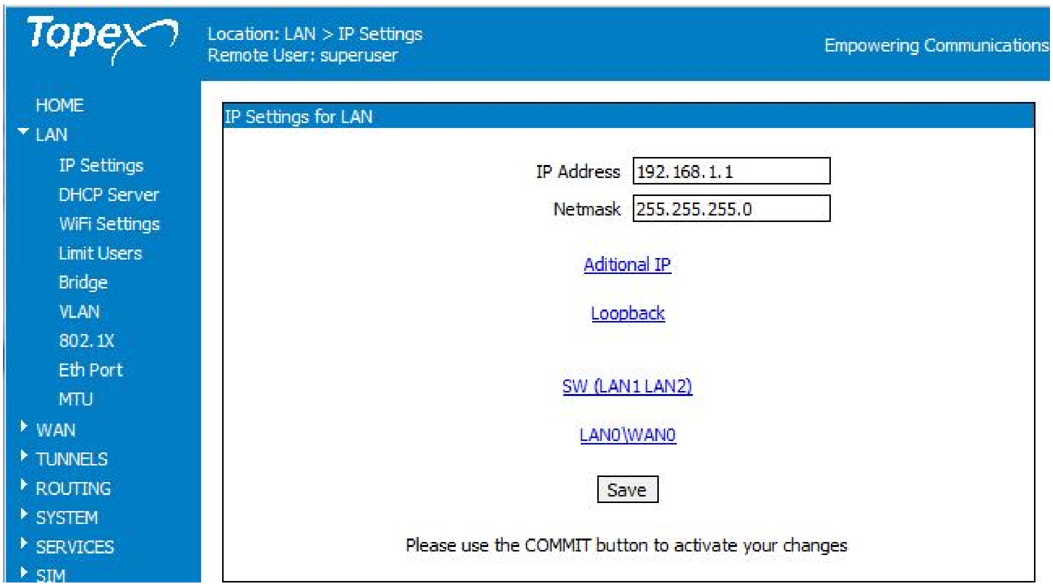


```
Pinging 192.168.148.148 with 32 bytes of data:
Reply from 192.168.148.148: bytes=32 time=2ms TTL=64
Reply from 192.168.148.148: bytes=32 time<1ms TTL=64
Reply from 192.168.148.148: bytes=32 time<1ms TTL=64
Reply from 192.168.148.148: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.148.148:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

5.2.3 Using “SW (LAN1, LAN2)” to disable two local ports

This is an extreme example of software configuration! As mentioned, Bytton LTE is a very versatile equipment.
Out of the four Ethernet ports, one is dedicated to WAN connection, but the others are fully configurable. By default, they are joined together in a switch, but you can take LAN1 and LAN2 out of this switch and assign them individual IP addresses and subnet masks.
A powerful application of this technique is **software disabling** of two of the Ethernet ports of Bytton LTE, as described below.
Suppose you use Bytton ICR in an application that requires that the router features a single LAN port for the users.
There are better solution than placing covers over the extra ports or asking the manufacturer NOT to assemble the respective RJ-45 connectors!
The disabling of the ports that are not used may be performed from software, via the Web pages of configuration (when you log-in as Superuser), respectively IP Settings, as explained below:

To software-disable two of the three LAN Ethernet ports of Bytton ICR, go to the Menu **LAN>IP Settings** and click the blue link “SW LAN1_LAN2”.



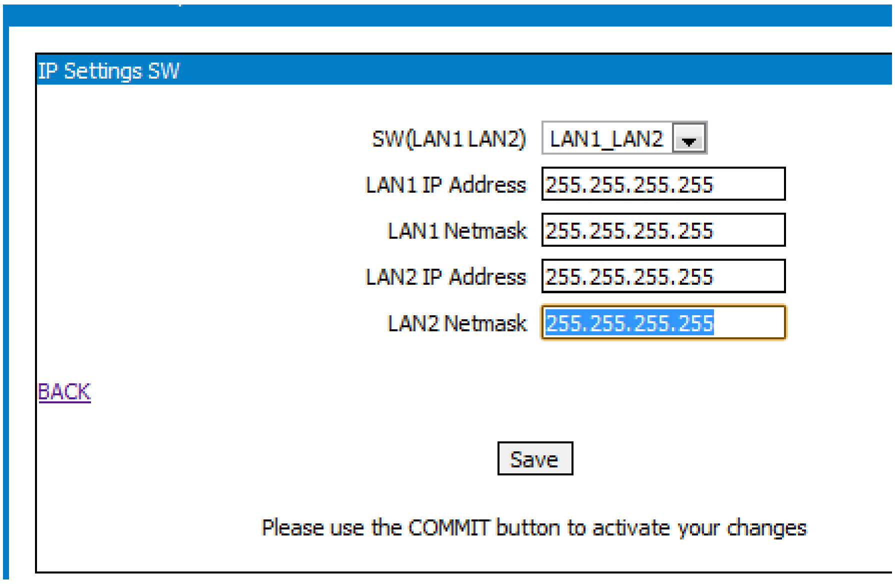
Location: LAN > IP Settings
Remote User: superuser

IP Settings for LAN

IP Address 192.168.1.1
Netmask 255.255.255.0

Please use the COMMIT button to activate your changes

In the window “IP Settings SW” that shows up, set the SW (LAN1, LAN2) to **LAN1_LAN2** and enter for both LAN ports the IP address ”255.255.255.255” and the subnet mask also “255.255.255.255”:



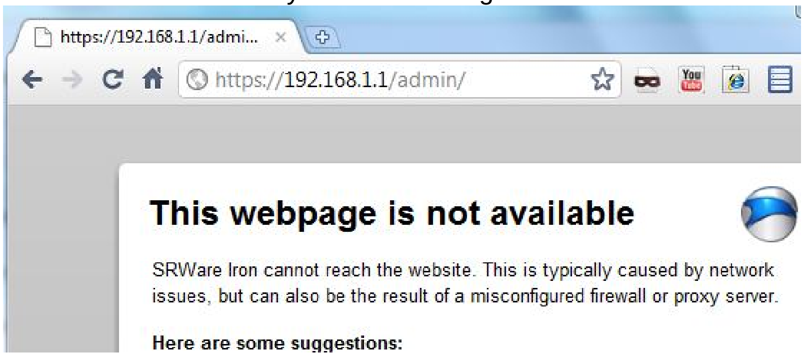
IP Settings SW

SW(LAN1 LAN2) LAN1_LAN2
LAN1 IP Address 255.255.255.255
LAN1 Netmask 255.255.255.255
LAN2 IP Address 255.255.255.255
LAN2 Netmask 255.255.255.255

Please use the COMMIT button to activate your changes

Save this settings with Save then use Commit to make the changes permanent. Following a reboot, the Bytton equipment starts operating with the new parameters, and now LAN1 and LAN2, although physically active, are disabled from software. When you connect a cable to them, nothing happens!

The browsers will show you error messages such as:

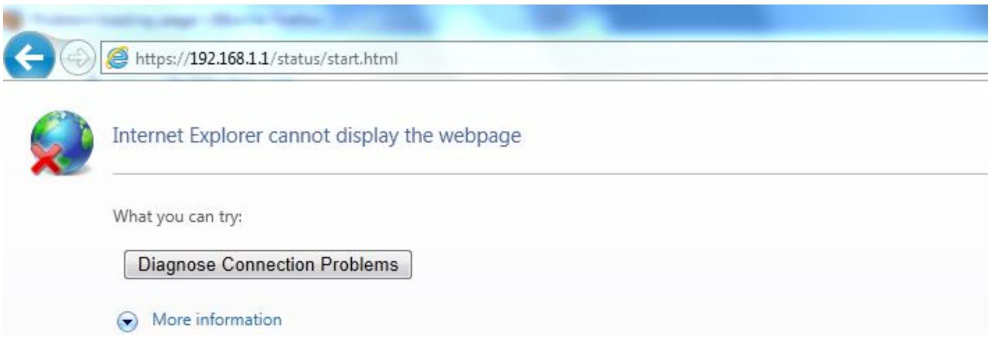


This webpage is not available

SRWare Iron cannot reach the website. This is typically caused by network issues, but can also be the result of a misconfigured firewall or proxy server.

Here are some suggestions:

Or:


https://192.168.1.1/status/start.html
Diagnose Connection Problems
More information

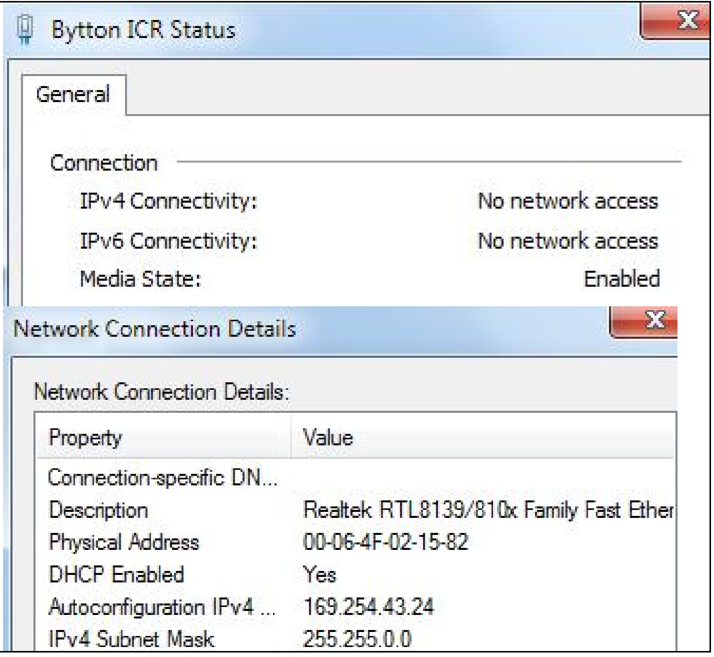
Internet Explorer cannot display the webpage

What you can try:

The green LED in the connector lights up, and the yellow LED is permanently ON, it does not blink to indicate data traffic – the respective Ethernet port is physically preset, but disabled by software!

On the computer connected to the disabled ports of Bytton ICR, Network Status will show “No Network access”, instead of the of the normal display:

When you ask for details, it will show Windows-default, not usable IP address of 169.254.43.24!



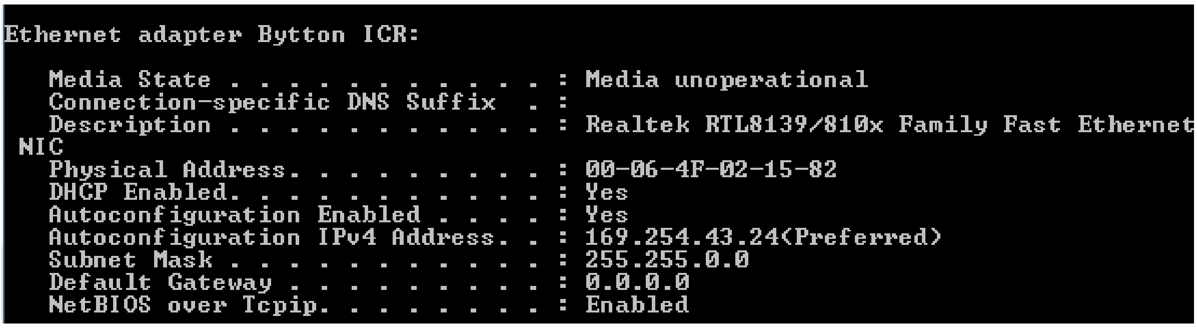
Connection

IPv4 Connectivity:	No network access
IPv6 Connectivity:	No network access
Media State:	Enabled

Network Connection Details:

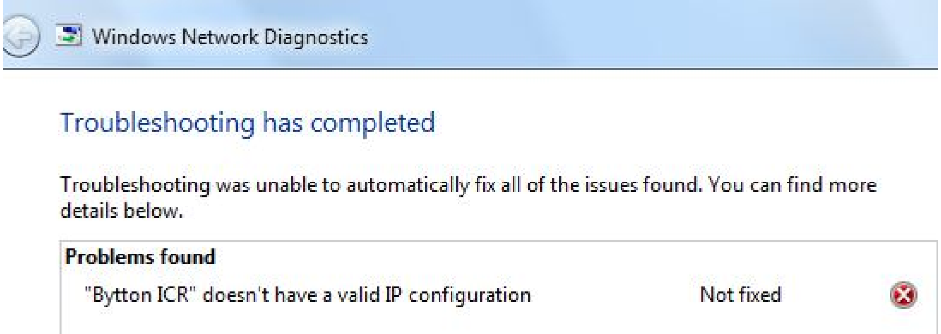
Property	Value
Connection-specific DN...	
Description	Realtek RTL8139/810x Family Fast Ether
Physical Address	00-06-4F-02-15-82
DHCP Enabled	Yes
Autoconfiguration IPv4 ...	169.254.43.24
IPv4 Subnet Mask	255.255.0.0

Also, the operating system command “ipconfig” will show the respective Ethernet port as being “unoperational”:



```
Ethernet adapter Bytton ICR:

   Media State . . . . . . . . . . . : Media unoperational
   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Realtek RTL8139/810x Family Fast Ethernet
 NIC
   Physical Address. . . . . . . . . : 00-06-4F-02-15-82
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   Autoconfiguration IPv4 Address. . : 169.254.43.24(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.0.0
   Default Gateway . . . . . . . . . : 0.0.0.0
   NetBIOS over Tcpip. . . . . . . . : Enabled
```

The Windows Network Diagnostic tool will try to troubleshoot the unresponsive Ethernet port, but will give up:



Troubleshooting has completed

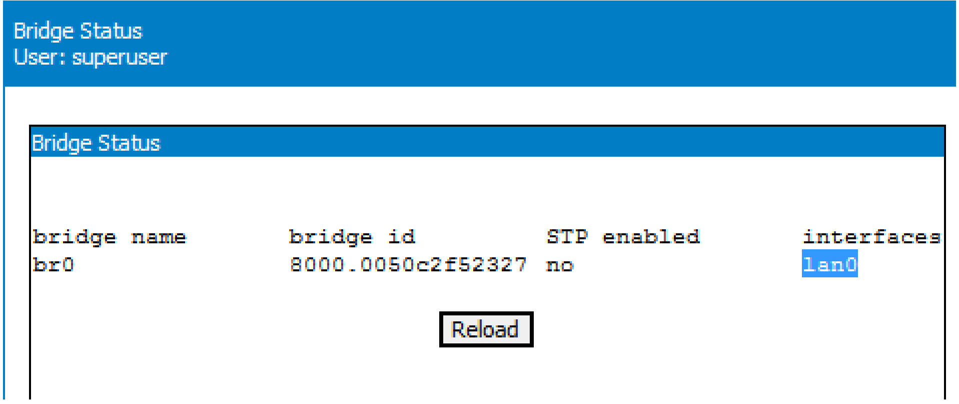
Troubleshooting was unable to automatically fix all of the issues found. You can find more details below.

Problems found

"Bytton ICR" doesn't have a valid IP configuration   Not fixed ☒

Now only the port LAN0 is active for the local network.

This can be seen very well in “Bridge Status”, where only the interface “**lan0**” is present:

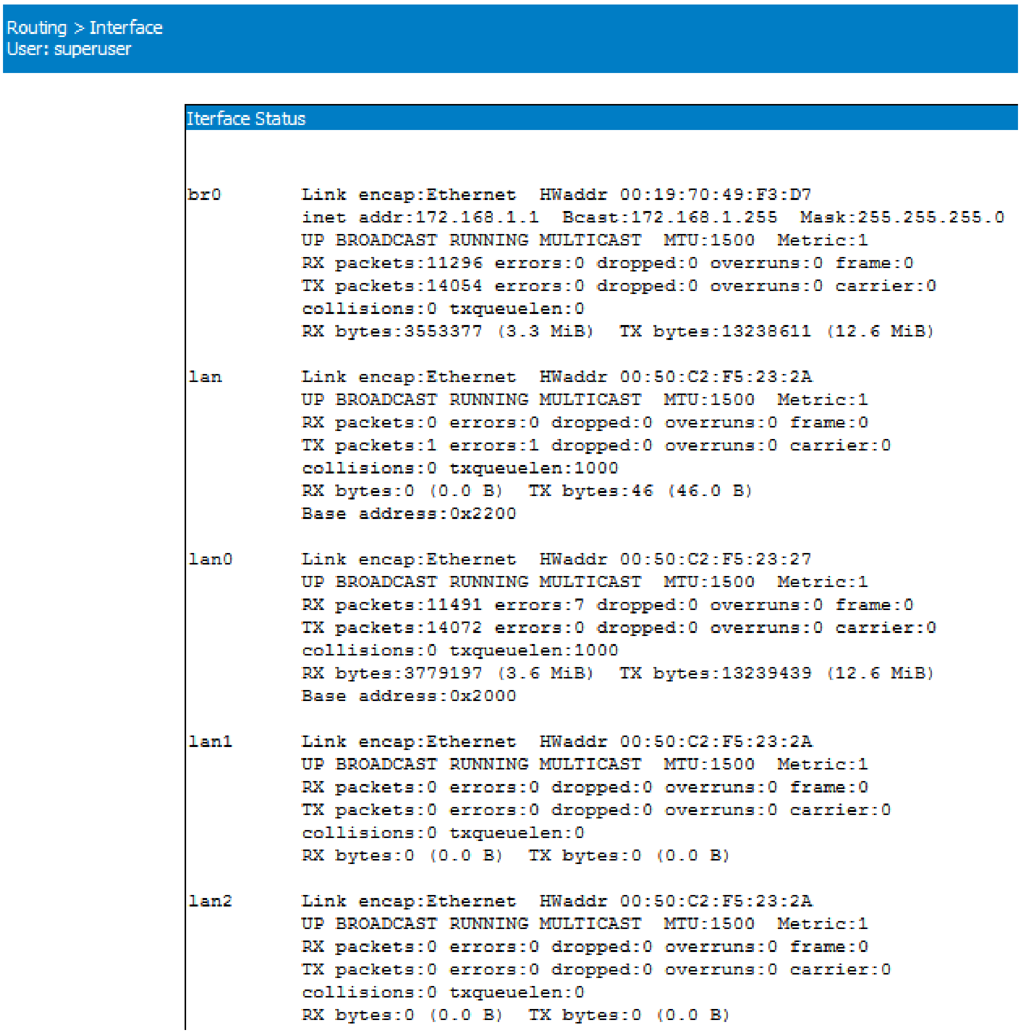


Bridge Status
User: superuser

Bridge Status

```
bridge name     bridge id           STP enabled     interfaces
br0             8000.0050c2f52327   no              lan0
```

And it may be seen also in the “Interface Status” window, as shown below:



Routing > Interface
User: superuser

Iterface Status

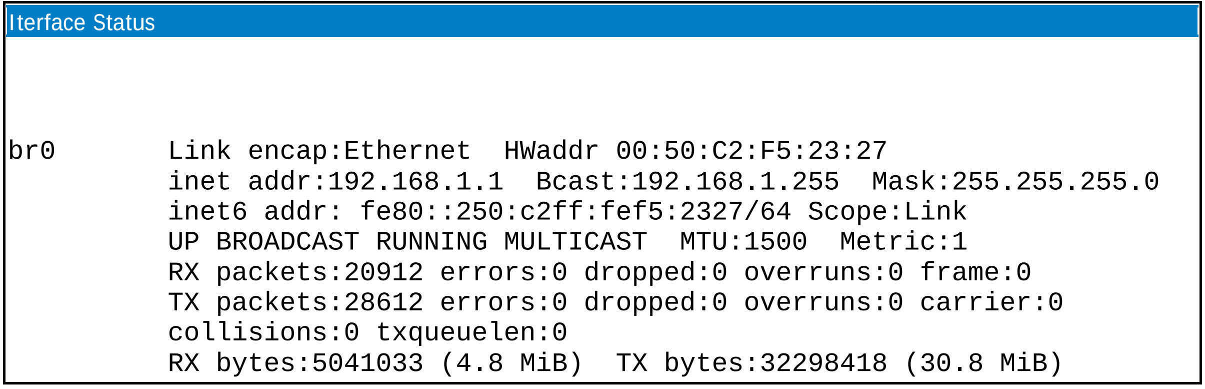
```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:172.168.1.1  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:11296 errors:0 dropped:0 overruns:0 frame:0
          TX packets:14054 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:3553377 (3.3 MiB)  TX bytes:13238611 (12.6 MiB)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:11491 errors:7 dropped:0 overruns:0 frame:0
          TX packets:14072 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3779197 (3.6 MiB)  TX bytes:13239439 (12.6 MiB)
          Base address:0x2000

lan1      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan2      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

Explanations:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:172.168.1.1  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:11348 errors:0 dropped:0 overruns:0 frame:0
          TX packets:14116 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:3559084 (3.3 MiB)  TX bytes:13263482 (12.6 MiB)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:11543 errors:7 dropped:0 overruns:0 frame:0
          TX packets:14134 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3785632 (3.6 MiB)  TX bytes:13264310 (12.6 MiB)
          Base address:0x2000

lan1      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan2      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
```

```
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:62185 errors:17 dropped:0 overruns:0 frame:0
          TX packets:10270 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:16237000 (15.4 MiB)  TX bytes:3560509 (3.3 MiB)
          Base address:0x3000
```

The bridge **Br0** is practiqually identical to **lan0**, which is the only active LAN port.



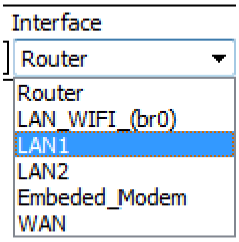
Iterface Status

```
br0       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:192.168.1.1  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::250:c2ff:fef5:2327/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:20912 errors:0 dropped:0 overruns:0 frame:0
          TX packets:28612 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:5041033 (4.8 MiB)  TX bytes:32298418 (30.8 MiB)
```

```
lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet6 addr: fe80::250:c2ff:fef5:2327/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:21380 errors:0 dropped:0 overruns:0 frame:0
          TX packets:28624 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5596158 (5.3 MiB)  TX bytes:32315725 (30.8 MiB)
          Base address:0x2000
```

Its traffic goes out via **wan** port.

The **lan1** and **lan2** ports, have absolutely nil data traffic.
The LAN1 and LAN2 ports do show up in the “Interface” dorp list, but they are disabled from software, they behave as they did not exist!
They do not have IP addresses, only their respective MACs (HWaddr)

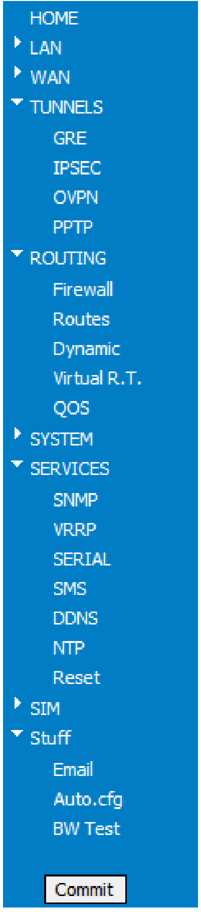


Interface: Router

```
lan1      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet6 addr: fe80::250:c2ff:fef5:232a/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:492 (492.0 B)

lan2      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet6 addr: fe80::250:c2ff:fef5:232a/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:492 (492.0 B)
```

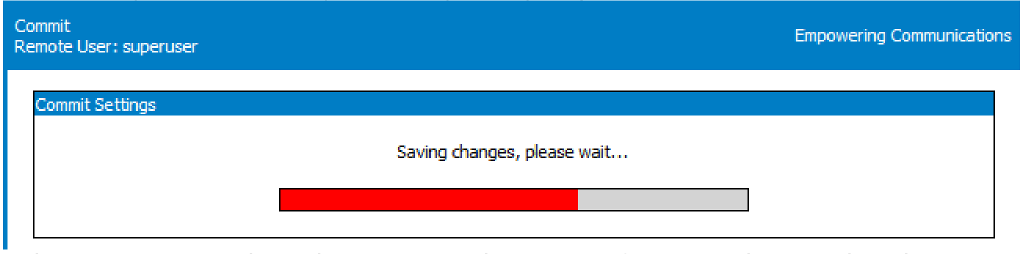
5.2.4 Commit

The “Commit” option described here is not specific to LAN section, but rather it is a general option for the Bytton LTE equipment.



If you performed configuration changes, using the “Save” button is not enough since it saves the modifications only into the temporary memory.

You should always press the “Commit” button if you want to make these changes permanent.
This button is located at the bottom of the Menu list, to the left side of the screen.
You will see a “Commit Settings” message and, underneath it, a red progress bar over black background which says: “Saving changes, please wait …”



Saving changes, please wait...

Figure 5-23: Commit Settings command – aspect of progress bar “Saving changes”.

The message is really necessary, saving will take some times, because the changed settings are saved into permanent (Flash) memory of the equipment.

Bytton LTE is unavailable during Commit, you will see an error message for the broken connection. Then the equipment resets, and when it starts again, the new set of parameters will be active.

Warning!

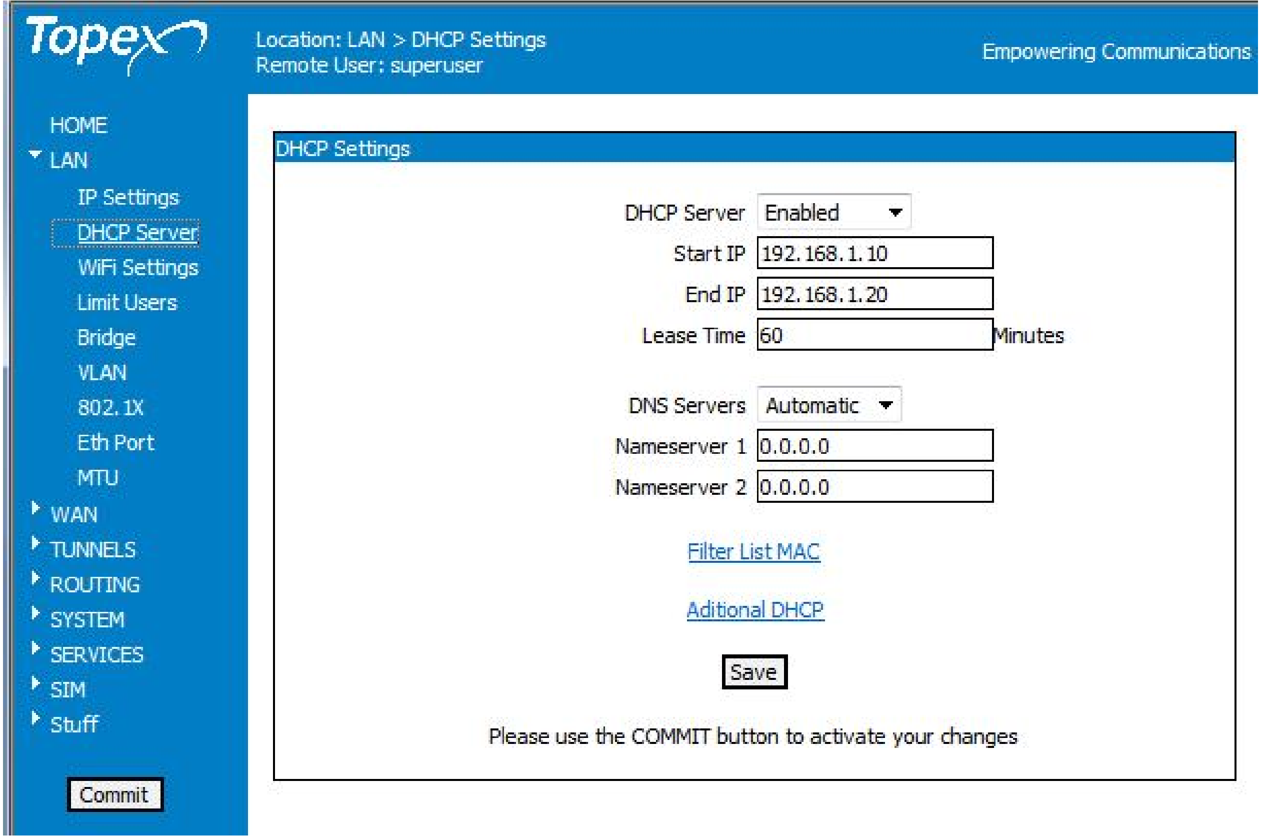
While committing changes, when resetting Bytton LTE or while loading a new program image, the equipment will cease operation for a few seconds. This means all connections: data link, WiFi, serial, LAN and WAN will be interrupted, then will resume when Bytton LTE starts again.

For instance, the status bar at the bottom of the screen will temporary indicate that the LAN connection with Bytton LTE is not available (“cable unplugged” or “limited connectivity” message and connection icon with a red “x”.

Then Bytton LTE restarts with the new parameters, and the LAN connection is immediately restored.

5.2.5 DHCP Settings

Settings for the DHCP server of the local network, servers used for DNS, and MAC addresses filtering:



Location: LAN > DHCP Settings
Remote User: superuser

DHCP Settings

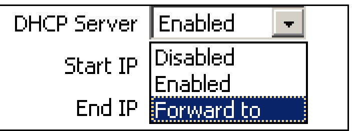
DHCP Server: Enabled
Start IP: 192.168.1.10
End IP: 192.168.1.20
Lease Time: 60 Minutes

DNS Servers: Automatic
Nameserver 1: 0.0.0.0
Nameserver 2: 0.0.0.0

Please use the COMMIT button to activate your changes

Figure 5-24: LAN webpage – DHCP Server.

DHCP Server:

Enabled, Disabled or Forward to. By default it is Enabled, thus the Bytton LTE router acts as a DHCP server for the local network: it will dynamically assign IP addresses to clients on the internal network.	 DHCP Server: Enabled Start IP End IP Disabled Enabled Forward to

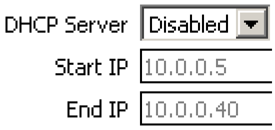
The Bytton LTE Wireless Router supports up to 254 IP addresses for your wireless network. When set to DISABLED, the IP addresses must be manually assigned by the network administrator. The option Forward to means the local requests for DHCP will be handled by a remote server, instead of Bytton.

Warning: *If you enable the DHCP feature of Bytton LTE, make sure that there is no other DHCP server in your local network!*

Start IP: Starting IP Address. The DHCP server allocates IP addresses in a user specified range (a pool of addresses). The Start option sets the **first** IP address in the pool.

End IP: End IP Address. The End option sets the **end** IP address, the last address in the pool to be assigned by the DHCP server in your local network.

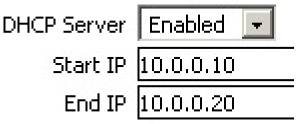
Note 1: *if the DHCP server is disabled, the fields below it, Start IP and End IP, will be displayed in grey color. This shows you that the respective parameters are disabled.*



DHCP Server: Disabled
Start IP: 10.0.0.5
End IP: 10.0.0.40

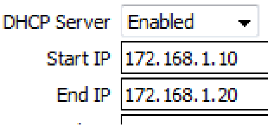
Note 2: *Remember that the default IP address of Bytton LTE is 192.168.1.1, so the Start IP must be 192.168.1.2 or greater, but smaller than 192.168.1.254. You should set an adequate IP range for DHCP usage, for instance form 10 to 20 for a small network , or from 20 to 50 in case of a larger network.*

Note 3: *Of course, the DHCP setting must be correlated with the IP address of Rohde & Schwarz Topex S.A. Bytton LTE. For instance, if the requirements of your network compel you to use an IP such as* ***10.0.0.1****, instead of the default IP address "192.168.1.1.", the DHCP server must be also set for the* ***same range*** *of IP addresses, respectively from 10.0.0.xxx where xxx is from 10 up to 20:*

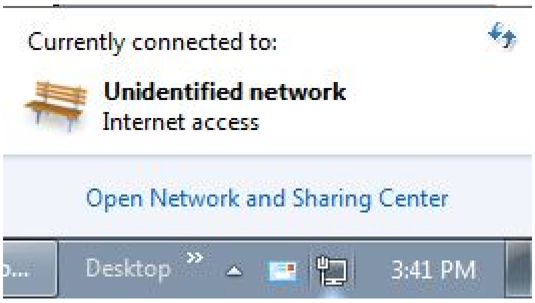


DHCP Server: Enabled
Start IP: 10.0.0.10
End IP: 10.0.0.20

Alternately, when the primary IP of the Bytton LTE box has been set to 172,168.1.1, instead of the default IP address "192.168.1.1.", the DHCP server must be also set for the same range of IP addresses, 172.168.1.yyy, where yyy may be from 10 up to 20 or a wider range:



DHCP Server: Enabled
Start IP: 172.168.1.10
End IP: 172.168.1.20



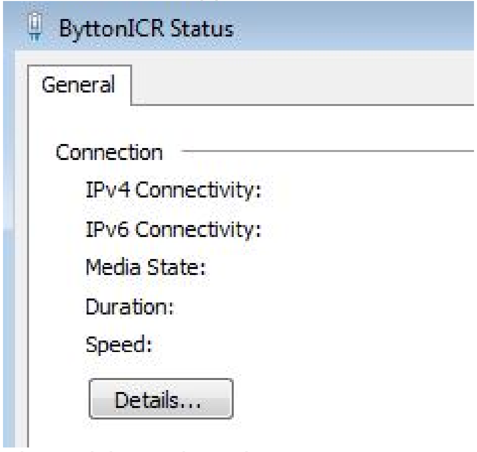
Currently connected to:
Unidentified network
Internet access
Open Network and Sharing Center

To check the correct assignment of IP address, double click the icon corresponding to the Bytton LTE network connection on the desktop of your computer.

Click the link "Open Network and Sharing Center:

Figure 5-25: Open Network and Sharing Center to verify the assignment of IP addresses.

The Status window for the network connection will appear, as shown.

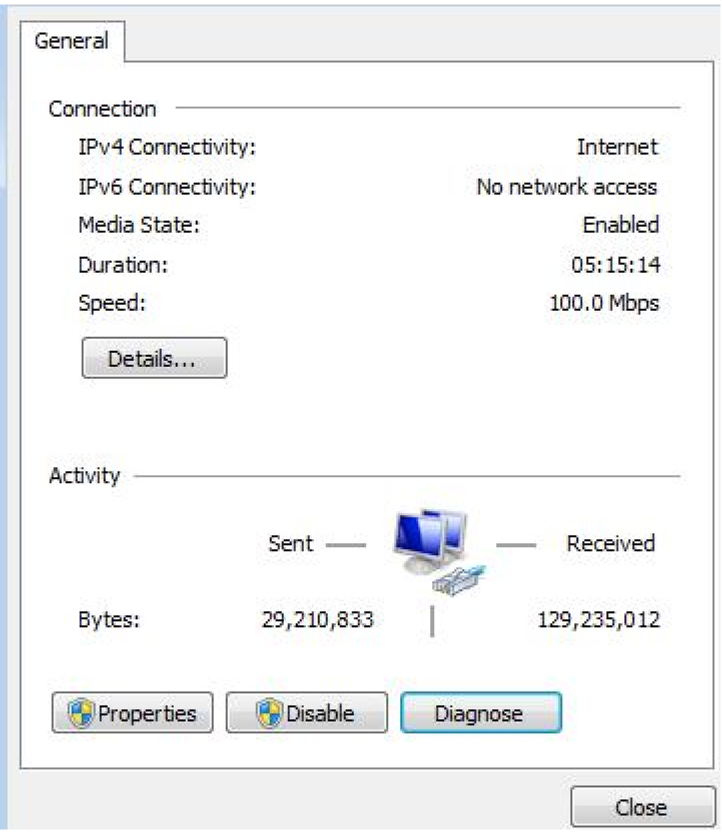


ByttonICR Status

General

Connection
IPv4 Connectivity:
IPv6 Connectivity:
Media State:
Duration:
Speed:

Fist, Click on the tab "**General**" to see general information (status, Internet access, connection duration, connection speed) about the respective network connection "Bytton_LTE ":



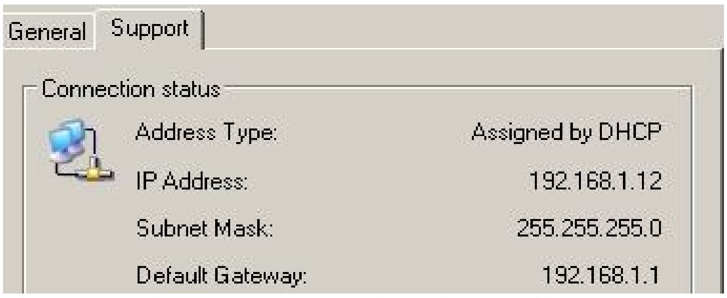
General

Connection
IPv4 Connectivity: Internet
IPv6 Connectivity: No network access
Media State: Enabled
Duration: 05:15:14
Speed: 100.0 Mbps

Activity
Sent — — Received
Bytes: 29,210,833 | 129,235,012

Figure 5-26: The General tab of the connection to Bytton LTE shows its current state.

The "Support" or "Details" window tells you that the IP address has been "Assigned by DHCP" and is in this example 192.168.1.12 (inside the range 10-20 that you have specified). You can also verify that the default gateway is 192.168.1.1 (the Bytton LTE device) and the Subnet Mask is 255.255.255.0.



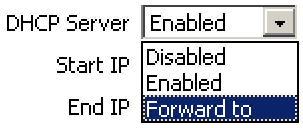
General | Support

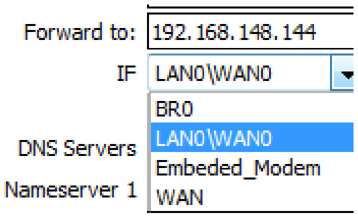
Connection status
Address Type: Assigned by DHCP
IP Address: 192.168.1.12
Subnet Mask: 255.255.255.0
Default Gateway: 192.168.1.1

Figure 5-27: The Details tab of the connection to Bytton LTE shows its IP address.

Forward to

You may select the third option, “**Forward to**”, to pass the DHCP requests to a remote server, instead of the local Bytton LTE equipment.


DHCP Server: Enabled


Forward to: 192.168.148.144

IF: LAN0\WAN0

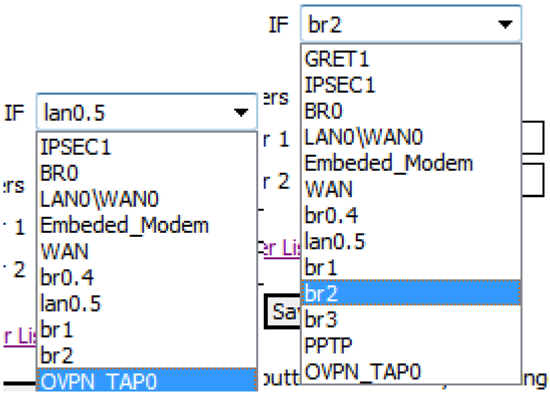
In this case, you must complete the IP address of that server, such as 192.168.144.88 in this example, and select the interface (IF) over which the DHCP requests will be forwarded (BR) for wired LAN or Wi-Fi, WAN port, PPP link of embedded modem, or LAN0/WAN0 configurable port).

Figure 5-28: Using the “Forward to” option for DHCP Server in LAN configuration webpage.

As you may notice, in addition to the “real”, physical interfaces mentioned above, the drop list for IF will also list all the virtual, logical interfaces that are defined on your Bytton LTE equipment:

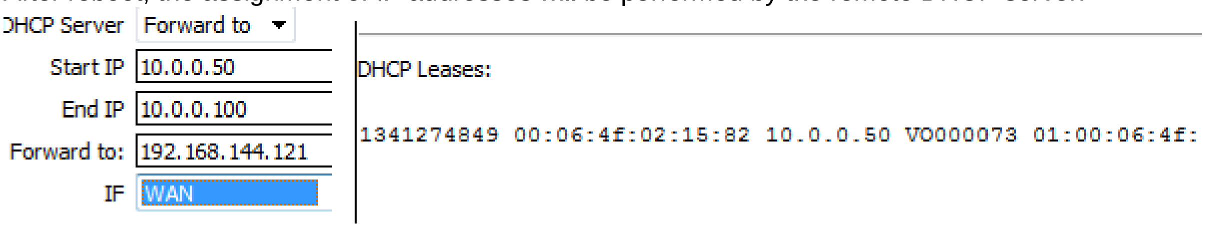
- LAN3/WAN, when the WAN0/LAN0 port is taken out of the LAN switch and assigned to a secondary WAN
- GRE tunnels: gret1, gret2
- IPSEC tunnels: ipsec1, ipsec2, and so on
- Virtual LANs
- Bridges between different interfaces: br1, br2, br3.
- Open VPNs (OVPN_TAP0)

And so on.


IF: lan0.5

IF: br2

After reboot, the assignment of IP addresses will be performed by the remote DHCP server:


DHCP Server: Forward to

Start IP: 10.0.0.50

End IP: 10.0.0.100

Forward to: 192.168.144.121

IF: WAN

DHCP Leases:

```
1341274849 00:06:4f:02:15:82 10.0.0.50 VO000073 01:00:06:4f:
```

DNS Servers:

Select which primary and secondary servers for DNS (Domain Name Service) that will be used. Options are **Automatic** (default) and Manual.

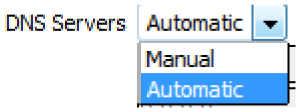
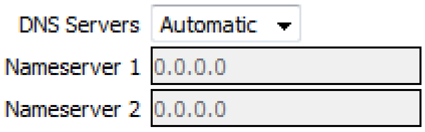

DNS Servers: Automatic

Figure 5-29: Select Manual or Automatic for DSN Servers.

When you leave the setting to the default **Automatic**, the equipment will look for DNS servers in the local or remote networks.


DNS Servers: Automatic

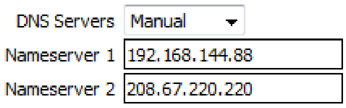
Nameserver 1: 0.0.0.0

Nameserver 2: 0.0.0.0

Also, when you have chosen “Automatic”, the fields below will be colored in gray, indicated they are not editable!

Figure 30a: When Automatic option is chosen, the next fields are inactive (grey color).

Should you select the option “Manual” instead of “Automatic”, then you must complete the IP addresses of the two Nameservers (primary and alternate) yourself.


DNS Servers: Manual

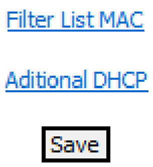
Nameserver 1: 192.168.144.88

Nameserver 2: 208.67.220.220

Figure 5-30b: Select Manual instead of Automatic for DSN Servers.

As can be seen from the examples above, the servers for DNS may be either in the local network or over the Internet or WAN.

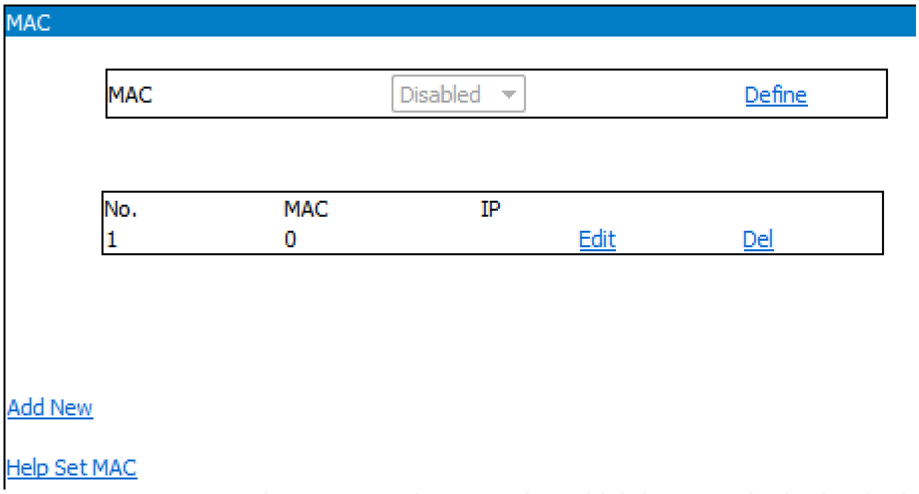
Filter List MAC



Click the first blue link located at the bottom to reach this feature.
It is an additional security feature, **for the whole Bytton ICR equipment**.

Figure 5-31: Click the link “Filter List MAC” to use this feature.

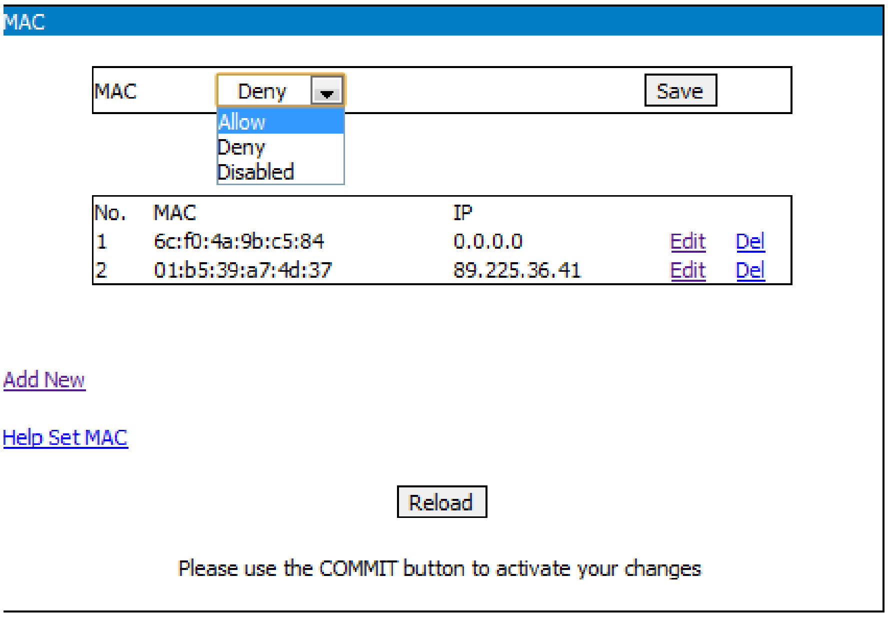
The “MAC” window shows up, where you can selectively accept or reject access form specific physical addresses. By default, this list is empty, you should use the link “Add New” at the bottom to create new entries:



MAC: Disabled

No.	MAC	IP		
1	0		Edit	Del

Figure 5-32: The MAC list, which is empty in the beginning.



MAC: Deny

No.	MAC	IP		
1	6c:f0:4a:9b:c5:84	0.0.0.0	Edit	Del
2	01:b5:39:a7:4d:37	89.225.36.41	Edit	Del

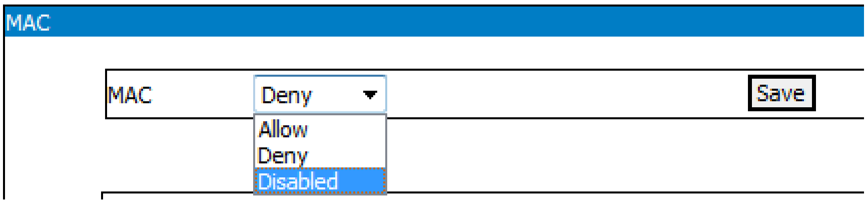
Please use the COMMIT button to activate your changes

Figure 5-33: Adding and editing entries in the table “Filter List MAC”.

An additional security feature, for the whole equipment – you can allow LAN traffic **only** form the MAC addresses that you specify here, or you can **deny** traffic for certain MAC addresses. You can also block the respective user to a certain IP address.
By default the table is empty, you must Add new entries, then Edit and Save them:

By default, it is **Disabled**, meaning this MAC filtering feature is inactive.

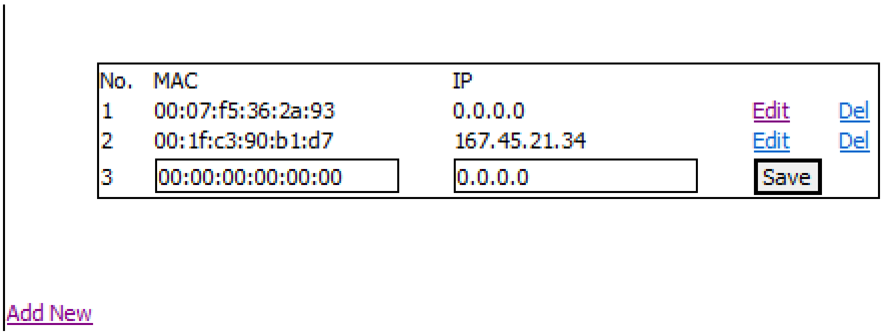
To activate it, fist, select either **Allow**, or **Den**y, then define the addresses which will be permitted, respectively rejected.



MAC

MAC: Deny ▾ [Save]

You can add as many records as you like in this table, but bear in mind that the rule you choose (either Accept them or Deny these MACs) will apply *for al physical addresses and IP addresses in the lis*t!



No.	MAC	IP		
1	00:07:f5:36:2a:93	0.0.0.0	Edit	Del
2	00:1f:c3:90:b1:d7	167.45.21.34	Edit	Del
3	00:00:00:00:00:00	0.0.0.0	Save	

Add New

Figure 5-34: Defining MAC entries in the table “Filter List MAC”.

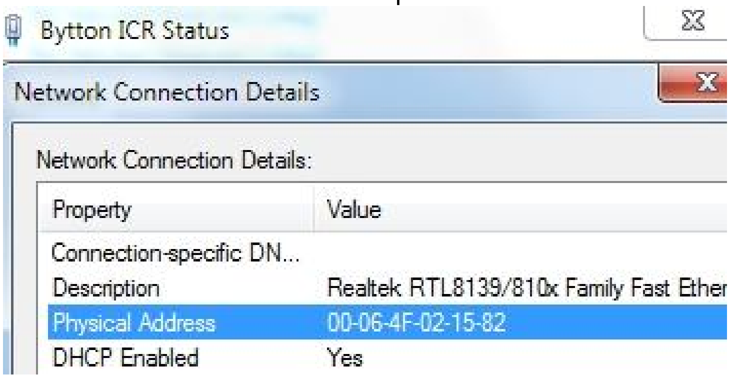
IP – it establishes a fixed IP address for the respective MAC source.

When you choose **Allow,** and type a value in the field ”IP” , the client with the respective MAC will get the corresponding IP address, like the 10.0.0.17 as shown the example above.

Instead of a dynamic address, assigned by DHCP, he will always have the same address that you establish here.

Example of usage for “Filter List MAC”:

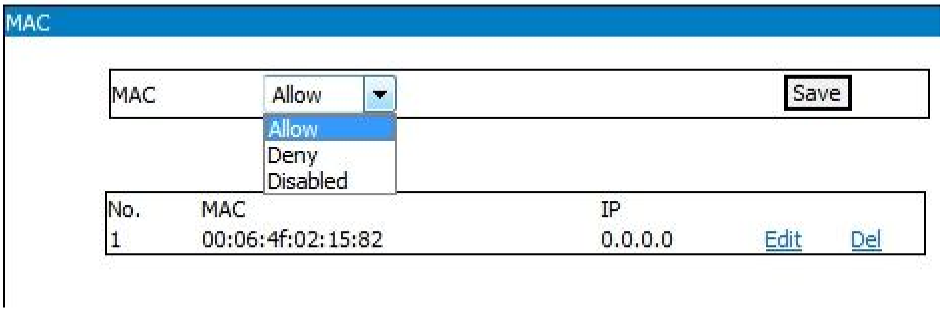
1. First, identify the MAC of the device that you want to connect to the bytton ICR equipement, such as the ntework card of the PC computer in this case:



Network Connection Details:

Property	Value
Connection-specific DN...	
Description	Realtek RTL8139/810x Family Fast Ether
Physical Address	00-06-4F-02-15-82
DHCP Enabled	Yes

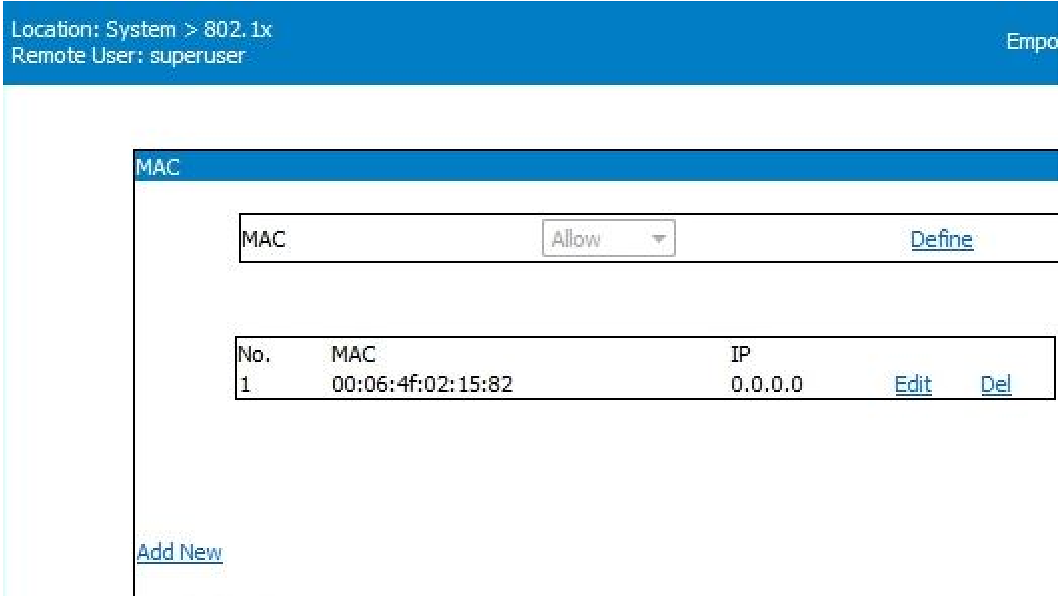
2. Enter this physical address into the field MAC, after choosing Allow as action for the MACs in the list:



MAC: Allow

No.	MAC	IP		
1	00:06:4f:02:15:82	0.0.0.0	Edit	Del

3. Save this configuration and Add new MAC values, if required:



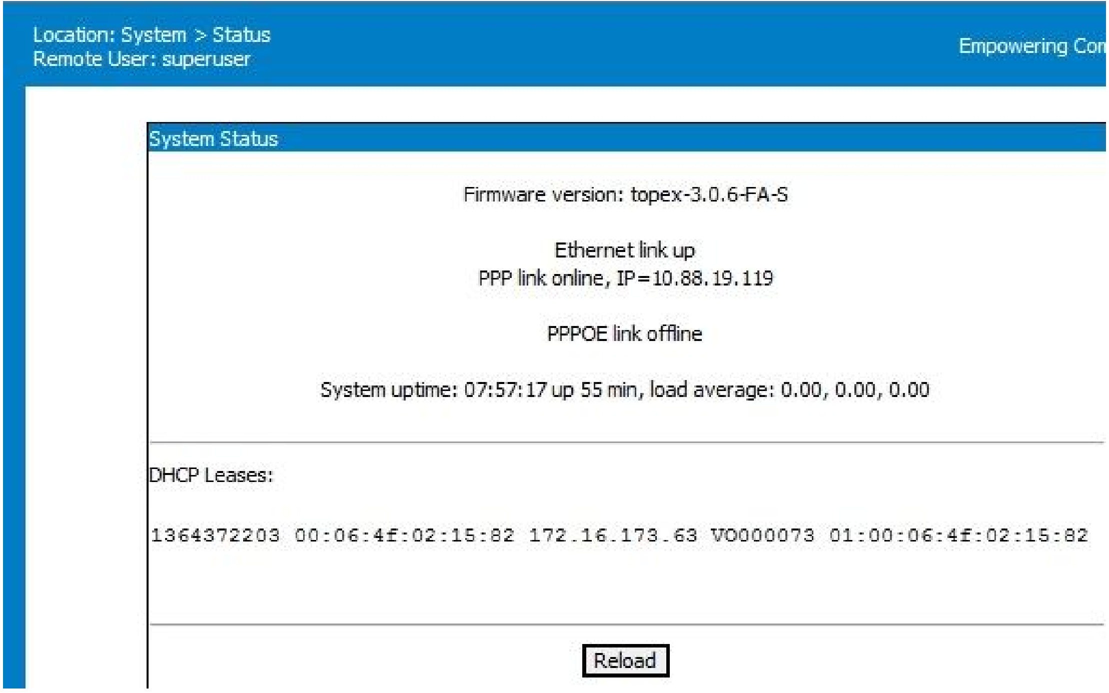
Location: System > 802.1x
Remote User: superuser

MAC: Allow

No.	MAC	IP		
1	00:06:4f:02:15:82	0.0.0.0	Edit	Del

4. When all required MAC values are entered, use Commit to make permament these settings
5. After reboot, Bytton will take into consideration only the equipment that features on the corresponding Ethernet pot the MAC that you have

specified:



Firmware version: topex-3.0.6-FA-S

Ethernet link up
PPP link online, IP=10.88.19.119

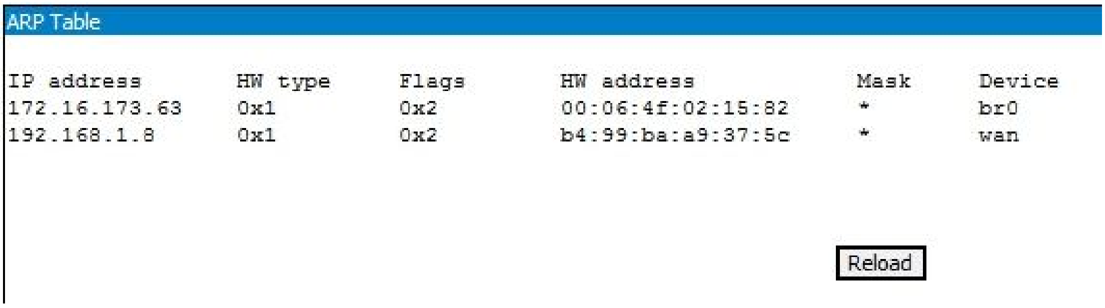
PPPOE link offline

System uptime: 07:57:17 up 55 min, load average: 0.00, 0.00, 0.00

DHCP Leases:

```
1364372203 00:06:4f:02:15:82 172.16.173.63 VO000073 01:00:06:4f:02:15:82
```

6. This MAC is also visible in the ARP Table of ETH Port, for the **br0** interface:



```
IP address       HW type     Flags       HW address            Mask     Device
172.16.173.63    0x1         0x2         00:06:4f:02:15:82     *        br0
192.168.1.8      0x1         0x2         b4:99:ba:a9:37:5c     *        wan
```

7. When you try to connect other devices, with different MAC values, to the respective LAN port or to the other available Ethernet ports of the equipment, they will be ingnored – connection is permitted only for devices whoose physical addresses have been inserted in the MAC list!

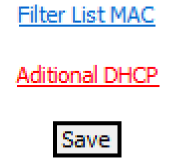
Notes:

1. A similar feature, called "MAC Security" , is also available in the Web page "WiFi Settings" (see the next chapter).

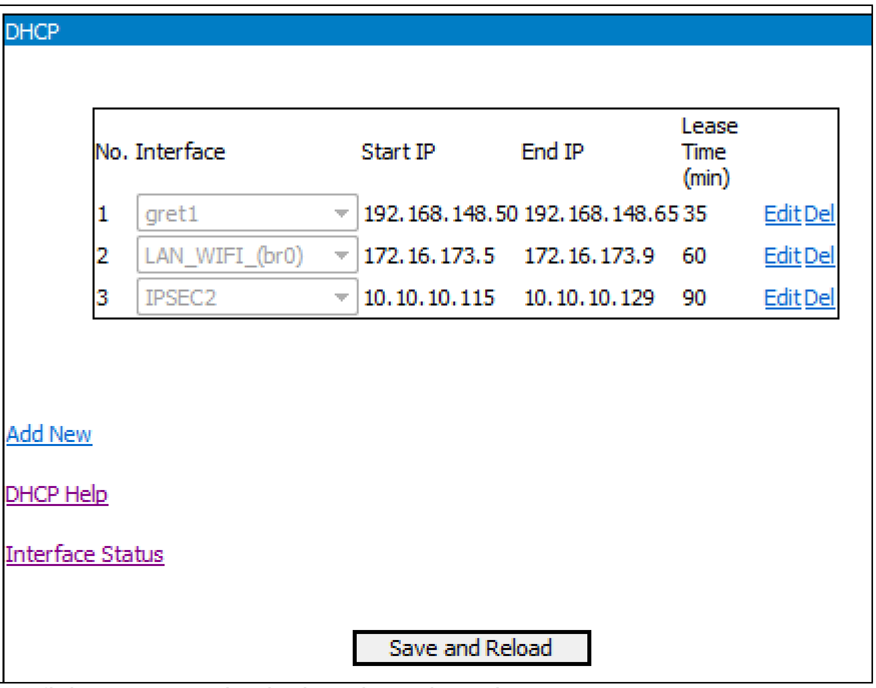
2.The MAC Security for WiFi lets you specify up to five physical addresses whose access will be selective allowed or denied.

*But the respective feature applied **only** to the wireless clients connected to Bytton LTE, while Filter List MAC described previously **applies to all local** connections, no matter if they are cabled Ethernet or WiFi!*

3.The MAC filtering feature does not guarantee a high level of security, since the hardware address can be faked. Thus, you should not rely solely on MAC filtering to assure security of your local network!

Additional DHCP: Click the last link at the bottom to reach that window for configuration additional DHCP services:	 Filter List MAC Aditional DHCP Save

This feature allows you to set up additional DHC services, over different interfaces of Bytton.
You may choose the interface form the drop list, then set up the start and end Ip addresses, and finally the lease time, for each of these interfaces, as shown

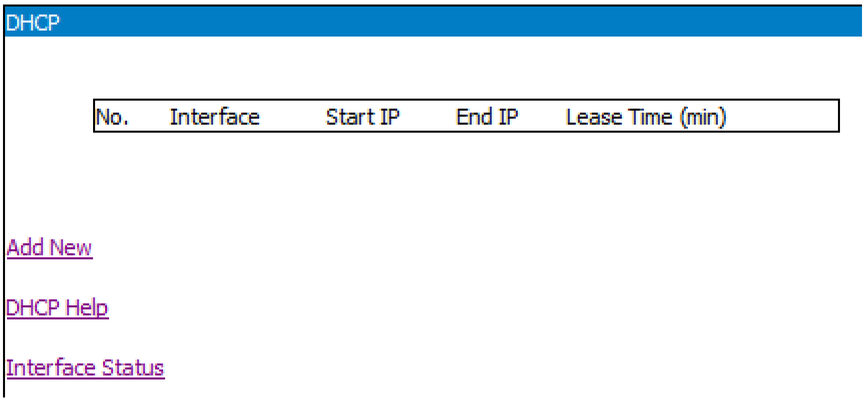


DHCP

No.	Interface	Start IP	End IP	Lease Time (min)		
1	gret1	192.168.148.50	192.168.148.65	35	Edit	Del
2	LAN_WIFI_(br0)	172.16.173.5	172.16.173.9	60	Edit	Del
3	IPSEC2	10.10.10.115	10.10.10.129	90	Edit	Del

Figure 5-35: Defining MAC entries in the table “Filter List MAC”.

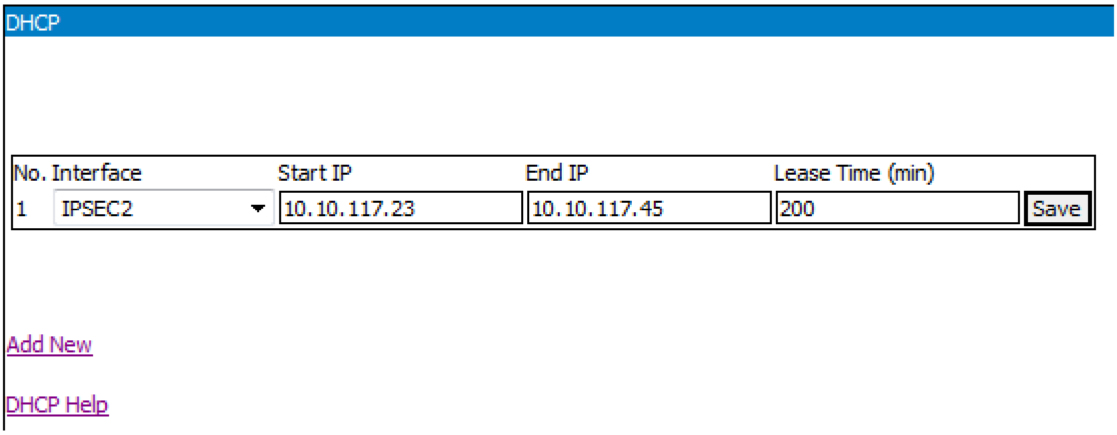
At fist the list is empty, as shown:



DHCP

No.	Interface	Start IP	End IP	Lease Time (min)

You must use the link “Add new” to the left to add a new entry, and then edit and Save it:



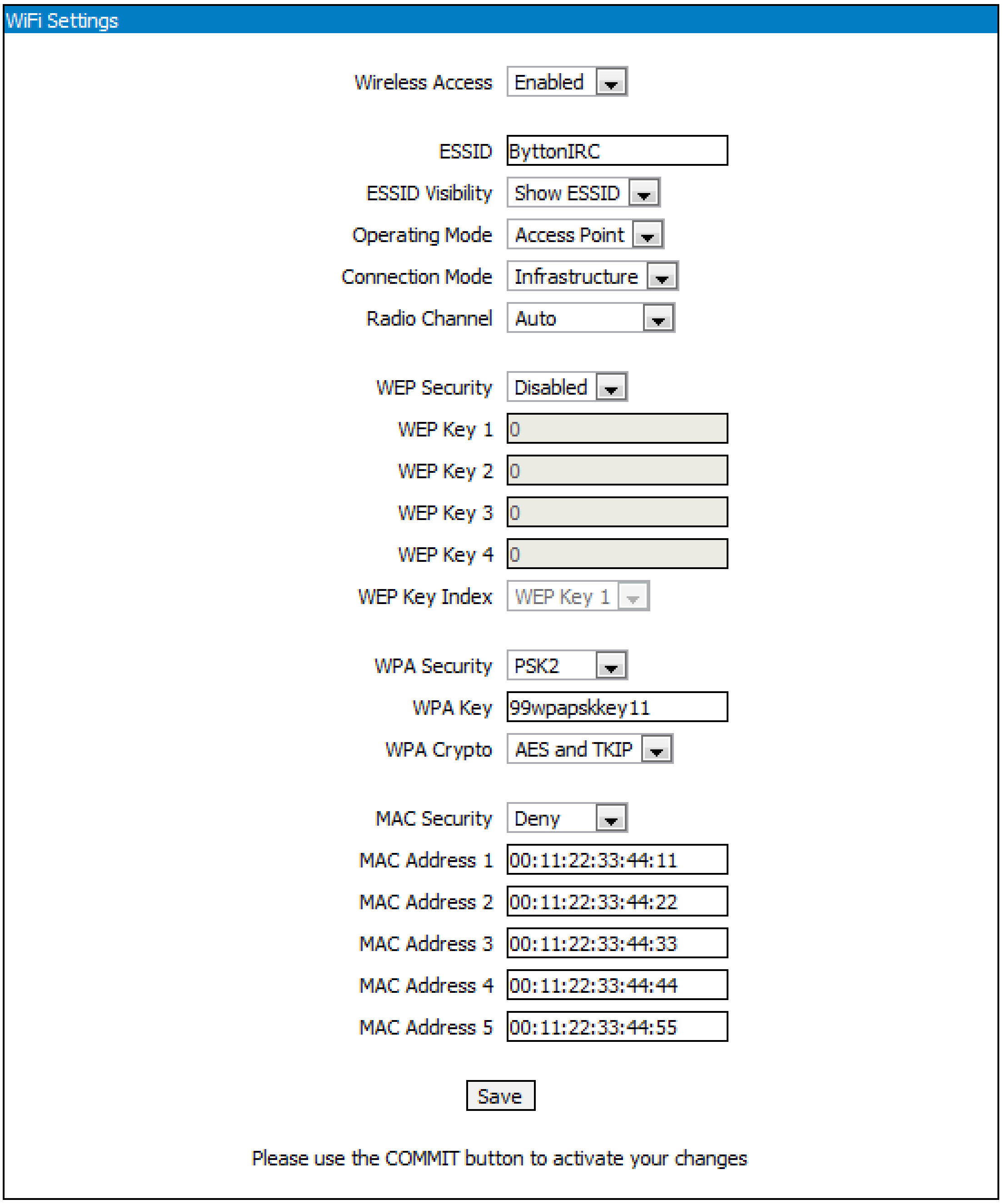
DHCP

No.	Interface	Start IP	End IP	Lease Time (min)	
1	IPSEC2	10.10.117.23	10.10.117.45	200	Save

Figure 5-36: Editing MAC entries in the table “Filter List MAC”.

5.2.6 WiFi Settings

Here you can establish the settings for the embedded wireless Access Point (802.11b/g base station) of the Bytton LTE router:



WiFi Settings

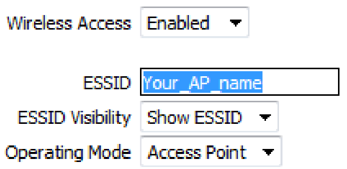
Wireless Access	Enabled
ESSID	ByttonIRC
ESSID Visibility	Show ESSID
Operating Mode	Access Point
Connection Mode	Infrastructure
Radio Channel	Auto
WEP Security	Disabled
WEP Key 1	0
WEP Key 2	0
WEP Key 3	0
WEP Key 4	0
WEP Key Index	WEP Key 1
WPA Security	PSK2
WPA Key	99wpapskkey11
WPA Crypto	AES and TKIP
MAC Security	Deny
MAC Address 1	00:11:22:33:44:11
MAC Address 2	00:11:22:33:44:22
MAC Address 3	00:11:22:33:44:33
MAC Address 4	00:11:22:33:44:44
MAC Address 5	00:11:22:33:44:55

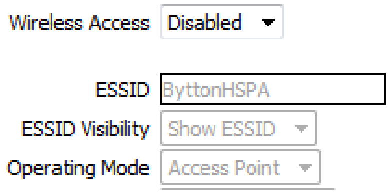
Please use the COMMIT button to activate your changes

Figure 5-37: The LAN page for WiFi Settings.

Note:
The MAC addresses set from this page, are the unique MAC assigned to the network interfaces of the client devices connected to Bytton router.

Wireless access:
You may enable or disable the wireless access to the Bytton LTE device.
When enabled, the green LED marked “WiFi” on the front panel lights up.
“ESSID” is the character string that you want to be broadcast as the name of your wireless network.


Wireless Access: Enabled
ESSID: Your_AP_name
ESSID Visibility: Show ESSID
Operating Mode: Access Point


Wireless Access: Disabled
ESSID: ByttonHSPA
ESSID Visibility: Show ESSID
Operating Mode: Access Point

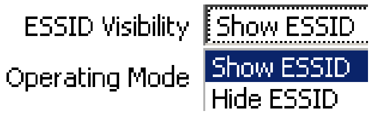
By default, the Wireless Access is **Enabled**. When you set to to **Disable**, the Wi-Fi features will be inactive, the front panel LED turns off.

To indicate inactivity, all the following fields will be colored in gray, showing you that this section is inactive (you cannot perform changes here).

ESSID: InternetCaffe ANTARES

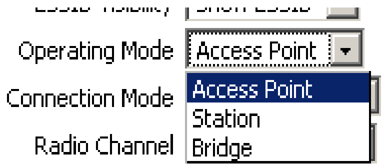
ESSID: name of the Wireless LAN.
ESSID is a unique name, of length up to 32 characters, which identifies the embedded wireless Access Point of BYTTON in the wireless LAN. All devices in the wireless network must have the same ESSID. We strongly recommend changing the default, which is **ByttonHSPA**.

ESSID Visibility: Shows or hides the ID, making your router visible/invisible to others. By default an ESSID is visible, meaning it is being broadcasted to all Wi-Fi devices placed in its area, thus making the network prone intruders.


ESSID Visibility: Show ESSID

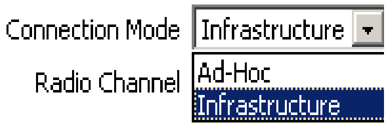
Operating Mode:

Access Point – standard mode of operation, Bytton LTE acts as a base station for several Wi-Fi clients.
Station – BYTTON acts as a Wi-Fi client instead, it connects to an existing Access Point.


Operating Mode: Access Point

Bridge – performs transparent bridging between two remote Access Points, also known as Wireless Distribution System (WDS) that allows connecting to several APs. It is most commonly as a Wi-Fi repeater located midway between two APs.

Connection Mode: It has two options, Infrastructure and Ad-Hoc.

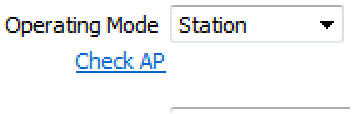

Connection Mode: Infrastructure

Infrastructure: default operation mode. Several Wi-Fi clients can connect to the Bytton LTE equipment, which is acting as server.

The “Infrastructure” mode takes full advantage of the AP's ability to cover wide areas.
Ad-Hoc: two wireless clients interconnect directly, without the need for an AP. In this connection mode, the Bytton links directly to a computer with Wi-Fi or an AP that is set to work in Ad-Hoc mode.

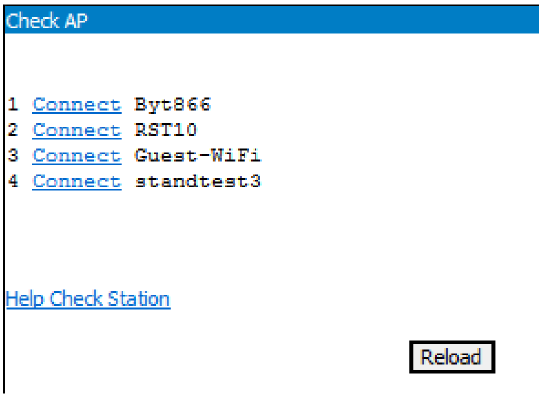
The “Ad Hoc” Mode is easier to set up, thus recommended for a very small or temporary network.

This setting is related to the previous one - usually, the “Ad-Hoc” connection is used when Operating Mode is set to “Station”.


Operating Mode: Station

When you set “Operating Mode” to **Station** instead of the default Access Point, an additional link show up below this fields, “Check AP”. Obviously, since Bytton is now a Wi-Fi client, it must see the WiFi base stations that are active in the area!

Click the link Check AP



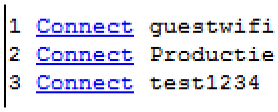
Check AP

```
1 Connect Byt866
2 Connect RST10
3 Connect Guest-WiFi
4 Connect standtest3
```

:

A pop-up window titled “Check AP” appears, showing the active WiFi Access Points that can be detected.

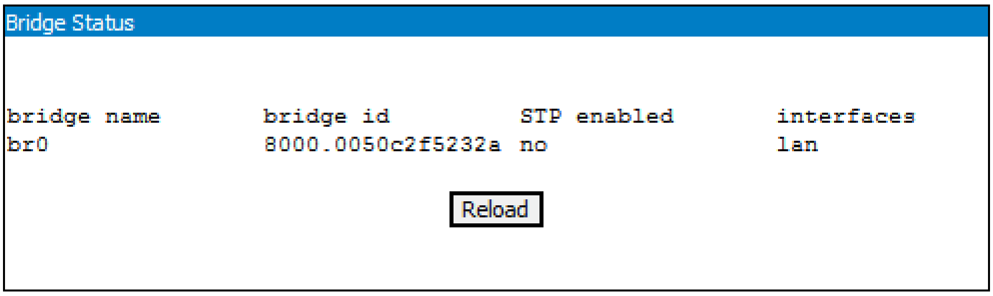
Each AP name has a corresponding “Connect” link, click it to connect to the respective WiFi base station.



```
1 Connect guestwifi
2 Connect Productie
3 Connect test1234
```

Notes:

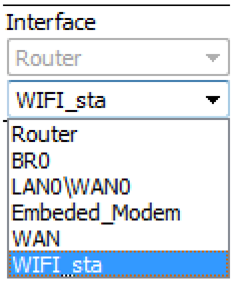
1. When you set the Bytton’s WiFi to Station instead of Access Point, its green indicator LED will turn off: the wireless module is active, but it functions as a **client**, not as server!
2. If you look at Bridge Status, you will notice that BR0 now contains only the “lan” Ethernet port, wlan0 was taken out of the default local bridge:



Bridge Status

```
bridge name     bridge id           STP enabled     interfaces
br0             8000.0050c2f5232a   no              lan
```

3. As a consequence of being removed from the default bridge “br0”,



Interface

Router

WIFI_sta

in this configuration the WiFi module acting as client (Station) shows up in the Interfaces drop list as “WiFI_sta”, a distinct interface or Bytton, while previously in was included in the BR0 default local bridge!

Connections to WiFi AP’s

In the System Log of Bytton LTE you o can see these connections:

```
Jul 13 13:06:30 bytton user.notice root: LOG guestwifi
Jul 13 13:05:50 bytton user.info kernel: br0: port 2(wlan0) entering learning state
Jul 13 13:06:01 bytton cron.err crond[1640]: USER root pid 5330 cmd net_moni
Jul 13 13:06:01 bytton cron.err crond[1640]: USER root pid 5331 cmd ntpcr
Jul 13 13:06:05 bytton user.info kernel: br0: port 2(wlan0) entering forwarding state
Jul 13 13:06:30 bytton user.notice root: LOG guestwifi
Jul 13 13:06:31 bytton user.notice root: CONNECT ON WIFI AP: guestwifi
Jul 13 13:06:31 bytton user.info kernel: device wlan0 left promiscuous mode
Jul 13 13:06:31 bytton user.info kernel: br0: port 2(wlan0) entering disabled state
Jul 13 13:07:01 bytton cron.err crond[1640]: USER root pid 5510 cmd net_moni
Jul 13 13:08:01 bytton cron.err crond[1640]: USER root pid 5633 cmd net_moni
Jul 13 13:09:01 bytton cron.err crond[1640]: USER root pid 5744 cmd net_moni
Jul 13 13:09:01 bytton cron.err crond[1640]: USER root pid 5745 cmd ntpcr
Jul 13 13:10:01 bytton cron.err crond[1640]: USER root pid 5864 cmd net_moni
Jul 13 13:10:59 bytton user.notice root: LOG Productie
Jul 13 13:11:00 bytton user.notice root: CONNECT ON WIFI AP: Productie
Jul 13 13:11:01 bytton cron.err crond[1640]: USER root pid 6038 cmd net_moni
……………………………………………………………………………………
```

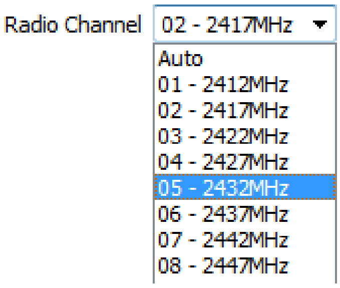
Also, in **ROUTING>Routes** you can see now the route for the wlan local wireless interface:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
192.168.148.4   0.0.0.0         255.255.255.254 U     0      0        0 wan
172.27.1.0      0.0.0.0         255.255.255.0   U     0      0        0 wlan0
191.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

The wifi connection to “**172.27.1.1**” may be also seen in the System Log:

```
Jul 19 10:46:23 bytton user.info kernel: cfg80211: Calling CRDA to update
world regulatory domain
Jul 19 10:46:29 bytton user.notice root: LOG guestwifi
Jul 19 10:46:30 bytton user.notice root: CONNECT ON WIFI AP: guestwifi
Jul 19 10:46:30 bytton user.debug kernel: wlan0: authenticate with
00:15:f2:3d:60:36 (try 1)
Jul 19 10:46:30 bytton user.debug kernel: wlan0: authenticated
Jul 19 10:46:30 bytton user.debug kernel: wlan0: associate with
00:15:f2:3d:60:36 (try 1)
Jul 19 10:46:30 bytton user.debug kernel: wlan0: RX AssocResp from
00:15:f2:3d:60:36 (capab=0x401 status=0 aid=3)
Jul 19 10:46:30 bytton user.debug kernel: wlan0: associated
Jul 19 10:46:34 bytton daemon.info dnsmasq[1213]: read /etc/hosts - 1
addresses
Jul 19 10:46:57 bytton daemon.info dnsmasq[1213]: read /etc/hosts - 1
addresses
Jul 19 10:47:01 bytton cron.err crond[1670]: USER root pid 3310 cmd net_moni
Jul 19 10:47:03 bytton daemon.info dnsmasq[1213]: reading /etc/resolv.conf
Jul 19 10:47:03 bytton daemon.info dnsmasq[1213]: using nameserver
172.27.1.1#53
Jul 19 10:47:03 bytton daemon.info dnsmasq[1213]: using nameserver 8.8.8.8#53
----------------------------------------------------------------------
```

Radio Channel: Selects the Wi-Fi channel in the 2400 MHz band.



Radio Channel: 02 - 2417MHz

In this band there are up to 14 channels, placed 5 MHz apart.
When left on “Auto” (default setting) and the AP will automatically select the radio channel with the strongest signal.

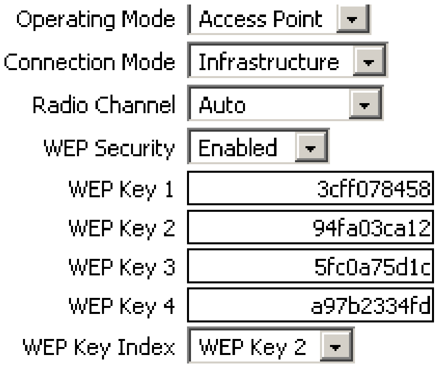
If instead of Auto, you are selecting a certain channel, make sure all devices are broadcasting on the same channel.

This setting may be left on default, and changed only when experiencing interference with other devices.

Figure 5-35: Select the Radio Channels of the WiFi Access Point.

WEP Security: Enables or disables WEP (Wired Equivalent Privacy) encryption.
WEP encryption is used to protect data transmitted from one end point to another.
The encryption level (64-bit or 128-bit) is given by the length of the WEP Key you enter.
If you enable WEP, these fields become active as shown here:

WEP Key 1 … 4: The data keys used for encryption/decryption. There are up to four keys, their values must be the same on the BYTTON Access Point and on the wireless stations connected to it. When using a 64-bit WEP encryption key, the password must be 5 characters long, and when using 128-bit WEP encryption key the password must be 10 characters long.



Operating Mode	Access Point
Connection Mode	Infrastructure
Radio Channel	Auto
WEP Security	Enabled
WEP Key 1	3cff078458
WEP Key 2	94fa03ca12
WEP Key 3	5fc0a75d1c
WEP Key 4	a97b2334fd
WEP Key Index	WEP Key 2

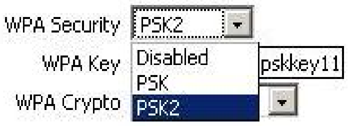
Figure 5-38: Select and set up the WEP Security features.

WEP Key Index: shows which key is active. You may have a list of pre-defined keys out of which the system administrator periodically chooses the active one. The selected WEP key is automatically published to the clients of the Access Point.

Warning: *WEP is a basic encryption method and it was designed to provide a level of privacy equivalent to an unsecured wired LAN, so you should not rely only on WEP for protection.*

WPA sec: WPA Security
Settings for Wi-Fi Protected Access, a Wi-Fi standard designed to improve the security features of WEP.
It features improved data encryption through the temporal key integrity protocol (TKIP) and user authentication, through the extensible authentication protocol (EAP).
EAP is built on a secure public-key encryption system to ensure that only authorized network users can access the Wi-Fi network.

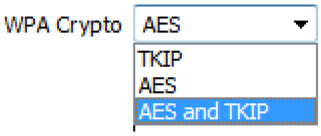
You can select to Disable the WPA security, or to use PSK or PSK2 keys.
PSK means "pre-shared keys": the keys are public, every user is given the same passphrase.



WPA Security	PSK2
WPA Key	pskkey11
WPA Crypto	

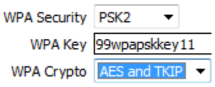
The pre-shared key version is called WPA-Personal or WPA2-Personal, while the more secure version using 802.1X server authentication is WPA-Enterprise or WPA2-Enterprise.

In this case you must enter the respective key in the “WPA Key” field, the select the type of cryptography to be used for WPA:
You can select for cryptography TKIP, AES or both.



WPA Crypto AES

TKIP - Temporal Key Integrity Protocol is an enhanced data encryption technology that provides important data encryption enhancements, including a per-packet key-mixing function, a message integrity check (MIC), an extended initialization vector (IV) with sequencing rules, and a re-keying mechanism.
AES - Advanced Encryption Standard, which is an encryption algorithm highly recommended to ensure privacy of commercial transactions in the private sector.



WPA Security	PSK2
WPA Key	99wpapskkey11
WPA Crypto	AES and TKIP

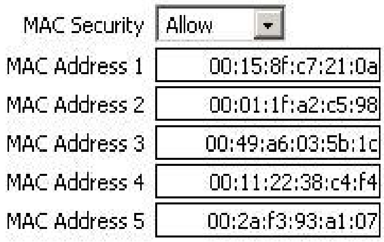
Figure 5-39: Select and set up the advanced WPA Security features.

*Of course, you should replace the default, generic passphrase (WPA Key) “**99wpapskkey11**” with a password of your own!*

MAC Security

Controls access to the Wi-Fi network based upon MACs (physical addresses of the client devices)
By default MAC Security is **Disabled**, allowing any wireless client to connect, without checking its MAC-address.

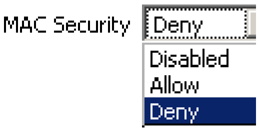
You can enter up to five MAC addresses to be filtered by this kind of physical ID security.



MAC Security: Allow
MAC Address 1: 00:15:8f:c7:21:0a
MAC Address 2: 00:01:1f:a2:c5:98
MAC Address 3: 00:49:a6:03:5b:1c
MAC Address 4: 00:11:22:38:c4:f4
MAC Address 5: 00:2a:f3:93:a1:07

Figure 5-40: Enable and configure MAC Security for WiFi.

Disabled: by default the MAC-based security feature is disabled, so the fields below are gray (inactive).
Allow: only users with the MAC addresses listed below will be allowed to join the local wireless network.
Deny: the users with the MAC addresses listed below will be denied access to the Wi-Fi network.



MAC Security: Deny

“Allow” is used to assure access only for authorized users, with known MAC addresses.

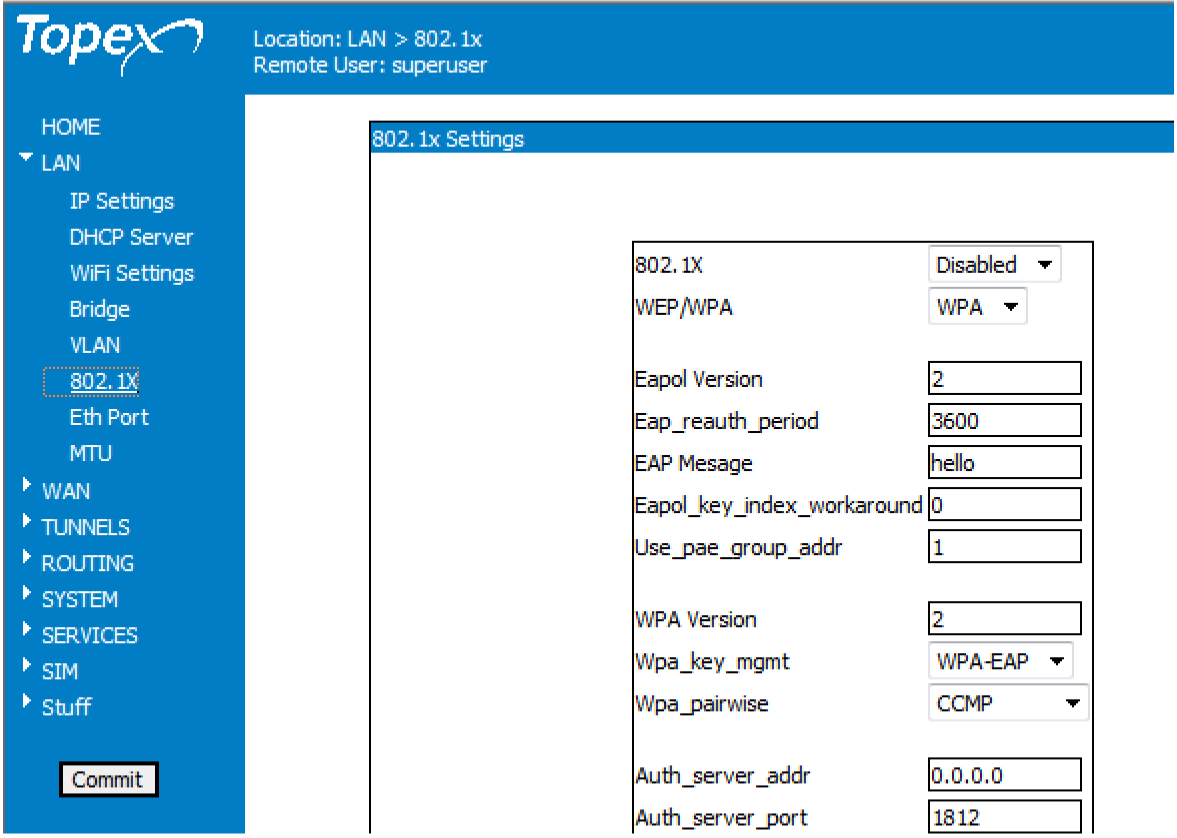
“Deny” should be used to prevent access for specific users, who have no right to access the wireless LAN, or which are legitimate, but whose computers become infected with a virus or other malware – the administrator temporary blocks their access, to prevent the spreading of the virus into the local network

Warning:
The filtering of MAC ID’s is not a proof security solution, you should not rely only on it to ensure security for the Wi-Fi network.
MAC addresses over a network could be faked, unauthorized persons can use Identity Theft (MAC Spoofing) to simulate MAC ID’s that are allowed to join the network.

5.2.7 “802.1x” Settings

This page controls settings related to the configuration for **EAPOL**, according to the standard **802.1X-2004** (Specification IEEE 802.1X-2004).

By default, it is Disabled:



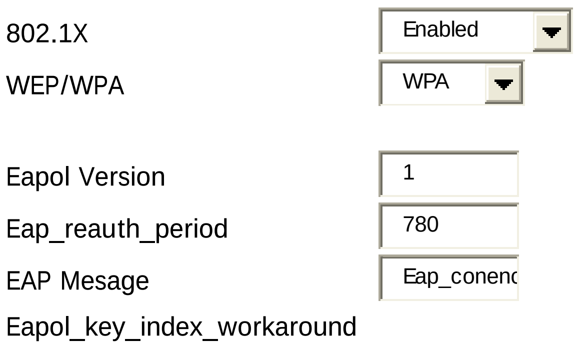
Location: LAN > 802.1x
Remote User: superuser

802.1x Settings

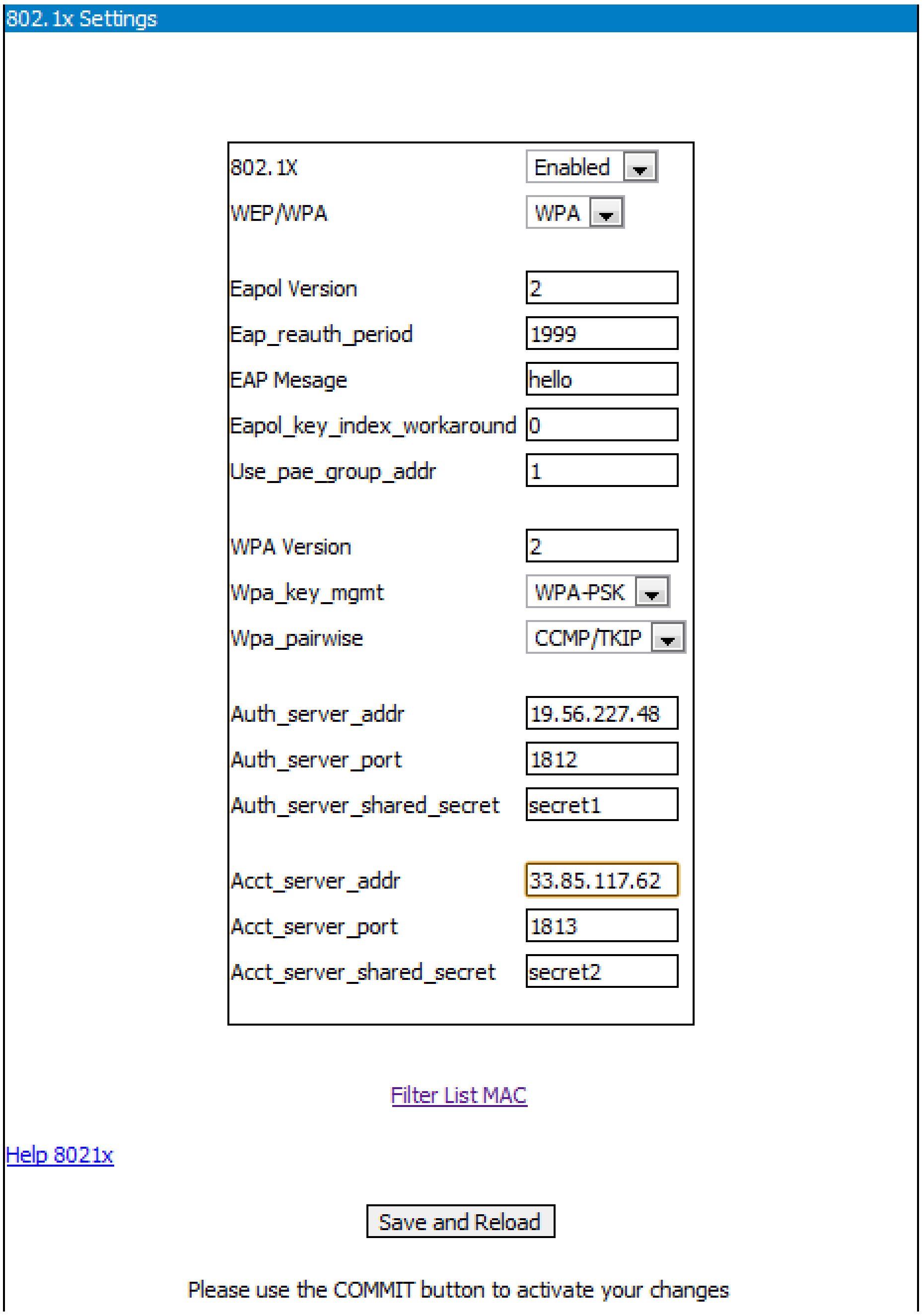
802.1X	Disabled
WEP/WPA	WPA
Eapol Version	2
Eap_reauth_period	3600
EAP Mesage	hello
Eapol_key_index_workaround	0
Use_pae_group_addr	1
WPA Version	2
Wpa_key_mgmt	WPA-EAP
Wpa_pairwise	CCMP
Auth_server_addr	0.0.0.0
Auth_server_port	1812

Figure 5-41: 802.1x Settings, by default Disabled.

When you need to use 802.1x authentication, you must **Enable** and configure this feature, as shown:



802.1X	Enabled
WEP/WPA	WPA
Eapol Version	1
Eap_reauth_period	780
EAP Mesage	Eap_conenc
Eapol_key_index_workaround	



802.1x Settings

802.1X	Enabled
WEP/WPA	WPA
Eapol Version	2
Eap_reauth_period	1999
EAP Mesage	hello
Eapol_key_index_workaround	0
Use_pae_group_addr	1
WPA Version	2
Wpa_key_mgmt	WPA-PSK
Wpa_pairwise	CCMP/TKIP
Auth_server_addr	19.56.227.48
Auth_server_port	1812
Auth_server_shared_secret	secret1
Acct_server_addr	33.85.117.62
Acct_server_port	1813
Acct_server_shared_secret	secret2

Please use the COMMIT button to activate your changes

Figure 5-42: Enable and configure settings for 802.1x EAPOL.

After you have enabled this feature, it will control authentication on the LAN side, allowing access only to the clients which are acknowledged by a Radius server.

Please use the COMMIT button to activate your changes

For details, please see the embedded help page:

```
##### IEEE 802.1X-2004 related configuration
# Require IEEE 802.1X authorization
#ieee8021x=1

# IEEE 802.1X/EAPOL version
# Is implemented based on IEEE Std 802.1X-2004 which defines EAPOL
# version 2. However, there are many client implementations that do not handle
# the new version number correctly (they seem to drop the frames completely).

#eapol_version=2
# Optional displayable message sent with EAP Request-Identity. The first \0
# in this string will be converted to ASCII-0 (nul). This can be used to
# separate network info (comma separated list of attribute=value pairs); see,
# e.g., draft-adrangi-eap-network-discovery-07.txt.
#eap_message=hello
#eap_message=hello\0networkid=netw,nasid=foo,portid=0,NAIRealms=example.com

# WEP rekeying (disabled if key lengths are not set or are set to 0)
# Key lengths for default/broadcast and individual/unicast keys:
# 5 = 40-bit WEP (also known as 64-bit WEP with 40 secret bits)
# 13 = 104-bit WEP (also known as 128-bit WEP with 104 secret bits)
#wep_key_len_broadcast=5
#wep_key_len_unicast=5
# Rekeying period in seconds. 0 = do not rekey (i.e., set keys only once)
#wep_rekey_period=300

# EAPOL-Key index workaround (set bit7) for WinXP Supplicant (needed only if
# only broadcast keys are used)
eapol_key_index_workaround=0

# EAP reauthentication period in seconds (default: 3600 seconds; 0 = disable
# reauthentication).
#eap_reauth_period=3600

# Use PAE group address (01:80:c2:00:00:03) instead of individual target
# address when sending EAPOL frames with driver=wired. This is the most common
# mechanism used in wired authentication, but it also requires that the port
# is only used by one station.
#use_pae_group_addr=1

##### RADIUS client configuration
#############################################
# for IEEE 802.1X with external Authentication Server, IEEE 802.11
# authentication with external ACL for MAC addresses, and accounting

# RADIUS authentication server
#auth_server_addr=127.0.0.1
#auth_server_port=1812
#auth_server_shared_secret=secret

# RADIUS accounting server
#acct_server_addr=127.0.0.1
#acct_server_port=1813
#acct_server_shared_secret=secret
```

Figure 5-43: Embedded Help for the parameters of 802.1x authentication for EAPOL.

Log examples of 802.11 authentication:

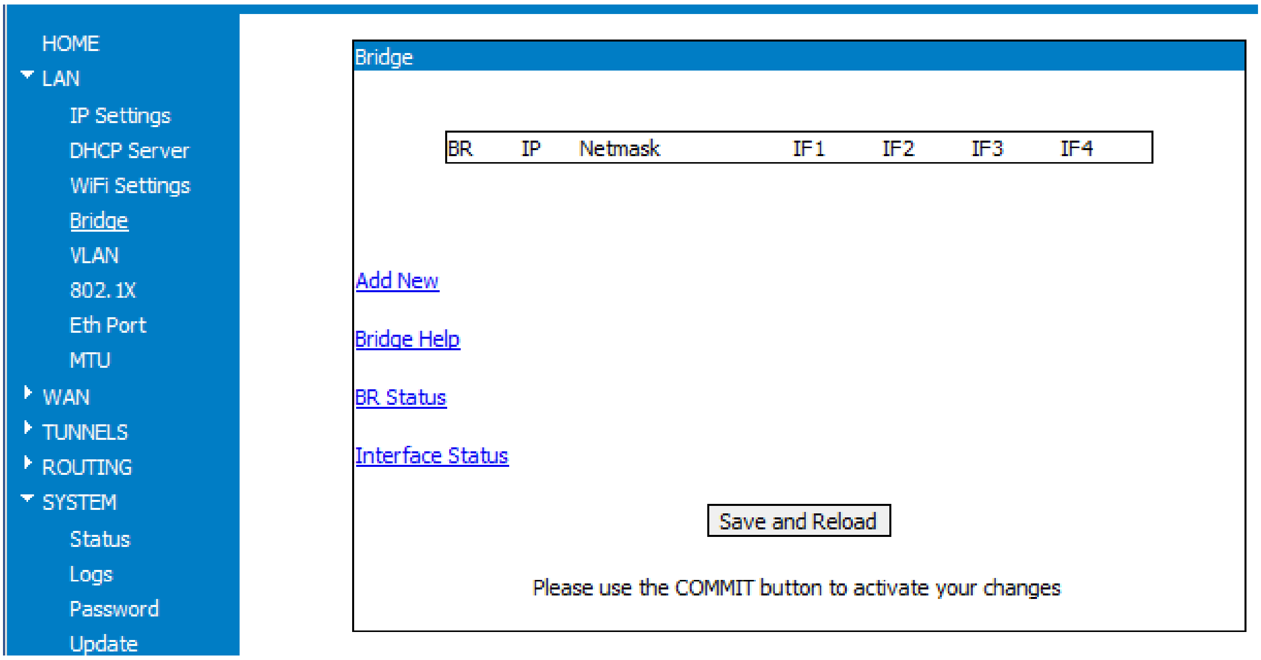
```
Jun 25 10:58:31 bytton daemon.info hostapd: wlan0: STA 58:1f:aa:dd:e2:f5 IEEE 802.11:
authenticated
Jun 25 10:58:31 bytton daemon.info hostapd: wlan0: STA 58:1f:aa:dd:e2:f5 IEEE 802.11: associated
(aid 2)
Jun 25 10:58:31 bytton daemon.info hostapd: wlan0: STA 58:1f:aa:dd:e2:f5 RADIUS: starting
accounting session 00000023-00000001
Jun 25 10:58:31 bytton daemon.info dnsmasq[1230]: DHCPREQUEST(br0) 10.0.0.14 58:1f:aa:dd:e2:f5
Jun 25 10:58:31 bytton daemon.info dnsmasq[1230]: DHCPACK(br0) 10.0.0.14 58:1f:aa:dd:e2:f5 cPhone-
4
---------------------------------

Jun 25 11:30:46 bytton daemon.info hostapd: wlan0: STA 58:1f:aa:dd:e2:f5 IEEE 802.11:
disassociated
```

5.2.8 Bridge

This page lets you to define and configure bridges between different physical or virtual interfaces of the Bytton LTE equipment.

“Bridging” is a technique for creating a virtual, wide-area Ethernet LAN, running on a single subnet, by joining different physical or logical interfaces.

In the beginning, the Bridge table is empty.

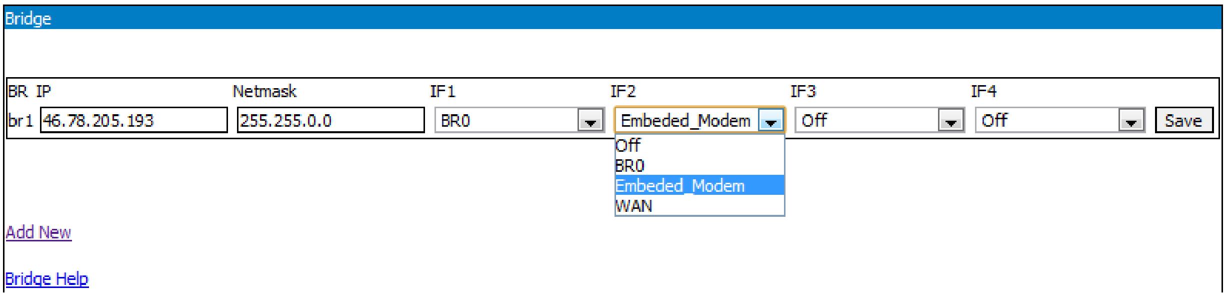


BR	IP	Netmask	IF1	IF2	IF3	IF4

Please use the COMMIT button to activate your changes

Figure 5-44: “Bridge” configuration page, empty in the beginning.

Bridging in Bytton LTE is a logical extension of the concept of Ethernet switch, bringing together several real or for logical interfaces. Bridging for Ethernet networks essentially involves combining an Ethernet interface with one or more virtual TAP interfaces and joining them together under the umbrella of a single bridge interface.
Generally, Ethernet bridges represent the software analog to a physical Ethernet switch. The Ethernet bridge can be thought of as a kind of software switch which can be used to connect multiple Ethernet interfaces (either physical or virtual) on a single machine while sharing a single IP subnet.
Most of the applications are related to building virtual private networks, for instance by bridging a physical Ethernet interface with an OpenVPN-driven TAP interface at two separate locations, it is possible to logically merge both Ethernet networks, as if they were a single Ethernet subnet.

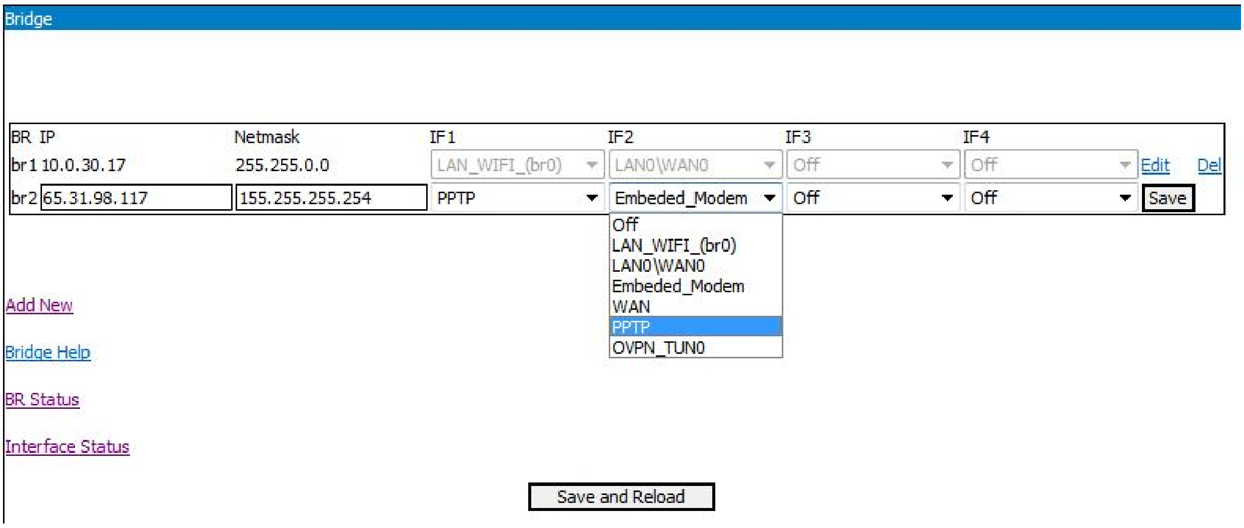


BR	IP	Netmask	IF1	IF2	IF3	IF4
br1	46.78.205.193	255.255.0.0	BR0	Embeded_Modem	Off	Off

The Bridge feature of Bytton LTE consist of a table (by default empty) and several useful links beneath it.

These clickable links include:
- Bridge **Help**,
- displaying the **State** of the bridges defined,
- displaying advanced info about all the Interfaces of the equipment:

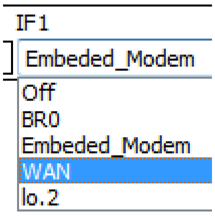
To create new bridge, use Add New, then Edit:

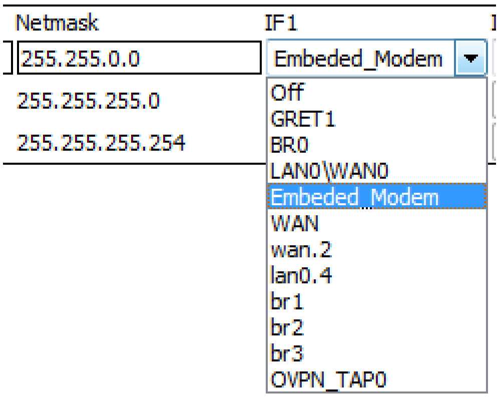


BR	IP	Netmask	IF1	IF2	IF3	IF4		
br1	10.0.30.17	255.255.0.0	LAN_WIFI_(br0)	LAN0\WAN0	Off	Off	Edit	Del
br2	65.31.98.117	155.255.255.254	PPTP	Embeded_Modem	Off	Off	Save	

Figure 5-45: Edit an entry in the “Bridge” table.

In the table, enter an IP address and net mask for the new bridge (br2 in the above example) and choose from the IF drop list the up to four interfaces (IF1 to IF4) that will be joined in the bridge. After a reboot of the Bytton equipment, these bridges (br1, br2, br3) will be active.

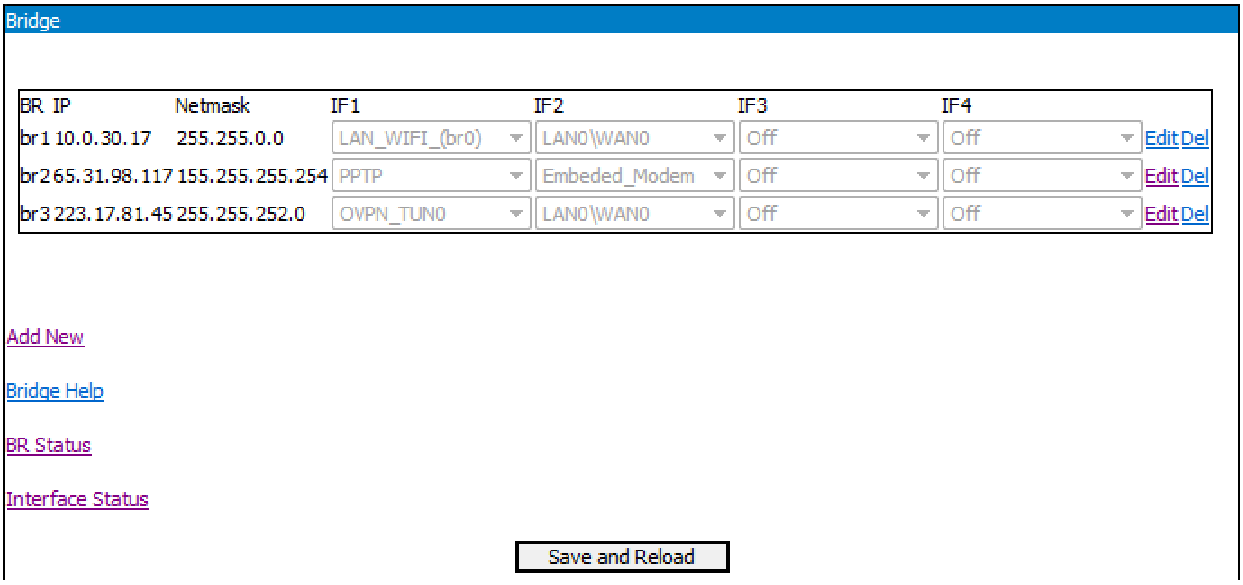




Note that the drop list displays all the interfaces available, not just the physical ones (BR0, WAN and Embedded Modem), as can be seen in the fist example.

When you have defined several bridges, virtual LANs, GRE or IPSEC tunnels, Open VPN TAPs, etc, then all those interfaces will be present in the drop list “Interface”, as illustrated in the second example.

You can define as many bridges as you need::

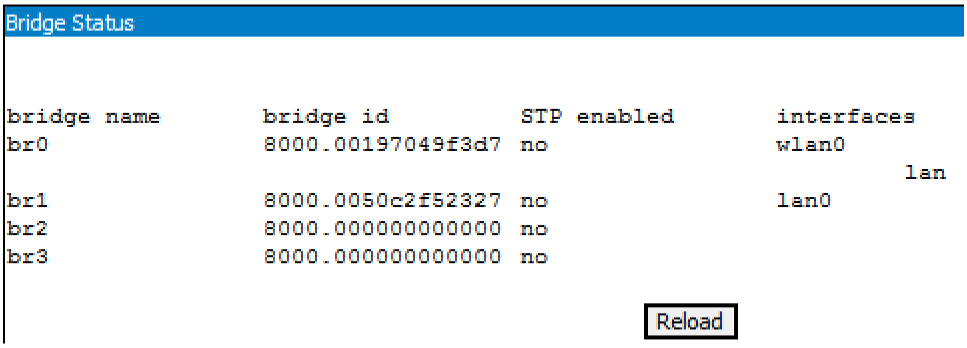


Bridge

BR IP	Netmask	IF1	IF2	IF3	IF4	
br1 10.0.30.17	255.255.0.0	LAN_WIFI_(br0)	LAN0\WAN0	Off	Off	Edit Del
br2 65.31.98.117	155.255.255.254	PPTP	Embeded_Modem	Off	Off	Edit Del
br3 223.17.81.45	255.255.252.0	OVPN_TUN0	LAN0\WAN0	Off	Off	Edit Del

Figure 5-46: Several entries in the “Bridge” table.

Once you define a bridge (br1, br2, br3 in these examples), they show up in Bridge Status:

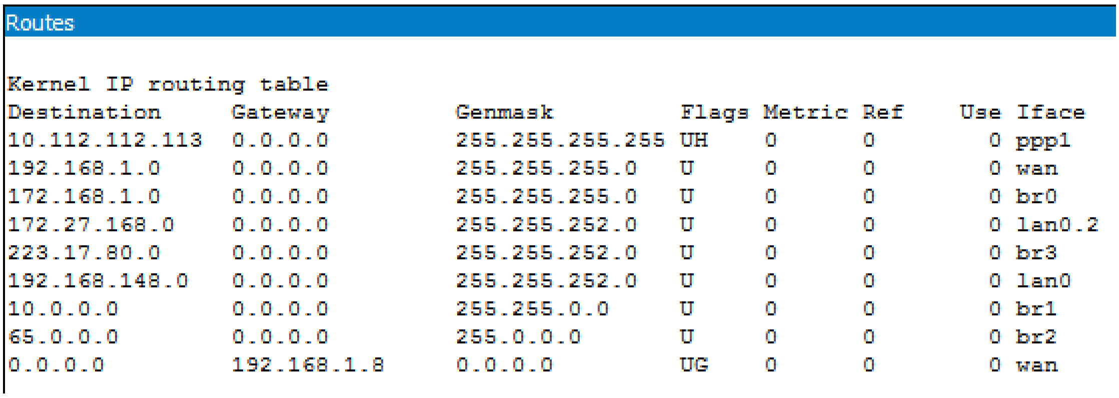


Bridge Status

```
bridge name         bridge id           STP enabled         interfaces
br0                 8000.00197049f3d7   no                  wlan0
                                                                     lan
br1                 8000.0050c2f52327   no                  lan0
br2                 8000.000000000000   no
br3                 8000.000000000000   no
```

Figure 5-47: Bridges showing up in “Bridge Status”.

And also the program automatically inserts the corresponding routes for them:



Routes

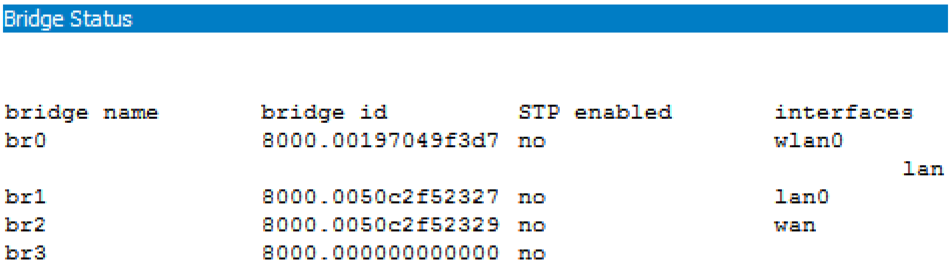
```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.112.112.113  0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
192.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 wan
172.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
172.27.168.0    0.0.0.0         255.255.252.0   U     0      0        0 lan0.2
223.17.80.0     0.0.0.0         255.255.252.0   U     0      0        0 br3
192.168.148.0   0.0.0.0         255.255.252.0   U     0      0        0 lan0
10.0.0.0        0.0.0.0         255.255.0.0     U     0      0        0 br1
65.0.0.0        0.0.0.0         255.0.0.0       U     0      0        0 br2
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

Figure 5-48: The same bridges in the “Routes” table.

And it also adjusts the Linux firewall to permit the packets to flow freely over the newly created interfaces.

Bridge Status:

You can check the state of the three bridges created above by the link “BR Status:



Bridge Status

```
bridge name         bridge id           STP enabled         interfaces
br0                 8000.00197049f3d7  no                  wlan0
                                                                      lan
br1                 8000.0050c2f52327  no                  lan0
br2                 8000.0050c2f52329  no                  wan
br3                 8000.000000000000  no
```

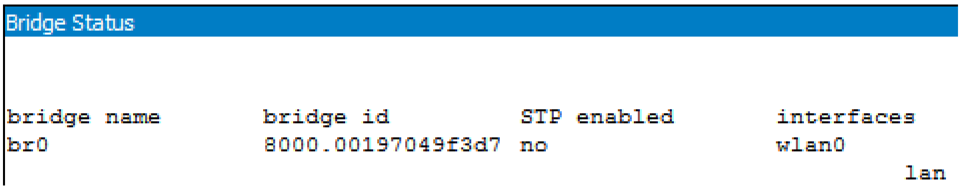
Figure 5-49: Details of bridges in the “Bridge Status” table.

Each bridge has an unique ID hex numbe, such as “8000.00197049f3d”7. This number shows up when the bridge is in effect, that means after you issued a “Commit”.

In the example above, the bridge br3 does not use ETH interfaces, so it dos not show up with the “interfaces” list,

Notice that “br0” exists by default, you cannot delete it.

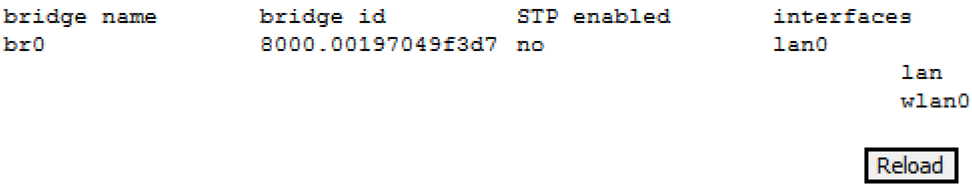
This bridge joins together interfaces wlan0 and **lan**, when WAN0/LAN0 was removed form the local switch and was assigned an IP address to be used for WAN,



Bridge Status

```
bridge name         bridge id           STP enabled         interfaces
br0                 8000.00197049f3d7  no                  wlan0
                                                                      lan
```

And it joins **lan0**, **wlan0** and **lan** whenever WAN0/LAN0 is still connected in the three-port LAN switch and does not have an IP for WAN (the default situation).

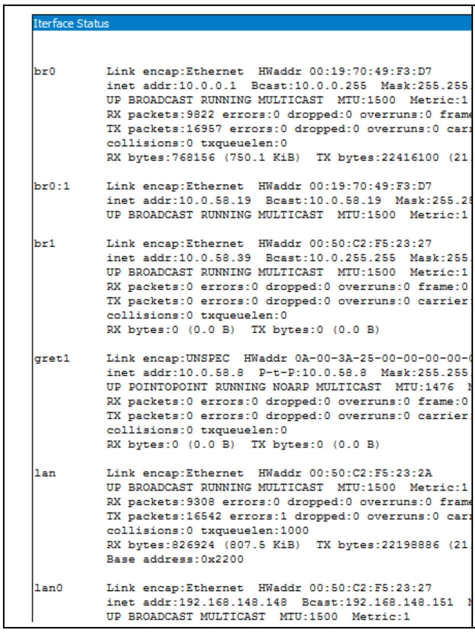


```
bridge name         bridge id           STP enabled         interfaces
br0                 8000.00197049f3d7  no                  lan0
                                                                      lan
                                                                      wlan0
```

5.2.9 “Interface Status” and “Test Net” features

These are auxiliary features, not items of the main menu, but they deserve a special chapter for their description, since they are both useful and complex (each of them opens up a Web page with several parameters and fields):

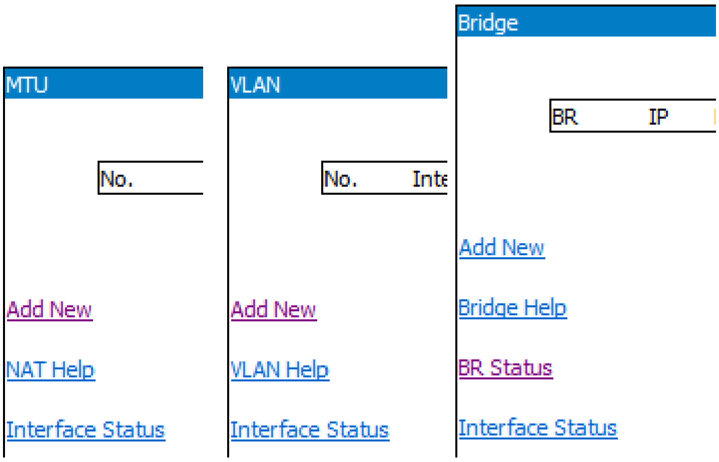
Interface Status:



Iterface Status

```
br0        Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
           inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:9822 errors:0 dropped:0 overruns:0 frame
           TX packets:16957 errors:0 dropped:0 overruns:0 car
           collisions:0 txqueuelen:0
           RX bytes:768156 (750.1 KiB)  TX bytes:22416100 (21

br0:1      Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
           inet addr:10.0.58.19  Bcast:10.0.58.19  Mask:255.25
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1

br1        Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
           inet addr:10.0.58.39  Bcast:10.0.255.255  Mask:255
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:0 errors:0 dropped:0 overruns:0 frame:0
           TX packets:0 errors:0 dropped:0 overruns:0 carrier
           collisions:0 txqueuelen:0
           RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

gret1      Link encap:UNSPEC  HWaddr 0A-00-3A-25-00-00-00-00-
           inet addr:10.0.58.8  P-t-P:10.0.58.8  Mask:255.255
           UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1476
           RX packets:0 errors:0 dropped:0 overruns:0 frame:0
           TX packets:0 errors:0 dropped:0 overruns:0 carrier
           collisions:0 txqueuelen:0
           RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan        Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:9308 errors:0 dropped:0 overruns:0 frame
           TX packets:16542 errors:1 dropped:0 overruns:0 car
           collisions:0 txqueuelen:1000
           RX bytes:826924 (807.5 KiB)  TX bytes:22198886 (21
           Base address:0x2200

lan0       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
           inet addr:192.168.148.148  Bcast:192.168.148.151
           UP BROADCAST MULTICAST  MTU:1500  Metric:1
```

This link is present at the bottom of several of the LAN configuration pages of the Web interface for Bytton LTE, as shown:



etc.

Figure 5-50: The window “Interface Status” and the corresponding link present in several configuration pages.

When you click this link, it brings up a page that shows info about the state of all the current network interfaces (real and virtual, physical and logical, bridges and so on) of the equipment:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:172.168.1.1  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:383 errors:0 dropped:0 overruns:0 frame:0
          TX packets:365 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:57956 (56.5 KiB)  TX bytes:124681 (121.7 KiB)

br1       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:10.0.58.27  Bcast:10.0.58.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:410 errors:0 dropped:0 overruns:0 frame:0
          TX packets:368 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:73340 (71.6 KiB)  TX bytes:124819 (121.8 KiB)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:192.168.148.148  Bcast:192.168.148.151  Mask:255.255.255.252
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
          Base address:0x2000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:530 errors:0 dropped:0 overruns:0 frame:0
          TX packets:530 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:29284 (28.5 KiB)  TX bytes:29284 (28.5 KiB)

mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-10-07-00-00-00-00-00-00-00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:50 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:4313 (4.2 KiB)  TX bytes:0 (0.0 B)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:6043 errors:0 dropped:0 overruns:0 frame:0
          TX packets:174 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:382541 (373.5 KiB)  TX bytes:26281 (25.6 KiB)
          Base address:0x3000

wlan0     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:41 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:13386 (13.0 KiB)
```

"**Iface Status**" shows details about all the interfaces of Bytton. Info about the **real** Ethernet interfaces include MAC (physical address), Internet address (logical address), Broadcast, subnet mask, MTU value, metric, statistics (packets, errors, collisions, mega bytes transferred) for the reception (RX) and respectively transmission (RX).

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:172.168.1.1  Bcast:172.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:230 errors:0 dropped:0 overruns:0 frame:0
          TX packets:139 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:15484 (15.1 KiB)  TX bytes:13454 (13.1 KiB)

br1       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:10.0.30.17  Bcast:10.0.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:6719 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:429564 (419.4 KiB)  TX bytes:0 (0.0 B)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:291 errors:0 dropped:0 overruns:0 frame:0
          TX packets:142 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:26140 (25.5 KiB)  TX bytes:13592 (13.2 KiB)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:192.168.148.254  Bcast:192.168.151.255  Mask:255.255.252.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:8063 errors:0 dropped:0 overruns:0 frame:0
          TX packets:103 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1729782 (1.6 MiB)  TX bytes:4738 (4.6 KiB)
          Base address:0x2000
```

```
lan0.2    Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:172.27.168.253  Bcast:172.27.171.255  Mask:255.255.252.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
```

The logical or virtual interfaces, such as bridges, are indicated by a digital point, such as “0.2” or “1.5” or by numbers following the name (br1). Being just aliases, they share all the same physical address, and they show no information about actual data transfers (bytes and packets sent and received).

Br0 is the default bridge, **lan** is the physical two-port Ethernet switch, **wan** is the Ethernet WAN connection while **lan0** is the LAN/WAN configurable port.

When you configure each local port with its own IP address, **lan1** and **lan2** will also show up (by default they are joined in the same physical switch).

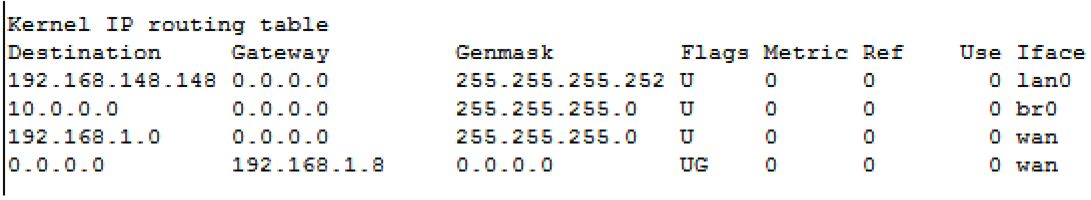
Wlan0 is the wireless LAN (the embedded WiFi access point).

Lo is the Local Loopback interface. The same parameters are shown for the virtual, local loopback interface, at the standard address for loopback, “127.0.0.1”.
Since it is a loopback interface, the number of bytes sent out will always be identical to the number of bytes received.

A few commented examples will show how **Iface Status** may be used to find out what is going on over the interfaces of Bytton LTE:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:939212 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2177060 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:53567762 (51.0 MiB)  TX bytes:3226717991 (3.0 GiB)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:939249 errors:90 dropped:0 overruns:0 frame:0
          TX packets:2177088 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:66719815 (63.6 MiB)  TX bytes:3226719279 (3.0 GiB)
          Base address:0x2200

mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-00-00-00-00-00-00-00-00-
00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:5813 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:493200 (481.6 KiB)  TX bytes:0 (0.0 B)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2285694 errors:114 dropped:0 overruns:0 frame:0
          TX packets:937458 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3233247828 (3.0 GiB)  TX bytes:60998194 (58.1 MiB)
          Base address:0x3000
```

In this instance, the connection to the Internet is done via the Ethernet WAN port. Large downloads were performed, you can see that the 3 GiB of data enters via WAN and gets out via LAN.
See also the corresponding routing table:

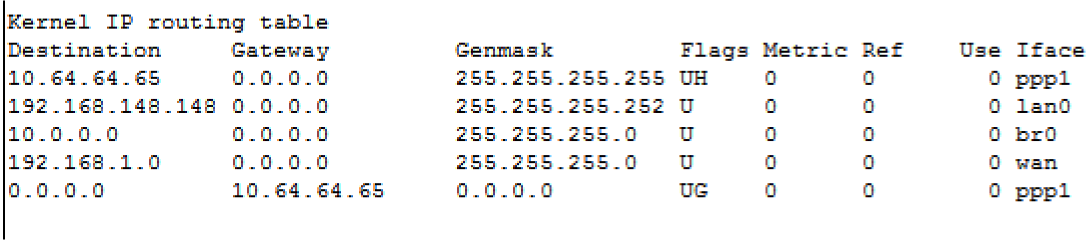


```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

When the connection is achieved via 3G/4G mobile network instead or cabled Ethernet, Iface Status reflects the changes – data comes in via ppp1 and gets out through lan. The wan traffic is nil, while the WiFi interface **wlan0** is active, but not used for data transfers:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:79688 errors:0 dropped:0 overruns:0 frame:0
          TX packets:147260 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:6811273 (6.4 MiB)  TX bytes:200265195 (190.9 MiB)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:79737 errors:4 dropped:0 overruns:0 frame:0
          TX packets:147300 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:7931397 (7.5 MiB)  TX bytes:200267035 (190.9 MiB)
          Base address:0x2200

mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-00-00-00-00-00-00-00-00-00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:9621 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:831943 (812.4 KiB)  TX bytes:0 (0.0 B)

ppp1      Link encap:Point-to-Point Protocol
          inet addr:93.122.148.36  P-t-P:10.64.64.65  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:145818 errors:0 dropped:0 overruns:0 frame:0
          TX packets:77754 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:197537140 (188.3 MiB)  TX bytes:6328242 (6.0 MiB)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.1.255  Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
          Base address:0x3000
```

And the corresponding routing table:

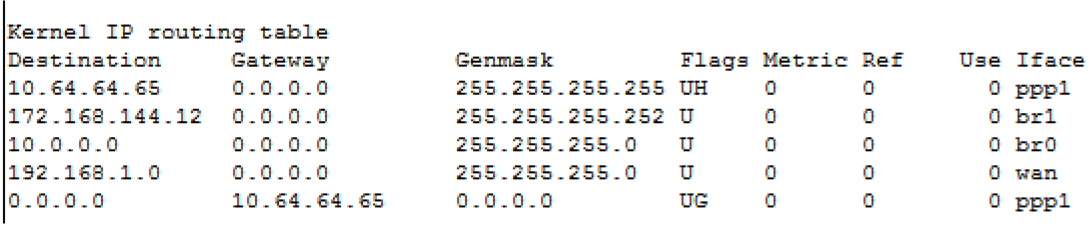


```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

Another example with bridge **br1** created, **lan0** and **lan** as distinct ports, still connecting via mobile modem over **ppp1**:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:160416 errors:0 dropped:0 overruns:0 frame:0
          TX packets:298549 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:11770863 (11.2 MiB)  TX bytes:412043839 (392.9 MiB)

br1       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:172.168.144.15  Bcast:172.168.144.15  Mask:255.255.255.252
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:66410 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:3467166 (3.3 MiB)  TX bytes:0 (0.0 B)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:160518 errors:3 dropped:0 overruns:0 frame:0
          TX packets:298568 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:14025308 (13.3 MiB)  TX bytes:412045038 (392.9 MiB)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:113 errors:0 dropped:0 overruns:0 frame:0
          TX packets:28 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:12119 (11.8 KiB)  TX bytes:2112 (2.0 KiB)
          Base address:0x2000

ppp1      Link encap:Point-to-Point Protocol
          inet addr:93.122.148.36  P-t-P:10.64.64.65  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:299890 errors:0 dropped:0 overruns:0 frame:0
          TX packets:161518 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:408205520 (389.2 MiB)  TX bytes:11469615 (10.9 MiB)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:73692 errors:16 dropped:0 overruns:0 frame:0
          TX packets:178 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5698342 (5.4 MiB)  TX bytes:7516 (7.3 KiB)
          Base address:0x3000
```

And the corresponding routing table:

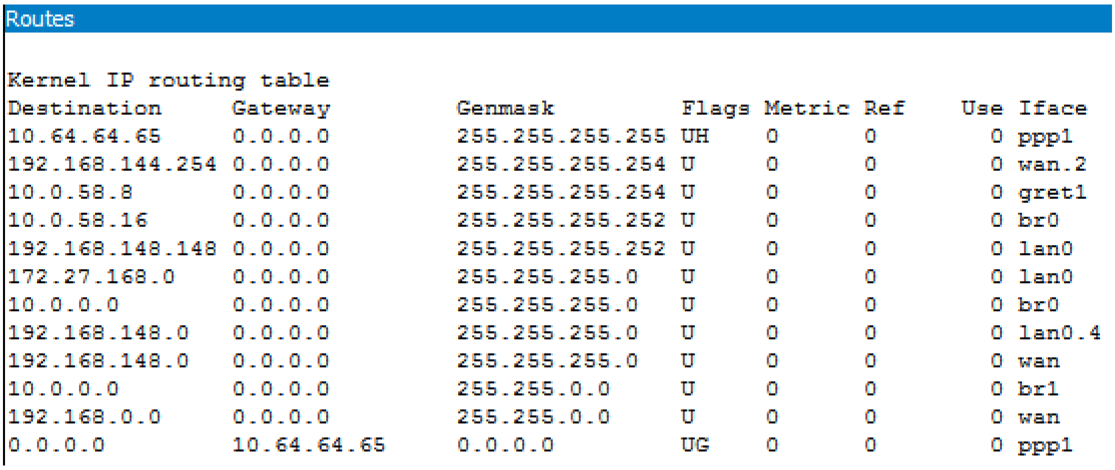


```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
172.168.144.12  0.0.0.0         255.255.255.252 U     0      0        0 br1
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

Other examples:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:10092 errors:0 dropped:0 overruns:0 frame:0
          TX packets:17301 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:799516 (780.7 KiB)  TX bytes:22576730 (21.5 MiB)

gret1     Link encap:UNSPEC  HWaddr 0A-00-3A-25-00-00-00-00-00-00-00-00-00-00-00-00
          inet addr:10.0.58.8  P-t-P:10.0.58.8  Mask:255.255.255.254
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1476  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:9584 errors:0 dropped:0 overruns:0 frame:0
          TX packets:16878 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:870647 (850.2 KiB)  TX bytes:22358900 (21.3 MiB)
          Base address:0x2200

lan0.4    Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:192.168.148.255  Bcast:192.168.148.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan0:2    Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:172.27.168.244  Bcast:172.27.168.255  Mask:255.255.255.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          Base address:0x2000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:1221 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1221 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:68033 (66.4 KiB)  TX bytes:68033 (66.4 KiB)

mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-10-07-00-00-00-00-00-00-00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1582 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:122456 (119.5 KiB)  TX bytes:0 (0.0 B)

ppp1      Link encap:Point-to-Point Protocol
          inet addr:93.122.148.36  P-t-P:10.64.64.65  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:16822 errors:0 dropped:0 overruns:0 frame:0
          TX packets:9646 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:22149899 (21.1 MiB)  TX bytes:704660 (688.1 KiB)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:28290 errors:9 dropped:0 overruns:0 frame:0
          TX packets:4 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1784161 (1.7 MiB)  TX bytes:269 (269.0 B)
          Base address:0x3000

wlan0     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:629 errors:0 dropped:0 overruns:0 frame:0
          TX packets:605 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:99197 (96.8 KiB)  TX bytes:255677 (249.6 KiB)
```

The corresponding Routes table:

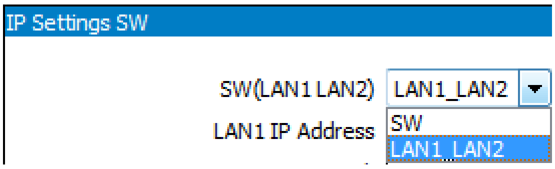


Routes

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
192.168.144.254 0.0.0.0         255.255.255.254 U     0      0        0 wan.2
10.0.58.8       0.0.0.0         255.255.255.254 U     0      0        0 gret1
10.0.58.16      0.0.0.0         255.255.255.252 U     0      0        0 br0
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
172.27.168.0    0.0.0.0         255.255.255.0   U     0      0        0 lan0
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 lan0.4
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
10.0.0.0        0.0.0.0         255.255.0.0     U     0      0        0 br1
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

No LAN in the default bridge!

When the LAN1 and LAN2 Ethernet ports are removed from the default Ethernet switch, as shown here:

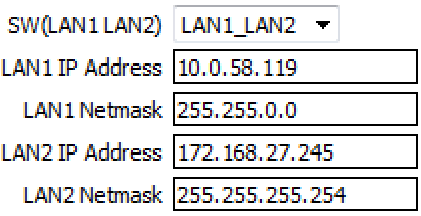


IP Settings SW

SW(LAN1 LAN2) LAN1_LAN2

LAN1 IP Address

and instead assigned independent IP addresses, in different address ranges :



SW(LAN1 LAN2) LAN1_LAN2

LAN1 IP Address 10.0.58.119

LAN1 Netmask 255.255.0.0

LAN2 IP Address 172.168.27.245

LAN2 Netmask 255.255.255.254

the default bridge, **br0**, contains now only the WiFi interface, **wlan0,** since the four ETH ports are now all individually assigned :

```
   bridge name bridge id          STP enabled   interfaces
br0            8000.00197049f3d7  no            wlan0
```

Note: as mentioned, the default bridge **br0** cannot be deleted. However, you can take all ETH ports out of it, as shwn here. If you als disable the Wi-Fi acces point, the default bridge will be … empty, it will contain no ports!

This configuration can also be clearly seen in **Ethernet Port > Port Status**, where each of the four Eth ports is now present and active (shows “link detected - yes”):

```
STATUS wan
        Speed: 100Mb/s
        Duplex: Full
        Auto-negotiation: on
        Link detected: yes
STATUS lan0
        Speed: 100Mb/s
        Duplex: Full
        Auto-negotiation: on
        Link detected: yes
STATUS lan1
        Speed: 100Mb/s
        Duplex: Full
        Auto-negotiation: on
        Link detected: yes
STATUS lan2
        Speed: 100Mb/s
        Duplex: Full
        Auto-negotiation: on
        Link detected: yes
```

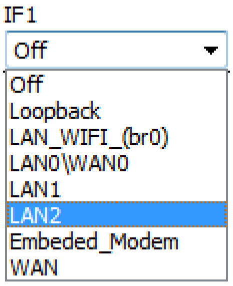
The corresponding additional ports, LAN1 and LAN2, show up in “Interface Status”:

```
lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:76 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:11149 (10.8 KiB)  TX bytes:46 (46.0 B)

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:16332 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1013345 (989.5 KiB)  TX bytes:46 (46.0 B)

lan1      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:10.0.58.119  Bcast:10.0.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0

lan2      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:172.168.27.245  Bcast:172.168.255.255
Mask:255.255.255.254
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
```

and they will also be present in the Routing table:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
172.168.27.244  0.0.0.0         255.255.255.254 U     0      0        0 lan2
192.168.148.254 0.0.0.0         255.255.255.254 U     0      0        0 lan0
191.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
10.0.0.0        0.0.0.0         255.255.0.0     U     0      0        0 lan1
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

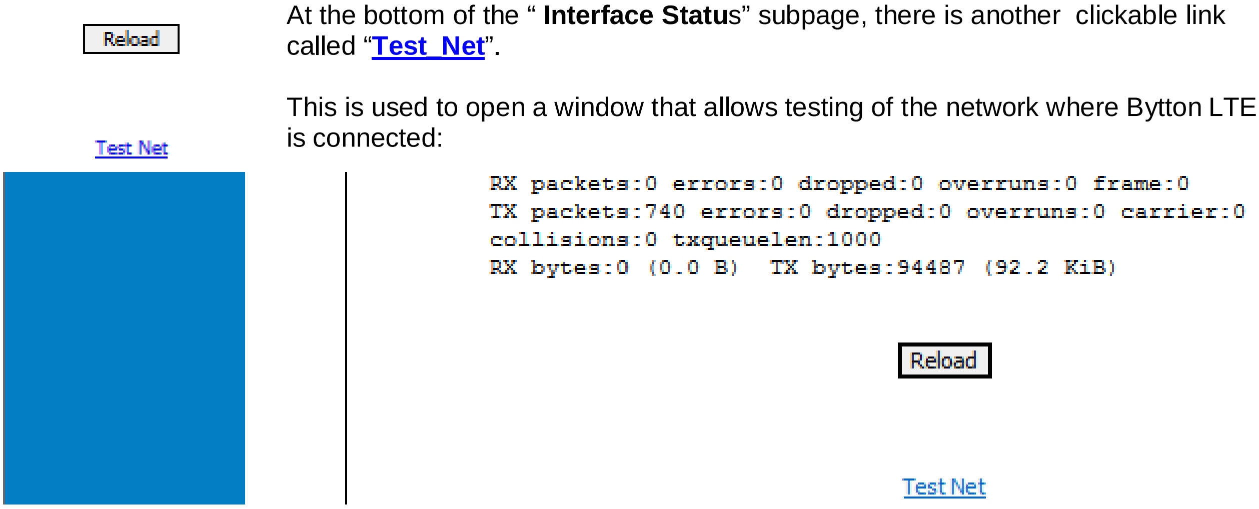
From now on, the newly created LAN1 and LAN2 ports will be displayed as options in the “Interfaces” drop list which shows up in several configuration menus of the Bytton LTE equipment:



Test Net – tools for testing the networks

At the bottom of the “ **Interface Status**” subpage, there is another clickable link called “**Test_Net**”.

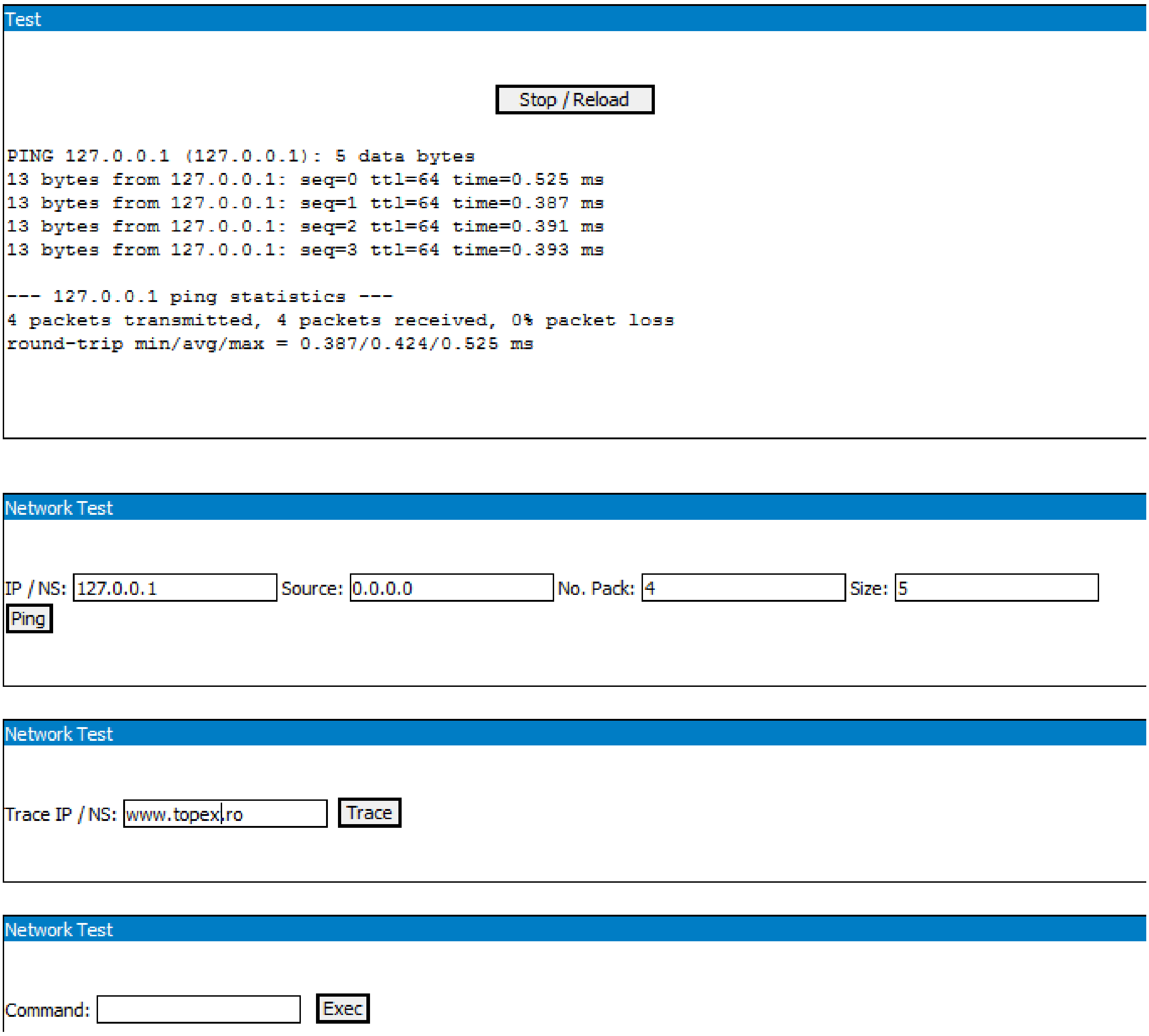
This is used to open a window that allows testing of the network where Bytton LTE is connected:



```
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:740 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B)  TX bytes:94487 (92.2 KiB)
```

Figure 5-51: The link “Test Net” at the bottom of the “Interface Status” page.

This “Test” page features several tools used to thoroughly test the network:



```
PING 127.0.0.1 (127.0.0.1): 5 data bytes
13 bytes from 127.0.0.1: seq=0 ttl=64 time=0.525 ms
13 bytes from 127.0.0.1: seq=1 ttl=64 time=0.387 ms
13 bytes from 127.0.0.1: seq=2 ttl=64 time=0.391 ms
13 bytes from 127.0.0.1: seq=3 ttl=64 time=0.393 ms

--- 127.0.0.1 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0.387/0.424/0.525 ms
```

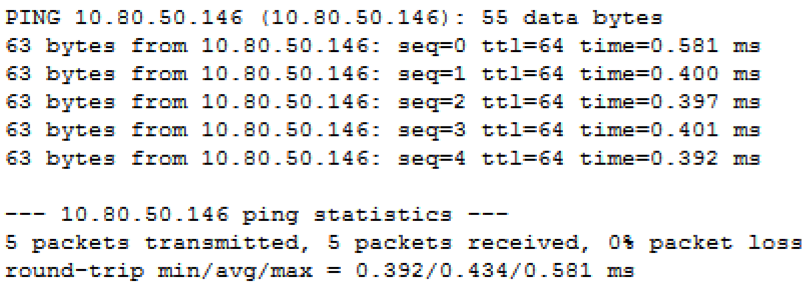
IP / NS: 127.0.0.1 Source: 0.0.0.0 No. Pack: 4 Size: 5

Trace IP / NS: www.topex.ro

Command:

Figure 5-52: Features of the“Test Net” page.

Network test
You can issue PING commands to different addresses, trace the route to a specified IP, or send other network commands.
The results are always shown in the upper pane, called “Test”:
For instance, you may PING different destination IP addresses (the default 127.0.0.1 is the loopback), specifying the number of test packets (5 in this example) and the size of their data payload, in bytes (55 data bytes in this example).



```
PING 10.80.50.146 (10.80.50.146): 55 data bytes
63 bytes from 10.80.50.146: seq=0 ttl=64 time=0.581 ms
63 bytes from 10.80.50.146: seq=1 ttl=64 time=0.400 ms
63 bytes from 10.80.50.146: seq=2 ttl=64 time=0.397 ms
63 bytes from 10.80.50.146: seq=3 ttl=64 time=0.401 ms
63 bytes from 10.80.50.146: seq=4 ttl=64 time=0.392 ms

--- 10.80.50.146 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 0.392/0.434/0.581 ms
```

When you choose the value “zero” for the payload, the packets will by instead eight bytes long:

```
PING 127.0.0.1 (127.0.0.1): 0 data bytes
8 bytes from 127.0.0.1: seq=0 ttl=64
8 bytes from 127.0.0.1: seq=1 ttl=64
8 bytes from 127.0.0.1: seq=2 ttl=64
8 bytes from 127.0.0.1: seq=3 ttl=64
--- 127.0.0.1 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

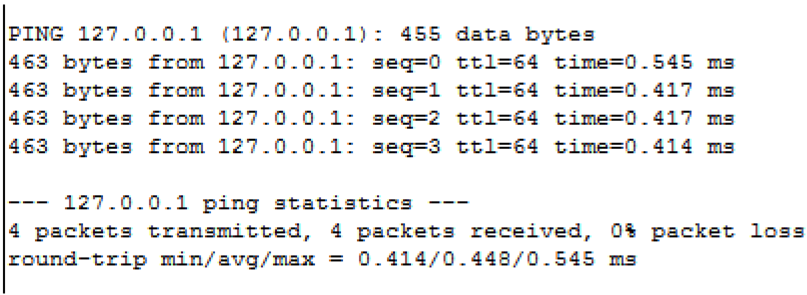
The longer the data packets sent, the higher propagation delay you will see:

```
PING 127.0.0.1 (127.0.0.1): 14000 data bytes
14008 bytes from 127.0.0.1: seq=0 ttl=64 time=1.731 ms
14008 bytes from 127.0.0.1: seq=1 ttl=64 time=1.293 ms
14008 bytes from 127.0.0.1: seq=2 ttl=64 time=1.245 ms
14008 bytes from 127.0.0.1: seq=3 ttl=64 time=1.343 ms
14008 bytes from 127.0.0.1: seq=4 ttl=64 time=1.248 ms

--- 127.0.0.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 1.245/1.372/1.731 ms

PING 127.0.0.1 (127.0.0.1): 48000 data bytes
48008 bytes from 127.0.0.1: seq=0 ttl=64 time=5.103 ms
48008 bytes from 127.0.0.1: seq=1 ttl=64 time=4.125 ms
48008 bytes from 127.0.0.1: seq=2 ttl=64 time=8.758 ms
--- 127.0.0.1 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 4.125/5.995/8.758 ms
```

When both addresses are in the local networ, the time of waiting for the answer is short:

```
PING 127.0.0.1 (127.0.0.1) from 192.168.1.148: 31 data bytes
39 bytes from 127.0.0.1: seq=0 ttl=64 time=0.572 ms
39 bytes from 127.0.0.1: seq=1 ttl=64 time=0.374 ms
39 bytes from 127.0.0.1: seq=2 ttl=64 time=0.374 ms
--- 127.0.0.1 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 0.374/0.440/0.572 ms
```

The results are displayed in the upper panel, in the example below for four packets of 455 data bytes each (463 bytes overall length) – response and propagation delay.
When you repeat the test another time, the results are close, but the response time are not exactly identical :



```
PING 127.0.0.1 (127.0.0.1): 455 data bytes
463 bytes from 127.0.0.1: seq=0 ttl=64 time=0.545 ms
463 bytes from 127.0.0.1: seq=1 ttl=64 time=0.417 ms
463 bytes from 127.0.0.1: seq=2 ttl=64 time=0.417 ms
463 bytes from 127.0.0.1: seq=3 ttl=64 time=0.414 ms

--- 127.0.0.1 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0.414/0.448/0.545 ms
```

```
PING 127.0.0.1 (127.0.0.1): 455 data bytes
463 bytes from 127.0.0.1: seq=0 ttl=64 time=0.556 ms
463 bytes from 127.0.0.1: seq=1 ttl=64 time=0.413 ms
463 bytes from 127.0.0.1: seq=2 ttl=64 time=0.404 ms
463 bytes from 127.0.0.1: seq=3 ttl=64 time=0.402 ms
--- 127.0.0.1 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0.402/0.443/0.556 ms
```

The “Source” field (inactive when left to the default value 0.0.0.0) allows you to Ping the destination with a different IP than the real one.

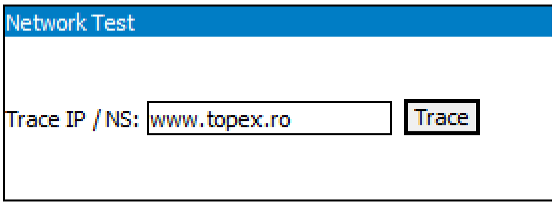
Longer round-trip delays are specific to mobile conections:

```
PING 209.202.254.14 (209.202.254.14) from 192.168.1.148: 31 data bytes
39 bytes from 209.202.254.14: seq=0 ttl=116 time=2711.108 ms
39 bytes from 209.202.254.14: seq=1 ttl=116 time=3260.654 ms
39 bytes from 209.202.254.14: seq=2 ttl=116 time=3064.698 ms
--- 209.202.254.14 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 2711.108/3012.153/3260.654 ms

PING 209.202.254.14 (209.202.254.14) from 192.168.1.148: 31 data bytes
39 bytes from 209.202.254.14: seq=0 ttl=116 time=3189.314 ms
39 bytes from 209.202.254.14: seq=1 ttl=116 time=3080.604 ms
39 bytes from 209.202.254.14: seq=2 ttl=116 time=3276.955 ms
--- 209.202.254.14 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 3080.604/3182.291/3276.955 ms
```

In the same destination-source configuration, and with identical size and number of PING packets, when Ethernet connection is used for WAN, the round-trip delays will be much shorter that in the previous case, when connection was achieved via PPP1:

```
PING 209.202.254.14 (209.202.254.14) from 192.168.1.148: 31 data bytes
39 bytes from 209.202.254.14: seq=0 ttl=111 time=127.213 ms
39 bytes from 209.202.254.14: seq=1 ttl=111 time=132.594 ms
39 bytes from 209.202.254.14: seq=2 ttl=111 time=127.035 ms

--- 209.202.254.14 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 127.035/128.947/132.594 ms

PING 209.202.254.14 (209.202.254.14) from 192.168.1.148: 31 data bytes
39 bytes from 209.202.254.14: seq=0 ttl=111 time=127.440 ms
39 bytes from 209.202.254.14: seq=1 ttl=111 time=127.259 ms
39 bytes from 209.202.254.14: seq=2 ttl=111 time=126.909 ms

--- 209.202.254.14 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 126.909/127.202/127.440 ms
```

Other network debugging tools are also available in the “Test Net” utility page.

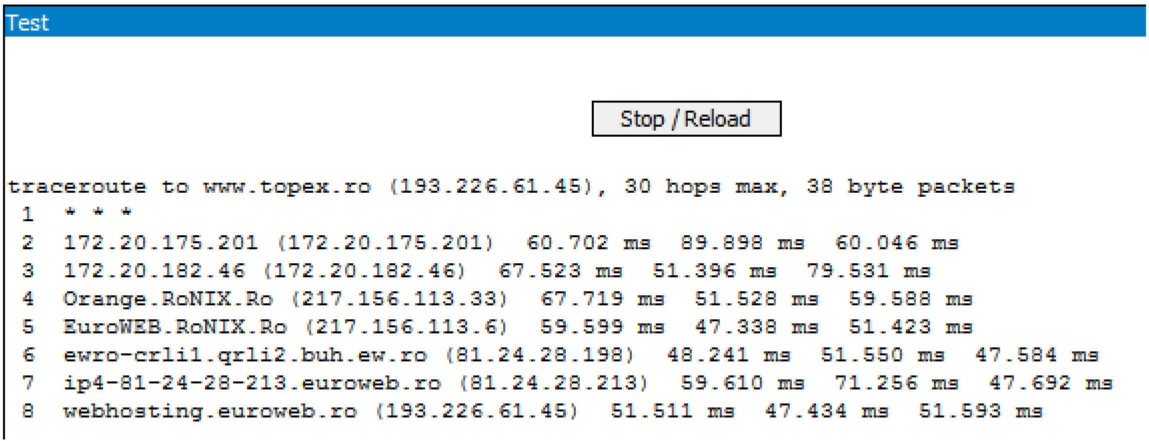


TRACE

For instance, the “Trace IP/NS” box allows you to trace the route towards the respective IP address and also looks up for addresses of nameservers used along this route.

The default Internet site to be traced is “google.ro”, since it is both relevant and supposedly always on.

See below a few examples of trace-ing different targets under various conditions of connecting to Internet:



```
traceroute to www.topex.ro (193.226.61.45), 30 hops max, 38 byte packets
 1  * * *
 2  172.20.175.201 (172.20.175.201)  60.702 ms  89.898 ms  60.046 ms
 3  172.20.182.46 (172.20.182.46)  67.523 ms  51.396 ms  79.531 ms
 4  Orange.RoNIX.Ro (217.156.113.33)  67.719 ms  51.528 ms  59.588 ms
 5  EuroWEB.RoNIX.Ro (217.156.113.6)  59.599 ms  47.338 ms  51.423 ms
 6  ewro-crli1.qrli2.buh.ew.ro (81.24.28.198)  48.241 ms  51.550 ms  47.584 ms
 7  ip4-81-24-28-213.euroweb.ro (81.24.28.213)  59.610 ms  71.256 ms  47.692 ms
 8  webhosting.euroweb.ro (193.226.61.45)  51.511 ms  47.434 ms  51.593 ms
```

```
traceroute to www.topex.ro (193.226.61.45), 30 hops max, 38 byte packets
 1  * * *
 2  172.20.175.201 (172.20.175.201)  64.266 ms  59.407 ms  47.852 ms
 3  172.20.182.46 (172.20.182.46)  71.693 ms  59.468 ms  47.834 ms
 4  MobileCarrierB.RoNIX.Ro (217.156.113.33)  63.496 ms  51.125 ms  47.809 ms
 5  EuroWEB.RoNIX.Ro (217.156.113.6)  71.198 ms  47.609 ms  51.548 ms
 6  ewro-crli1.qrli2.buh.ew.ro (81.24.28.198)  59.608 ms  47.121 ms  51.730 ms
 7  ip4-81-24-28-213.euroweb.ro (81.24.28.213)  67.992 ms  71.139 ms  48.347 ms
 8  webhosting.euroweb.ro (193.226.61.45)  67.754 ms  51.118 ms  47.859 ms
```

And respectively:

```
traceroute to k.ro (194.102.255.23), 30 hops max, 38 byte packets
 1  46.108.17.161 (46.108.17.161)  2.827 ms  3.334 ms  2.638 ms
 2  basarabia.20ge.adnettelecom.ro (46.108.3.165)  3.056 ms  2.532 ms  2.764
ms
 3  cr-rbas.40gbps.adnettelecom.ro (46.108.4.217)  2.982 ms  2.950 ms  3.019
ms
 4  cr-cr2.40gbps.adnettelecom.ro (46.108.4.221)  2.893 ms  3.282 ms  2.900 ms
 5  95.77.112.137 (95.77.112.137)  2.785 ms  3.276 ms  3.157 ms
 6  ro-buh01a-rd1-te-1-2-v519.upcnet.ro (95.77.36.249)  3.667 ms ro-buh01a-
rd1-v1796.upcnet.ro (95.77.36.61)  3.811 ms ro-buh01a-rd1-te-1-1-
v518.upcnet.ro (95.77.36.245)  3.157 ms
 7  ro-buh01a-ra1-v1324.astralnet.ro (95.77.36.122)  3.644 ms  3.034 ms  3.221
ms
 8  www.k.ro (194.102.255.23)  3.397 ms  3.547 ms  3.295 ms
```

Using the air (3G) interface:

```
traceroute to topex.ro (193.226.61.45), 30 hops max, 38 byte packets
 1  * * *
 2  172.20.175.201 (172.20.175.201)  1064.733 ms  1030.544 ms  1127.839 ms
 3  172.20.182.46 (172.20.182.46)  1139.473 ms  1118.869 ms  1019.323 ms
 4  MobileCarrierB.RoNIX.Ro (217.156.113.33)  1262.126 ms  1163.873 ms
1235.038 ms
 5  EuroWEB.RoNIX.Ro (217.156.113.6)  1327.847 ms  1206.329 ms  1363.900 ms
 6  ewro-crli1.qrli2.buh.ew.ro (81.24.28.198)  1247.112 ms  1271.456 ms  
1306.368 ms
 7  ip4-81-24-28-213.euroweb.ro (81.24.28.213)  1355.474 ms  1139.117 ms  
1139.388 ms
 8  webhosting.euroweb.ro (193.226.61.45)  1259.150 ms  1250.796 ms  1119.130 
ms
```

And respectively:

```
traceroute to k.ro (194.102.255.23), 30 hops max, 38 byte packets
 1  * * *
 2  172.20.175.201 (172.20.175.201)  2332.538 ms  1386.267 ms  1419.006 ms
 3  172.20.182.46 (172.20.182.46)  1363.214 ms  1270.032 ms  2586.818 ms
 4  MobileCarrierB-peer.astralnet.ro (83.103.173.38)  1283.790 ms  1324.193 ms  
1451.071 ms
 5  ro-buh01a-ri1-ge-2-1-2-v792.astralnet.ro (83.103.173.37)  1507.310 ms  
1258.578 ms  1207.041 ms
 6  95.77.36.69 (95.77.36.69)  1163.062 ms  1155.097 ms  986.773 ms
 7  ro-buh01a-rd1-te-1-3-v520.upcnet.ro (95.77.36.253)  920.070 ms ro-buh01a-
rd1-te-1-2-v519.upcnet.ro (95.77.36.249)  1298.911 ms ro-buh01a-rd1-te-1-1-
v518.upcnet.ro (95.77.36.245)  1238.873 ms
 8  ro-buh01a-ra1-v1324.astralnet.ro (95.77.36.122)  1150.084 ms  591.061 ms  
638.912 ms
 9  www.k.ro (194.102.255.23)  626.859 ms  695.420 ms  591.892 ms
```

When the Ethernet connection is used for WAN instead of the PPP1 link, response times are faster:

```
traceroute: warning: topex.ro has multiple addresses; using 172.27.168.7
traceroute to topex.ro (172.27.168.7), 30 hops max, 38 byte packets
 1  voluntarigw.topex.ro (192.168.1.8)  0.629 ms  0.522 ms  0.978 ms
 2  10.0.144.2 (10.0.144.2)  1.932 ms  1.950 ms  2.434 ms
 3  172.27.168.7 (172.27.168.7)  2.363 ms  2.529 ms  1.956 ms
```

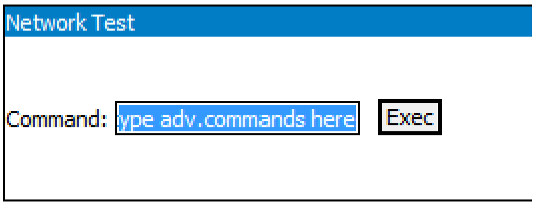
Or:

```
traceroute to k.ro (194.102.255.23), 30 hops max, 38 byte packets
 1  46.108.17.161 (46.108.17.161)  2.804 ms  2.191 ms  2.263 ms
 2  basarabia.20ge.adnettelecom.ro (46.108.3.165)  2.421 ms  2.130 ms  2.146 
ms
 3  cr-rbas.40gbps.adnettelecom.ro (46.108.4.217)  16.352 ms  2.396 ms  2.317 
ms
 4  cr-cr2.40gbps.adnettelecom.ro (46.108.4.221)  2.403 ms  2.222 ms  2.378 ms
 5  95.77.112.137 (95.77.112.137)  2.327 ms  3.272 ms  2.306 ms
 6  ro-buh01a-rd1-v1796.upcnet.ro (95.77.36.61)  2.789 ms ro-buh01a-rd1-te-1-
1-v518.upcnet.ro (95.77.36.245)  2.617 ms  3.874 ms
 7  ro-buh01a-ra1-v1324.astralnet.ro (95.77.36.122)  3.117 ms  2.704 ms  3.123 
ms
 8  www.k.ro (194.102.255.23)  2.426 ms  2.315 ms  2.399 ms
```

And respectively for the default for target *google.ro*:

```
traceroute: warning: www.google.ro has multiple addresses; using 173.194.39.87
traceroute to www-cctld.l.google.com (173.194.39.87), 30 hops max, 38 byte packets
 1  46.108.17.161 (46.108.17.161)  3.184 ms  2.300 ms  2.192 ms
 2  basarabia.20ge.adnettelecom.ro (46.108.3.165)  2.186 ms  2.115 ms  2.150 ms
 3  cr-rbas.40gbps.adnettelecom.ro (46.108.4.217)  2.485 ms  2.311 ms  2.186 ms
 4  72.14.213.18 (72.14.213.18)  37.016 ms  32.275 ms  31.882 ms
 5  72.14.238.44 (72.14.238.44)  32.337 ms  32.057 ms  32.083 ms
 6  72.14.236.68 (72.14.236.68)  32.768 ms  35.371 ms  35.273 ms
 7  209.85.241.213 (209.85.241.213)  47.464 ms  47.781 ms  58.493 ms
 8  72.14.234.251 (72.14.234.251)  47.933 ms  50.867 ms  48.061 ms
 9  bud01s10-in-f23.1e100.net (173.194.39.87)  47.493 ms  47.361 ms  47.254 ms
```

Commands



Finally, the field “Command” allows access to the BusyBox utility.

This is a a single small executable that combines tiny versions of many common UNIX utilities.

These utilities generally have fewer options than their full-featured GNU counterparts, but still the included optionstprovide the expected functionality and behave very much like the complete versions. BusyBox is designed to minimize size and to work with limited resources, thus is well fitted for embedded operating systems such as Bytton LTE.

See below a few examples:

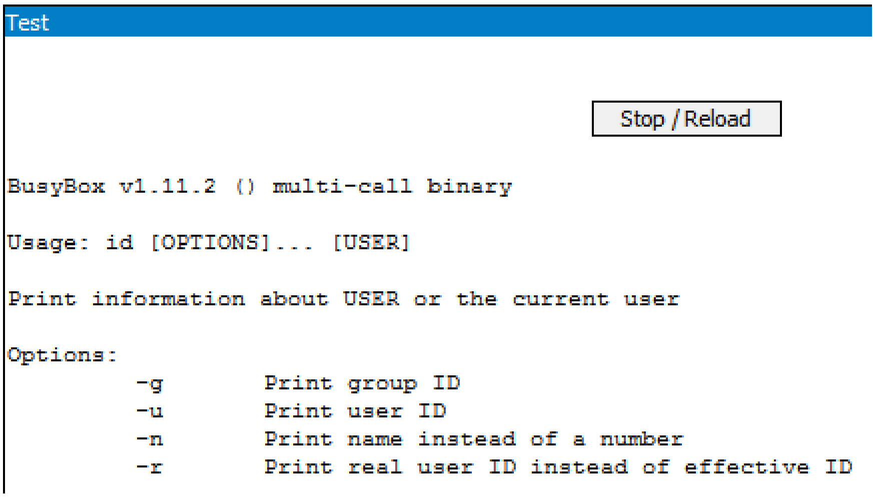
```
Linux bytton 2.6.34 #66 Tue Jun 12 17:31:38 EEST 2012 ppc unknown

-rwxr-xr-x    1 root     root         4074 Jun 13 11:13 8021x.awk
-rwxr-xr-x    1 root     root         4041 Jun 13 11:13 8021x.html
-rwxr-xr-x    1 root     root          583 Jun 13 11:13 AT.html
-rwxr-xr-x    1 root     root         3582 Jun 13 11:13 addip.html
drwxr-xr-x    2 root     root          160 Jun 13 11:13 adm.
```

Or

```
Filesystem           1k-blocks      Used Available Use% Mounted on
rootfs                   57344     15432     41912  27% /
/dev/root                57344     15432     41912  27% /
tmpfs                   100352      1176     99176   1% /tmp
tmpfs                   100352      1176     99176   1% /etc
tmpfs                   100352      1176     99176   1% /var
tmpfs                   100352      1176     99176   1% /dev
tmpfs                        0         0         0   0% /proc
tmpfs                   100352      1176     99176   1% /mnt
tmpfs                   100352      1176     99176   1% /www
proc                         0         0         0   0% /proc
devpts                       0         0         0   0% /dev/pts
sysfs                        0         0         0   0% /sys
```

Figure 5-54: Commands available in “Network Tests” page.

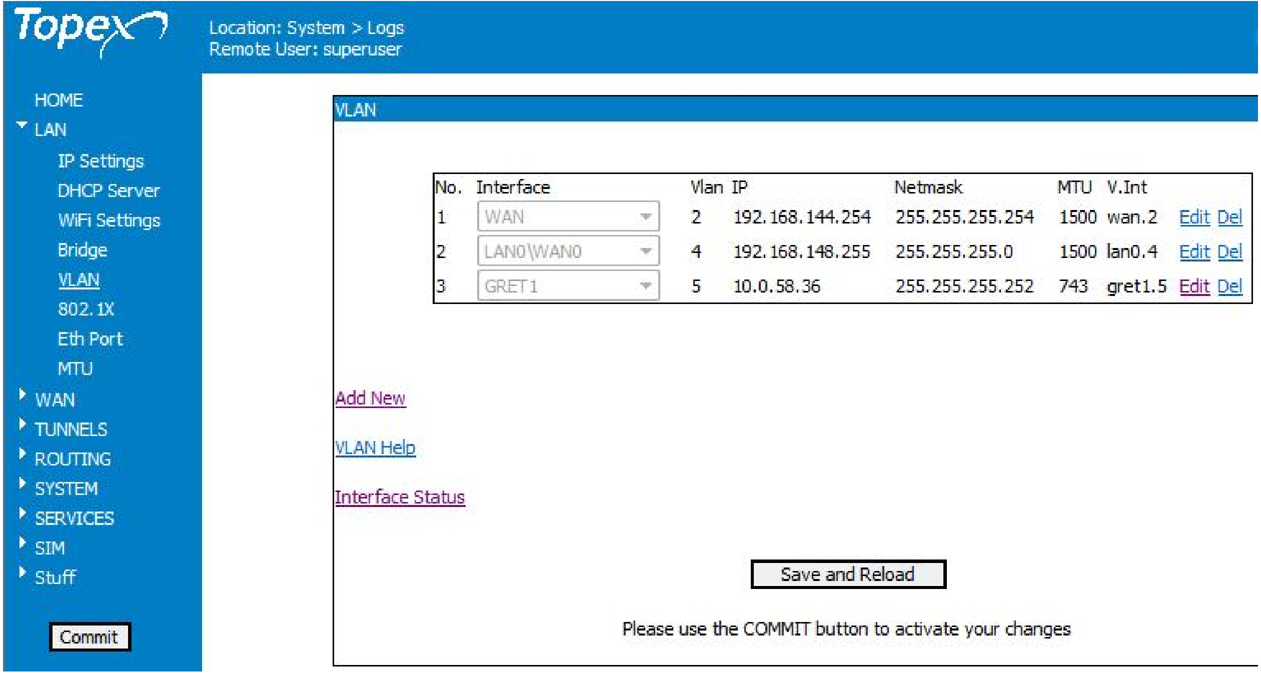
Should you enter an incorrect or ambiguous command, Busybox promots you for the correct syntax and available options.



```
BusyBox v1.11.2 () multi-call binary

Usage: id [OPTIONS]... [USER]

Print information about USER or the current user

Options:
        -g      Print group ID
        -u      Print user ID
        -n      Print name instead of a number
        -r      Print real user ID instead of effective ID
```

5.2.10 VLAN

This page configure the settings for the Virtual LANs of Bytton LTE.



Location: System > Logs
Remote User: superuser

VLAN

No.	Interface	Vlan	IP	Netmask	MTU	V.Int		
1	WAN	2	192.168.144.254	255.255.255.254	1500	wan.2	Edit	Del
2	LAN0\WAN0	4	192.168.148.255	255.255.255.0	1500	lan0.4	Edit	Del
3	GRET1	5	10.0.58.36	255.255.255.252	743	gret1.5	Edit	Del

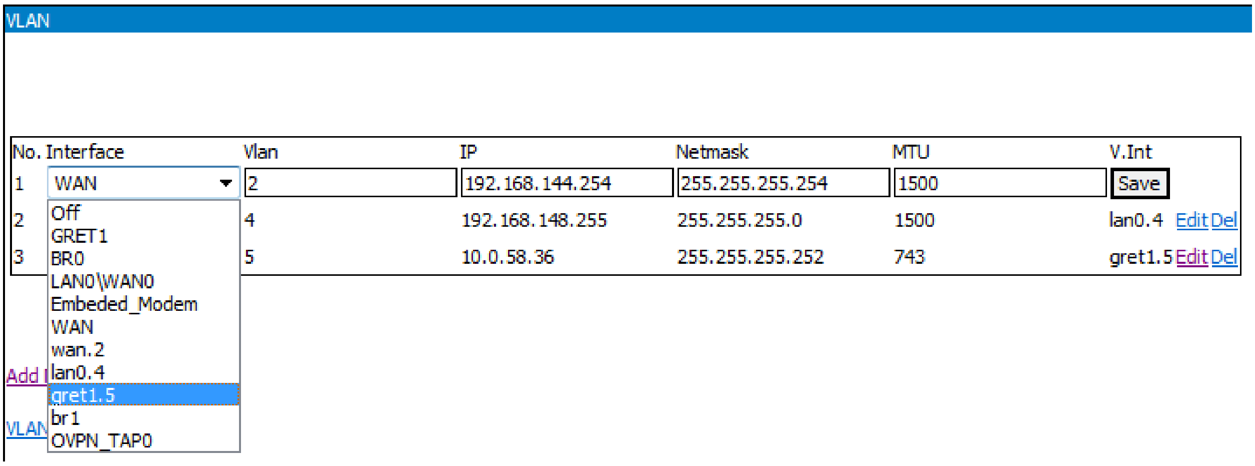
Please use the COMMIT button to activate your changes

Figure 5-55: The “VLAN” page with several virtual LANs defined.

A virtual or logical LAN is a subgroup in the physical local area network, which is created by software. It functions at Layer 2, unlike IP sub-networks which operate at Layer 3 level.

R&S Topex’s ByttonICR implements VLANs according to the IEEE standard 802.1q. This specifies additional bits (flags) to the data packets, marking them for prioritization and/or routing for VLAN.

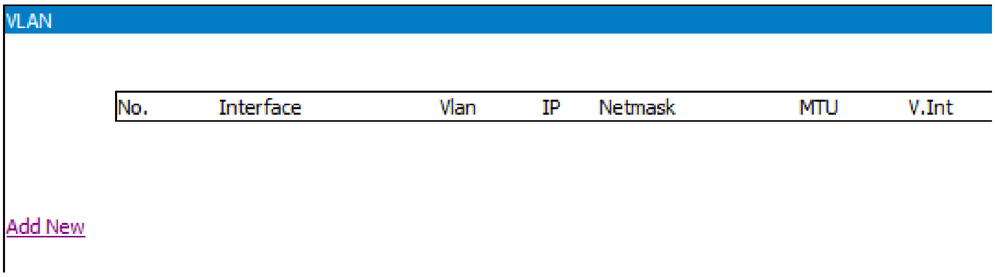
The “**VLAN**” table explained here lets you define several logical networks – for each one you must set up the Interface to be used, ID number for the respective VLAN, IP address and corresponding net mask, then establish the MTU.



VLAN

No.	Interface	Vlan	IP	Netmask	MTU	V.Int		
1	WAN	2	192.168.144.254	255.255.255.254	1500	Save		
2		4	192.168.148.255	255.255.255.0	1500	lan0.4	Edit	Del
3		5	10.0.58.36	255.255.255.252	743	gret1.5	Edit	Del

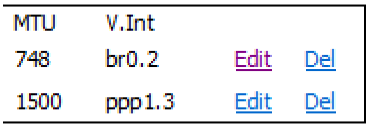
At first the table is empty, you must use Add New to create an additional entry, then **Edit** to change the parameters.



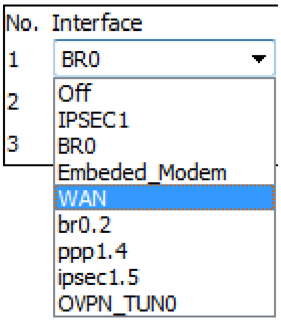
VLAN

No.	Interface	Vlan	IP	Netmask	MTU	V.Int

Also, each VLAN definition that you have entered may be individually saved or deleted, using the links to the right of the table.



MTU	V.Int		
748	br0.2	Edit	Del
1500	ppp1.3	Edit	Del

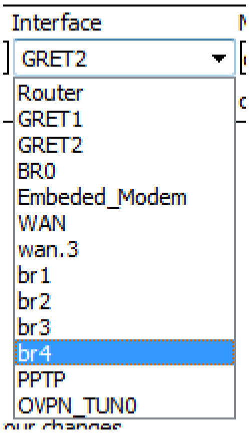


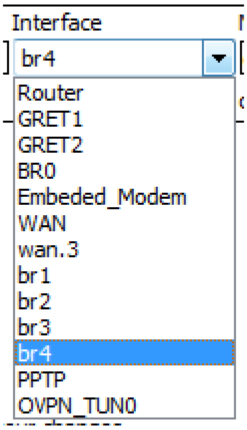
As you can see, when you set up the **Interface** to be used for each VLAN, the drop list shows not only the three physical interfaces:

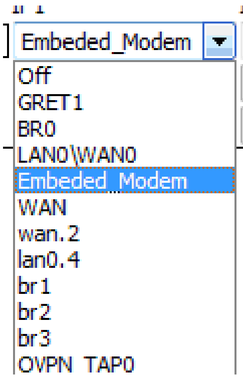
- BR0 (Eth ports for LAN and WiFi clients
- Embedded Modem
- Primary or secondary WAN,

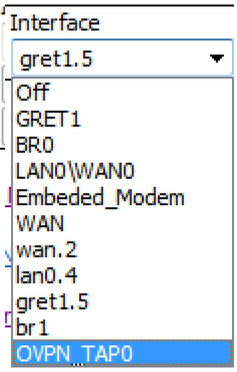
but also all the bridges and logical interfaces (IPSEC, GRE, PPTP or Open VPN Tunnels) that you have defined previously: IPSEC1, GRET1, GRET2, br0.2, br1, 2, 3, wan.3, lan.04, ppp1.4, ipsec1.5, OVPN_TUN or OVPN_TAP0!

Or:









What is a VLAN?

First, let's remember what is a "normal" LAN: one should consider not just the geographical definition (small area, just a few computers) since a FDDI network has thousands of users and an Internet Protocol "Class A" LAN can in theory accommodate more than 16 million devices organized into subnets!

The **logical** definition is more important: a LAN is a single broadcast domain, just one subnet. The broadcast domain is a restricted area in which information can be transmitted for all devices in the domain to receive. In this domain, any network equipment can transmit data directly to other equipment or device without going through a routing device. The reverse is also true, routers block broadcasts by design, so they must sit between LANs.

Between the members or the same LAN no routing is performed, there are only hubs, bridges and switches. Instead, routing is required between different LANs!

A virtual LAN is a logical domain where broadcasts and multicasts go only to the nodes in the respective virtual LAN. Membership is not dependent upon physical location or hardware, but instead is defined by the Manager of the network, hence the name "virtual LAN".

Why use VLANs?

- to minimize the broadcast domain. Broadcasts are required for the normal function of a network. Many protocols and applications depend on broadcast communication to function properly.
But certain network devices will send out large amounts of broadcast traffic that can really slow down the network, especially when it reaches a certain size, usually 600 devices or more. A layer 2 switched network is in a single broadcast domain and the broadcasts can reach the network segments which are so far where a particular broadcast has no scope and consume available network bandwidth. A layer 3 device (typically a router) is used to segment a broadcast domain.
VLANs may be used to segment a network, thus limiting the amount of broadcast: by segmenting a large LAN to smaller VLANs, the broadcast traffic will / can be reduced as each broadcast will be sent on to the relevant VLAN only. With VLAN, there will be less ARP messages and broadcasts!

- for Security. VLANs can be used as a security device to prevent specific hosts from seeing other hosts. The VLAN technique may help to restrict sensitive traffic originating from an enterprise department within itself. In a VLAN network environment, with multiple broadcast domains, the network Administrators have control over each port and user. Now malicious user can no longer just plug their workstation into any switch port and sniff the network traffic using a packet sniffer. The network administrator controls each port and whatever resources it is allowed to use. Usage of VLAN means an increase in security, since the information is encapsulated in an additional level and possibly analyzed.

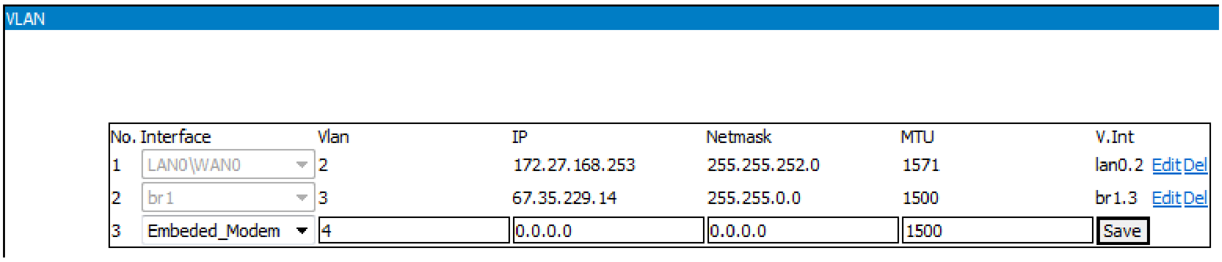
VLANs can separate traffic logically within a switch or station, son one VLAN can not communicate directly with stations on another VLAN. You can may also restrict which are allowed to communicate with other VLANs, thus improving security. For instance, you could set up a guest VLAN that only allows access to the Internet, not to other machines in the local network. Another “VoIP phone VLAN” may be created especially for IP phones only. Generally, inside a company, different sections, departments, buildings, floors, or even individual computers may be set up into their own networks, as large pr small as really required!

- Much greater flexibility in usage and more flexibility in administration.
Use: A VLAN has the same attributes as a physical local area network (LAN), but it allows for end stations to be grouped together even if they are not located on the same network switch or even in the same building. To physically replicate the functions of a VLAN, it would be necessary to install a separate, parallel collection of network cables and equipment which are kept separate from the primary network. Compared to this hardware approach, when you use VLANs, a new logical subgroup within a local area network may be simply created via software, fast and with low costs, instead of manually moving Ethernet cables in the network switches.
Since Virtual LANs are location-independent, the VLAN of a certain department may be all over the building. Users can move to another office or another building while remaining in the same LAN.
One of the greatest advantages of VLANs is precisely this: when a computer is physically moved to another location, it can remain logically in the same VLAN without any need for hardware reconfiguration.
Management: LAN membership is easily defined by the network manager. All modifications to the network are easier to perform, since all the architecture can be changed by simple parametering of the switches via the Web configuration interface of Bytton.
VLAN membership can be configured through software instead of physically relocating devices or connections.

- Costs: Any software implementation is cheaper than its hardware counterpart. Segmenting a large VLAN to smaller VLANs costs less than creating a routed network with routers because normally routers are more expensive than simple switches!
Also, since traffic between different LANs is routed, it is better to keep all traffic in a single LAN and avoid WAN links, which are expensive!

Using VLANs:

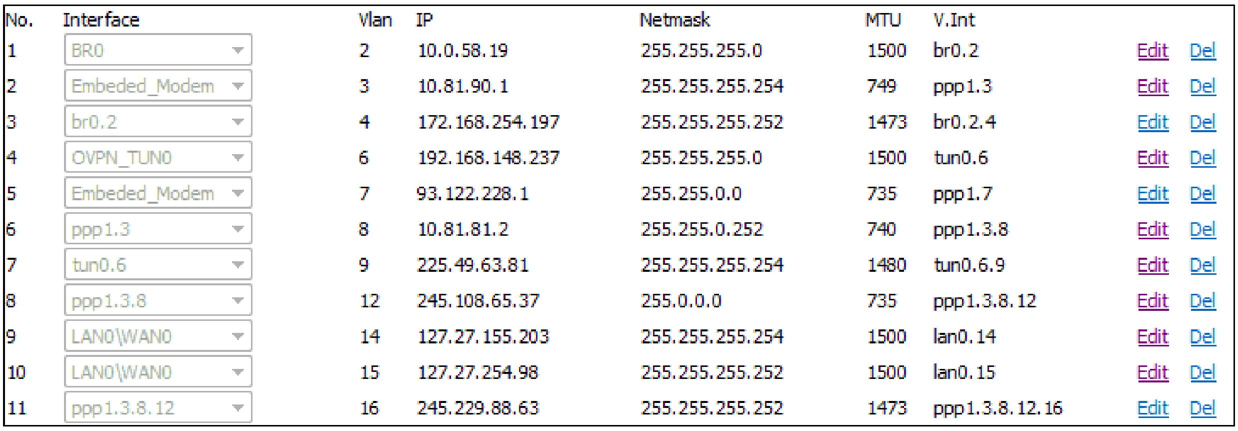
After defining the VLANs in the table, such as this:



VLAN

No.	Interface	Vlan	IP	Netmask	MTU	V.Int
1	LAN0\WAN0	2	172.27.168.253	255.255.252.0	1571	lan0.2 Edit Del
2	br1	3	67.35.229.14	255.255.0.0	1500	br1.3 Edit Del
3	Embeded_Modem	4	0.0.0.0	0.0.0.0	1500	Save

Or:



No.	Interface	Vlan	IP	Netmask	MTU	V.Int		
1	BR0	2	10.0.58.19	255.255.255.0	1500	br0.2	Edit	Del
2	Embeded_Modem	3	10.81.90.1	255.255.255.254	749	ppp1.3	Edit	Del
3	br0.2	4	172.168.254.197	255.255.255.252	1473	br0.2.4	Edit	Del
4	OVPN_TUN0	6	192.168.148.237	255.255.255.0	1500	tun0.6	Edit	Del
5	Embeded_Modem	7	93.122.228.1	255.255.0.0	735	ppp1.7	Edit	Del
6	ppp1.3	8	10.81.81.2	255.255.0.252	740	ppp1.3.8	Edit	Del
7	tun0.6	9	225.49.63.81	255.255.255.254	1480	tun0.6.9	Edit	Del
8	ppp1.3.8	12	245.108.65.37	255.0.0.0	735	ppp1.3.8.12	Edit	Del
9	LAN0\WAN0	14	127.27.155.203	255.255.255.254	1500	lan0.14	Edit	Del
10	LAN0\WAN0	15	127.27.254.98	255.255.255.252	1500	lan0.15	Edit	Del
11	ppp1.3.8.12	16	245.229.88.63	255.255.255.252	1473	ppp1.3.8.12.16	Edit	Del

then issuing a Commit command to make the changes permanent, the VLAN interfaces will be visible in Interface Status:

```
br0.19    Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:109.166.184.149  Bcast:109.255.255.255  Mask:255.0.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

br0.2     Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:10.0.58.19  Bcast:10.0.58.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

br0.2.4   Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          inet addr:172.168.254.197  Bcast:172.168.254.199  Mask:255.255.255.252
          UP BROADCAST RUNNING MULTICAST  MTU:1473  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan0.14   Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          inet addr:127.27.155.203  Bcast:127.255.255.255  Mask:255.255.255.254
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan0.15   Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
```

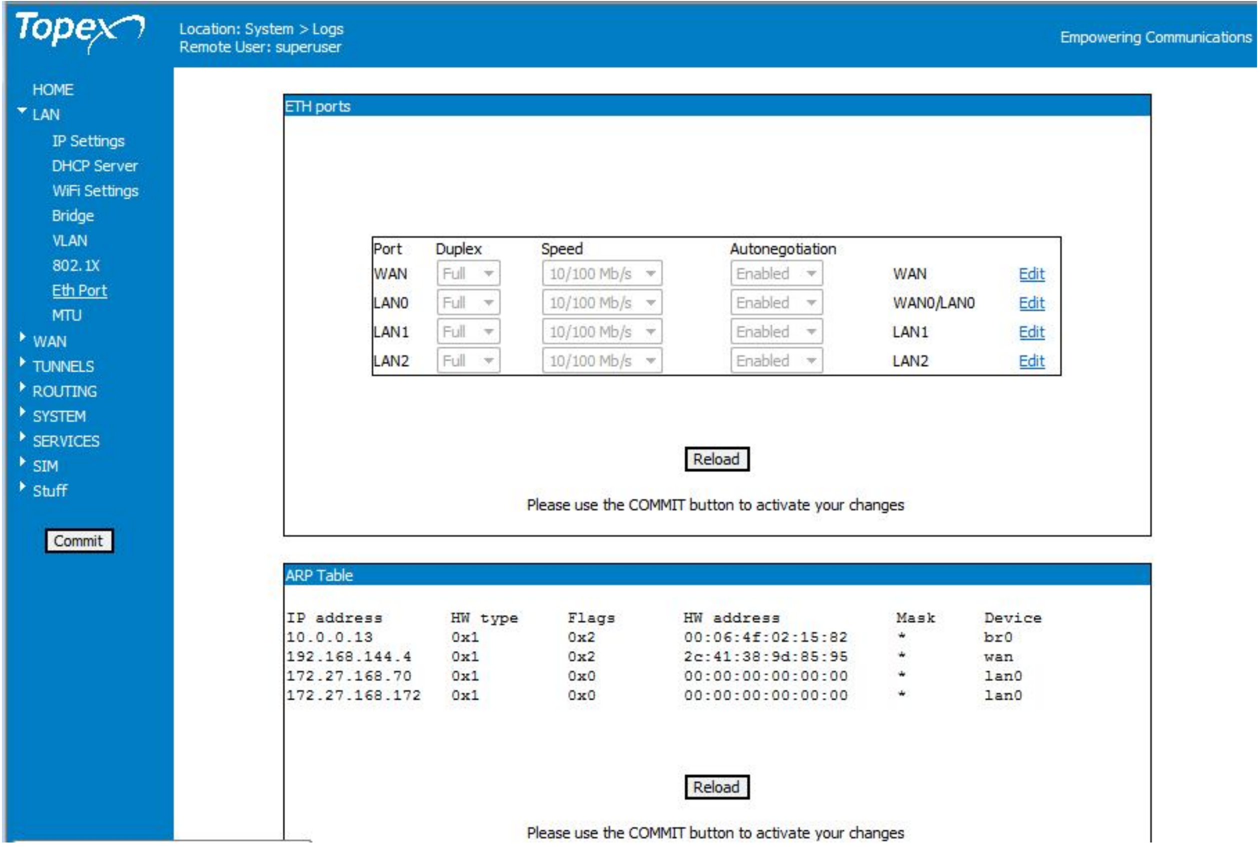
```
          inet addr:127.27.254.98  Bcast:127.27.254.99  Mask:255.255.255.252
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

wan.18    Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.148.254  Bcast:192.168.148.255  Mask:255.255.255.252
          UP BROADCAST RUNNING MULTICAST  MTU:1473  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

wan.20    Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:203.194.198.31  Bcast:203.194.198.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1480  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

wan:0     Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.148.4  Bcast:192.168.148.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          Base address:0x3000
```

The corresponding routes have been added in the static Routing Table of Bytton LTE:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
194.102.255.23  0.0.0.0         255.255.255.255 UH    0      0        0 wan
127.27.155.202  0.0.0.0         255.255.255.254 U     0      0        0 lan0.14
172.168.254.196 0.0.0.0         255.255.255.252 U     0      0        0 br0.2.4
192.168.148.252 0.0.0.0         255.255.255.252 U     0      0        0 wan.18
127.27.254.96   0.0.0.0         255.255.255.252 U     0      0        0 lan0.15
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
203.194.198.0   0.0.0.0         255.255.255.0   U     0      0        0 wan.20
10.0.58.0       0.0.0.0         255.255.255.0   U     0      0        0 br0.2
172.27.0.0      0.0.0.0         255.255.0.0     U     0      0        0 lan0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
109.0.0.0       0.0.0.0         255.0.0.0       U     0      0        0 br0.19
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

5.2.11 ETH Ports

This menu element allow for fine tuning (monitoring and control) of each ETH ports of the Bytton equipment:



Port	Duplex	Speed	Autonegotiation		
WAN	Full	10/100 Mb/s	Enabled	WAN	Edit
LAN0	Full	10/100 Mb/s	Enabled	WAN0/LAN0	Edit
LAN1	Full	10/100 Mb/s	Enabled	LAN1	Edit
LAN2	Full	10/100 Mb/s	Enabled	LAN2	Edit

Please use the COMMIT button to activate your changes

```
IP address      HW type     Flags      HW address           Mask      Device
10.0.0.13       0x1         0x2        00:06:4f:02:15:82    *         br0
192.168.144.4   0x1         0x2        2c:41:38:9d:85:95    *         wan
172.27.168.70   0x1         0x0        00:00:00:00:00:00    *         lan0
172.27.168.172  0x1         0x0        00:00:00:00:00:00    *         lan0
```

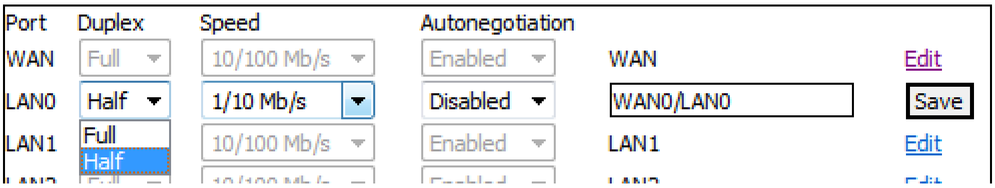
Please use the COMMIT button to activate your changes

Figure 5-56: The “ETH ports” page for physical configuration of Ethernet ports.

While previous “IP settings”, including LAN0/WAN0 and individual IP and netmask assignment for each port referred to the logical aspects, this configuration page refers to the **physical** parameters for each Ethernet port of the equipment!

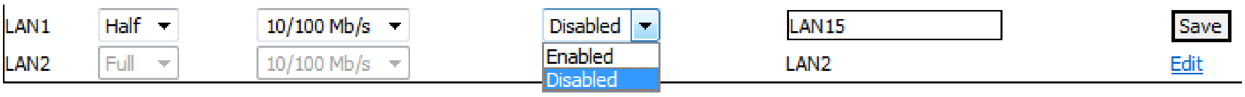
ETH Ports:

For each of these four ports you can establish precisely the network operating parameters:



Port	Duplex	Speed	Autonegotiation		
WAN	Full	10/100 Mb/s	Enabled	WAN	Edit
LAN0	Half	1/10 Mb/s	Disabled	WAN0/LAN0	Save
LAN1	Full Half	10/100 Mb/s	Enabled	LAN1	Edit

Respectively Duplex mode, Speed , Auto-negotiation and local name:



LAN1	Half	10/100 Mb/s	Disabled Enabled Disabled	LAN15	Save
LAN2	Full	10/100 Mb/s		LAN2	Edit

Duplex Mode: you may let the default Full duplex, or choose Half duplex instead

Speed: You may choose 1/10 Mbps instead of the default 10/100 Mps.

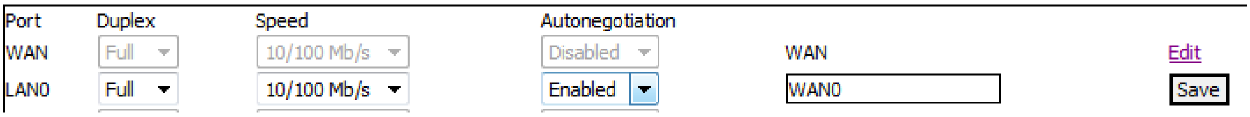
Auto-negotiation: by default it is Enabled.

Why disable the Auto-negotiation?

The automatic negotiation is an optional function of the IEEE 802.3u Fast Ethernet standard that enables Ethernet adapters to exchange automatically information over a link, about speed and duplex abilities. By default, the ETH ports of Bytton LTE are set to auto-negotiation, since different users may connect to it, having several types of network adapters. The users may have either a 10 Mb, a 100 Mb Ethernet, or a 10/100 Mb card in their notebooks, so the switch of Bytton must be able to negotiate their speed and duplex mode. The manual fine-tuning of these ports is provided to solve possible problems, which could happen, for instance when one port on the link operates at half-duplex while the other port operates at full-duplex.
This could occur when one or both ports on a link are reset and the auto-negotiation process does not result in both link partners having the same configuration.
Both sides of a link should have auto-negotiation on, or both sides should have it off. Thus, if the user's notebook cannot fully configure its Ethernet adapter, then Bytton must be able to adjust **its** network adapter accordingly!

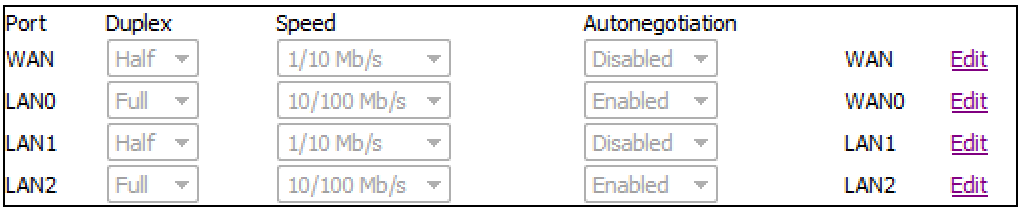
Interface name

You can also edit (change) the default names that Bytton assigns to its four Eth interfaces: wan, lan0, lan1, lan2, but this name will be valid only in this table:



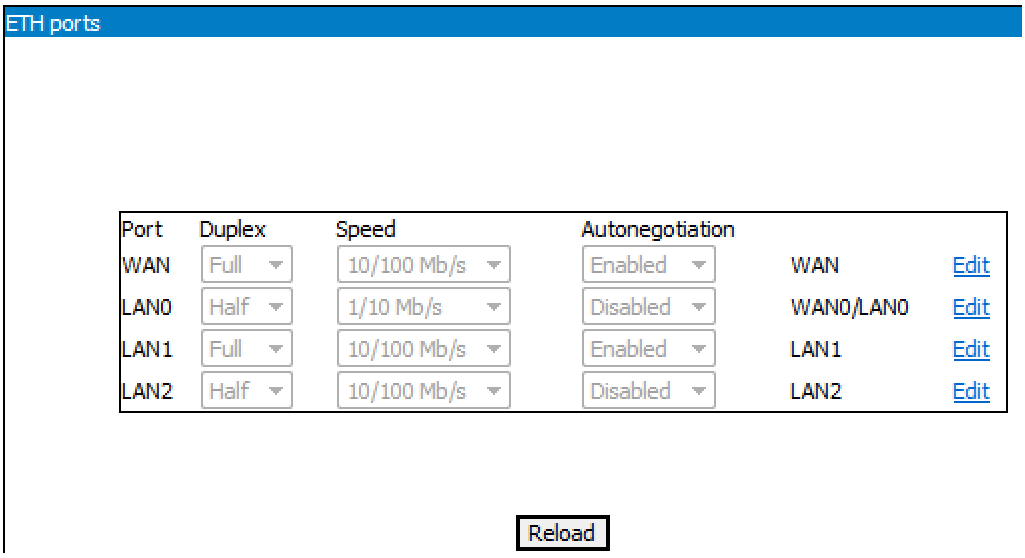
Port	Duplex	Speed	Autonegotiation		
WAN	Full	10/100 Mb/s	Disabled	WAN	Edit
LAN0	Full	10/100 Mb/s	Enabled	WAN0	Save

After Commit and reboot, the new names will show up in the ETH Ports table:



Port	Duplex	Speed	Autonegotiation		
WAN	Half	1/10 Mb/s	Disabled	WAN	Edit
LAN0	Full	10/100 Mb/s	Enabled	WAN0	Edit
LAN1	Half	1/10 Mb/s	Disabled	LAN1	Edit
LAN2	Full	10/100 Mb/s	Enabled	LAN2	Edit

Or:

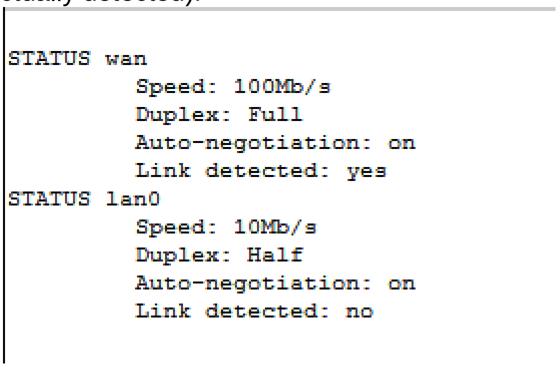


ETH ports

Port	Duplex	Speed	Autonegotiation		
WAN	Full	10/100 Mb/s	Enabled	WAN	Edit
LAN0	Half	1/10 Mb/s	Disabled	WAN0/LAN0	Edit
LAN1	Full	10/100 Mb/s	Enabled	LAN1	Edit
LAN2	Half	10/100 Mb/s	Disabled	LAN2	Edit

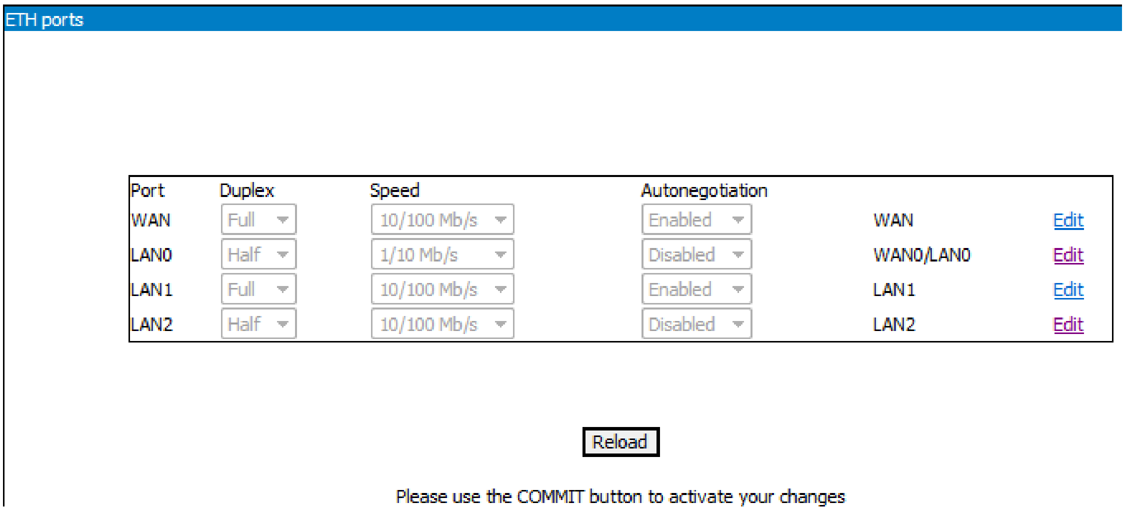
The central pane, "Port Status", shows the current state of the Ethernet ports of Bytton.

In the example below, the **wan** port is with the default settings (auto negotiation, full duplex) and is active for a 100Mbps connection, while **lan0** was set to half duplex, speed of 10 Mbps and is not in use (no link actually detected):



```
STATUS wan
         Speed: 100Mb/s
         Duplex: Full
         Auto-negotiation: on
         Link detected: yes
STATUS lan0
         Speed: 10Mb/s
         Duplex: Half
         Auto-negotiation: on
         Link detected: no
```

After a reboot, the new parameters for operation of Eth ports will be active, and will show up in the “ETH Port” panel located in the middle of the window, as shown in the following examples:

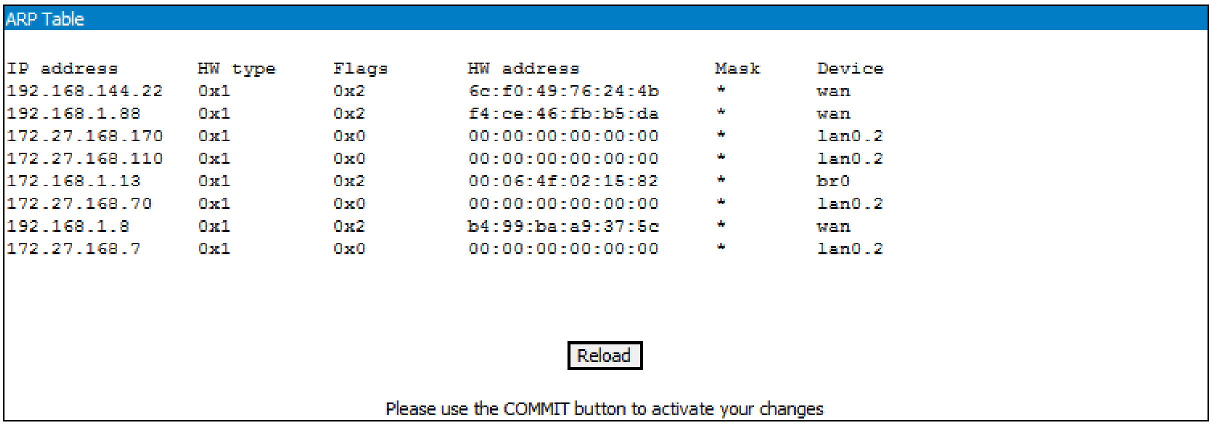


ETH ports

Port	Duplex	Speed	Autonegotiation		
WAN	Full	10/100 Mb/s	Enabled	WAN	Edit
LAN0	Half	1/10 Mb/s	Disabled	WAN0/LAN0	Edit
LAN1	Full	10/100 Mb/s	Enabled	LAN1	Edit
LAN2	Half	10/100 Mb/s	Disabled	LAN2	Edit

Please use the COMMIT button to activate your changes

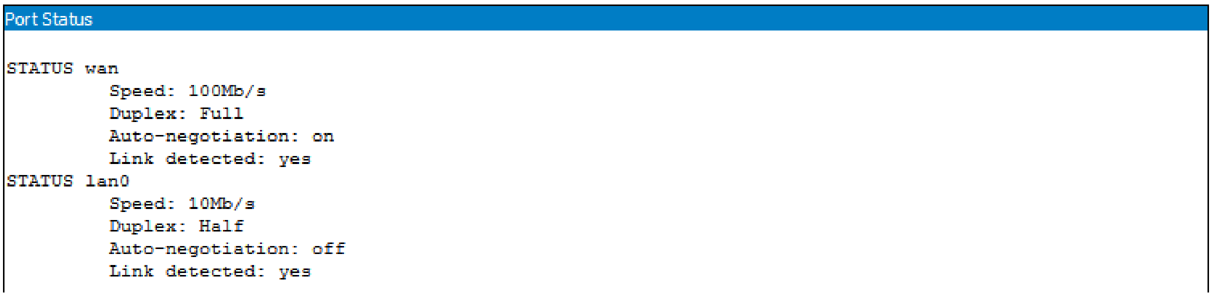
Or:



ARP Table

```
IP address       HW type     Flags      HW address          Mask     Device
192.168.144.22   0x1         0x2        6c:f0:49:76:24:4b   *        wan
192.168.1.88     0x1         0x2        f4:ce:46:fb:b5:da   *        wan
172.27.168.170   0x1         0x0        00:00:00:00:00:00   *        lan0.2
172.27.168.110   0x1         0x0        00:00:00:00:00:00   *        lan0.2
172.168.1.13     0x1         0x2        00:06:4f:02:15:82   *        br0
172.27.168.70    0x1         0x0        00:00:00:00:00:00   *        lan0.2
192.168.1.8      0x1         0x2        b4:99:ba:a9:37:5c   *        wan
172.27.168.7     0x1         0x0        00:00:00:00:00:00   *        lan0.2
```

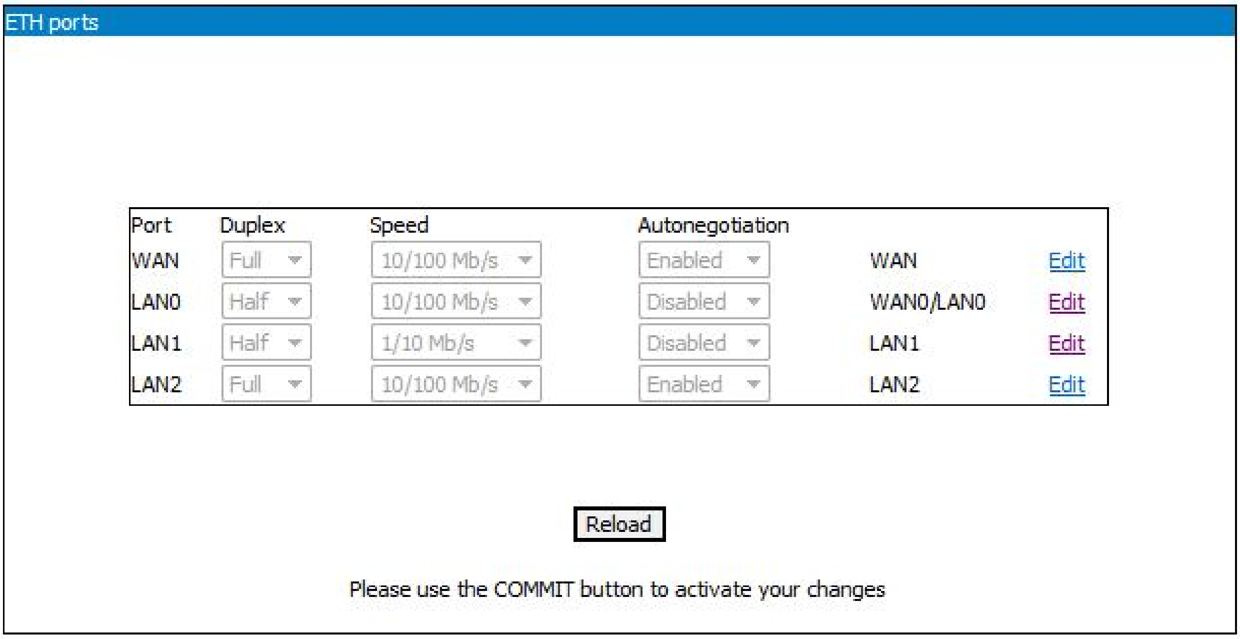
Please use the COMMIT button to activate your changes



Port Status

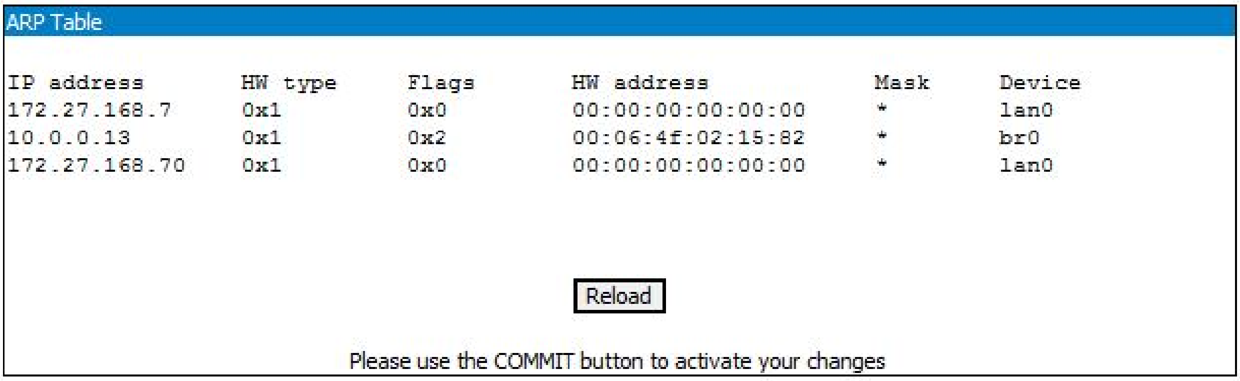
```
STATUS wan
         Speed: 100Mb/s
         Duplex: Full
         Auto-negotiation: on
         Link detected: yes
STATUS lan0
         Speed: 10Mb/s
         Duplex: Half
         Auto-negotiation: off
         Link detected: yes
```

Or:



Port	Duplex	Speed	Autonegotiation		
WAN	Full	10/100 Mb/s	Enabled	WAN	Edit
LAN0	Half	10/100 Mb/s	Disabled	WAN0/LAN0	Edit
LAN1	Half	1/10 Mb/s	Disabled	LAN1	Edit
LAN2	Full	10/100 Mb/s	Enabled	LAN2	Edit

Please use the COMMIT button to activate your changes



```
IP address       HW type     Flags       HW address            Mask     Device
172.27.168.7     0x1         0x0         00:00:00:00:00:00     *        lan0
10.0.0.13        0x1         0x2         00:06:4f:02:15:82     *        br0
172.27.168.70    0x1         0x0         00:00:00:00:00:00     *        lan0
```

Please use the COMMIT button to activate your changes

When every ETH port is individually configured (LAN1 and LAN2 have been assigned each its own IP, LAN0 is set to second WAN, but not connected), all four Ethernet ports will show up accordingly in the Port Status display pane:

```
STATUS wan
        Speed: 100Mb/s
        Duplex: Full
        Auto-negotiation: on
        Link detected: yes
STATUS lan0
        Speed: 10Mb/s
        Duplex: Half
        Auto-negotiation: off
        Link detected: no
STATUS lan1
        Speed: 100Mb/s
        Duplex: Full
        Auto-negotiation: on
        Link detected: yes
STATUS lan2
        Speed: 100Mb/s
        Duplex: Full
        Auto-negotiation: on
        Link detected: yes.
```

The routing table will also show the routes for the local ETH ports whose IP addresses have been individually assigned:

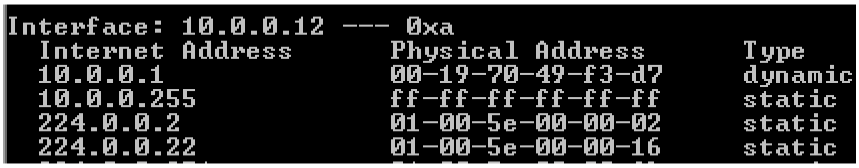
```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
193.57.235.84   192.168.1.8     255.255.255.255 UGH   0      0        0 wan
172.168.1.12    0.0.0.0         255.255.255.252 U     0      0        0 lan2
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
172.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 lan1
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

ARP TABLE

What is it?

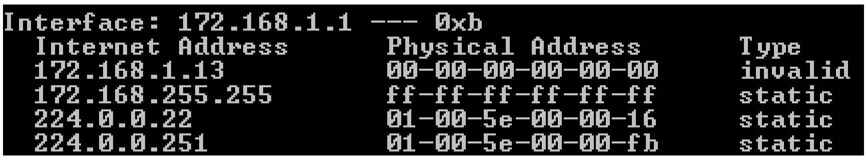
Generally, the Address Resolution Protocol (ARP) is a computer networking protocol for determining a network host's link layer or hardware address when only its Internet Layer (IP) or Network Layer address is known. This function is critical in local area networking as well as for routing internetworking traffic across gateways (routers) based on IP addresses when the next-hop router must be determined. ARP was defined as early as 1982 by RFC 826.

Each computer from a network maintains its own table of the mapping from Layer 3 addresses IP addresses such as 10.0.0.12) to Layer 2 addresses (physical Ethernet addresses or MACs such as 31:fc:01:90:e5:c7). In a modern computer this is maintained almost entirely by ARP packets on the local network and it thus often called the ARP table (cache)' as opposed to “table for Layer 2 addresses”'.

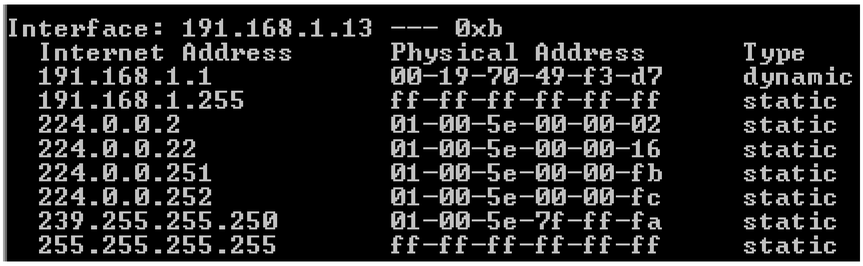


```
Interface: 10.0.0.12 --- 0xa
  Internet Address      Physical Address      Type
  10.0.0.1              00-19-70-49-f3-d7     dynamic
  10.0.0.255            ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
```

or

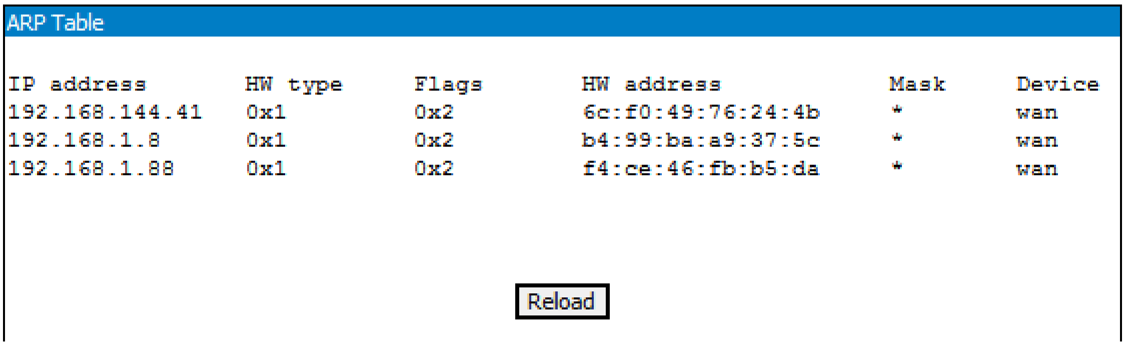


```
Interface: 172.168.1.1 --- 0xb
  Internet Address      Physical Address      Type
  172.168.1.13          00-00-00-00-00-00     invalid
  172.168.255.255       ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
```



```
Interface: 191.168.1.13 --- 0xb
  Internet Address      Physical Address      Type
  191.168.1.1           00-19-70-49-f3-d7     dynamic
  191.168.1.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

Currently, due to the overwhelming prevalence of IPv4 and Ethernet in general networking, ARP is most frequently used to translate IPv4 addresses (OSI Layer 3) into Ethernet MAC addresses (OSI Layer 2). In the next generation Internet Protocol, IPv6, ARP's functionality is provided by the Neighbor Discovery Protocol (NDP).

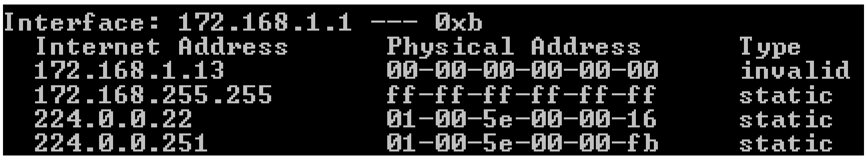


```
IP address       HW type    Flags    HW address           Mask    Device
192.168.144.41   0x1        0x2      6c:f0:49:76:24:4b    *       wan
192.168.1.8      0x1        0x2      b4:99:ba:a9:37:5c    *       wan
192.168.1.88     0x1        0x2      f4:ce:46:fb:b5:da    *       wan
```

In the ARP cache of ByttonICR, each entry shows the IP address, the hardware type (as 0x1 instead of „10Mbps Ethernet"), the flags, the hardware address (MAC), and optionally the corresponding mask and the name assigned to the respective device:

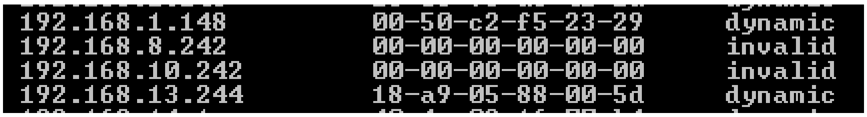
```
IP address       HW type     Flags       HW address           Mask     Device
192.168.1.2      0x1         0x2         00:0e:0c:4a:91:9c    *        wan
172.168.1.13     0x1         0x2         00:06:4f:02:15:82    *        br0
192.168.1.8      0x1         0x2         b4:99:ba:a9:37:5c    *        wan
192.168.1.88     0x1         0x2         f4:ce:46:fb:b5:da    *        wan
192.168.144.22   0x1         0x2         6c:f0:49:76:24:4b    *        wan
192.168.149.5    0x1         0x2         6c:62:6d:ad:61:7b    *        lan0
```

The type of ARP entries may be dynamic (most often used), static or … invalid!



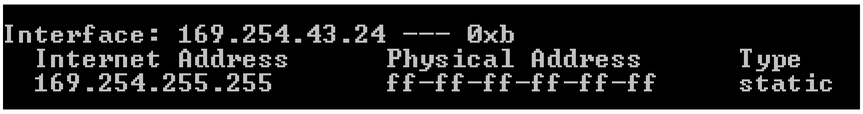
```
Interface: 172.168.1.1 --- 0xb
  Internet Address      Physical Address      Type
  172.168.1.13          00-00-00-00-00-00     invalid
  172.168.255.255       ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
```

Or::



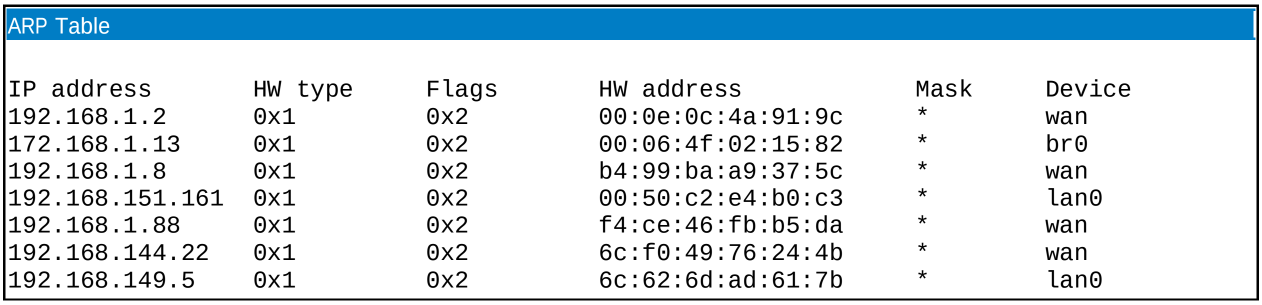
```
  192.168.1.148         00-50-c2-f5-23-29     dynamic
  192.168.8.242         00-00-00-00-00-00     invalid
  192.168.10.242        00-00-00-00-00-00     invalid
  192.168.13.244        18-a9-05-88-00-5d     dynamic
```

The invalid entries are the ones which show up incomplete or with MAC values of ffffffff… or 00000000, the device may not be actually connected to the network.



```
Interface: 169.254.43.24 --- 0xb
  Internet Address      Physical Address      Type
  169.254.255.255       ff-ff-ff-ff-ff-ff     static
```

Since dynamic ARP entries are the most common, the correct name would be ARP Cache, since a table implies rather static, persistent values:



ARP Table

```
IP address       HW type     Flags       HW address           Mask     Device
192.168.1.2      0x1         0x2         00:0e:0c:4a:91:9c    *        wan
172.168.1.13     0x1         0x2         00:06:4f:02:15:82    *        br0
192.168.1.8      0x1         0x2         b4:99:ba:a9:37:5c    *        wan
192.168.151.161  0x1         0x2         00:50:c2:e4:b0:c3    *        lan0
192.168.1.88     0x1         0x2         f4:ce:46:fb:b5:da    *        wan
192.168.144.22   0x1         0x2         6c:f0:49:76:24:4b    *        wan
192.168.149.5    0x1         0x2         6c:62:6d:ad:61:7b    *        lan0
```

Other examples or ARP Table shown on Bytton LTE:

```
IP address       HW type     Flags       HW address           Mask     Device
172.27.168.7     0x1         0x0         00:00:00:00:00:00    *        lan0
10.0.0.13        0x1         0x2         00:06:4f:02:15:82    *        br0
172.27.168.70    0x1         0x0         00:00:00:00:00:00    *        lan0
```

Respectively:

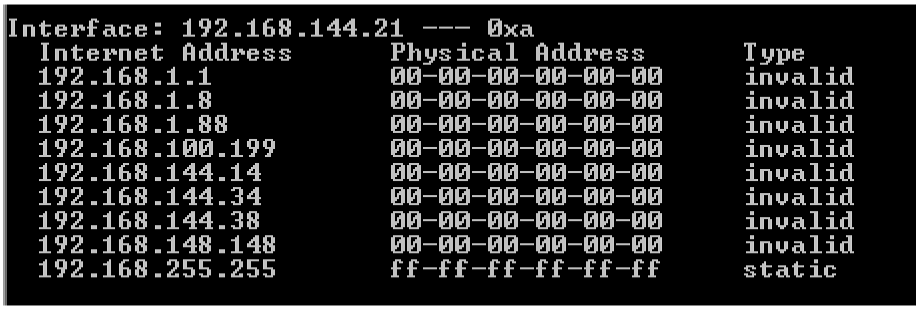
```
IP address       HW type     Flags       HW address           Mask     Device
172.27.168.70    0x1         0x0         00:00:00:00:00:00    *        lan0
10.0.0.13        0x1         0x2         00:06:4f:02:15:82    *        br0
192.168.1.8      0x1         0x2         b4:99:ba:a9:37:5c    *        wan
172.27.168.7     0x1         0x0         00:00:00:00:00:00    *        lan0

IP address       HW type     Flags       HW address           Mask     Device
172.27.168.70    0x1         0x0         00:00:00:00:00:00    *        lan0
172.27.168.170   0x1         0x0         00:00:00:00:00:00    *        lan0
10.0.0.13        0x1         0x2         00:06:4f:02:15:82    *        br0
```

```
192.168.1.8       0x1         0x2         b4:99:ba:a9:37:5c     *        wan
172.27.168.7      0x1         0x0         00:00:00:00:00:00     *        lan0
```

Usage of ARP table

All IP devices must have an ARP table. This ARP cache can be used for troubleshooting the network connectivity. When everything is working fine with ARP, you will have a dynamic ARP entry that is complete (both MAC and IP values are there).

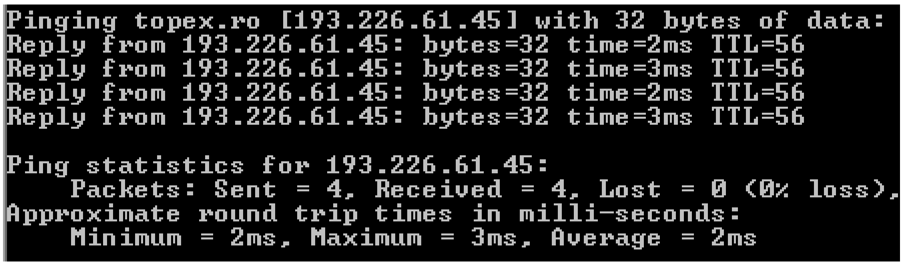
But if you do not have a complete entry, if you encounter problems:



```
Interface: 192.168.144.21 --- 0xa
  Internet Address      Physical Address      Type
  192.168.1.1           00-00-00-00-00-00     invalid
  192.168.1.8           00-00-00-00-00-00     invalid
  192.168.1.88          00-00-00-00-00-00     invalid
  192.168.100.199       00-00-00-00-00-00     invalid
  192.168.144.14        00-00-00-00-00-00     invalid
  192.168.144.34        00-00-00-00-00-00     invalid
  192.168.144.38        00-00-00-00-00-00     invalid
  192.168.148.148       00-00-00-00-00-00     invalid
  192.168.255.255       ff-ff-ff-ff-ff-ff     static
```

you can clear your ARP cache: Arp –d *

and then retry again to establish communication, by pinging the remote device you want to connect to:

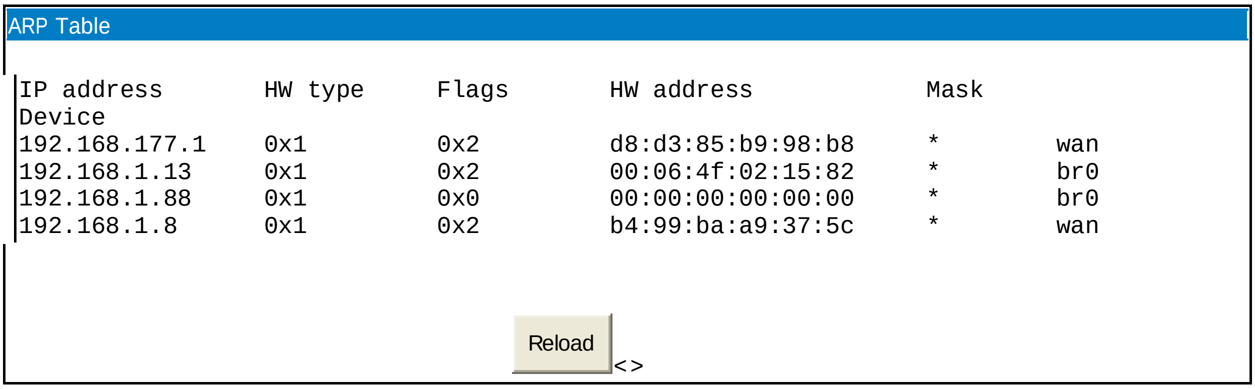


```
Pinging topex.ro [193.226.61.45] with 32 bytes of data:
Reply from 193.226.61.45: bytes=32 time=2ms TTL=56
Reply from 193.226.61.45: bytes=32 time=3ms TTL=56
Reply from 193.226.61.45: bytes=32 time=2ms TTL=56
Reply from 193.226.61.45: bytes=32 time=3ms TTL=56

Ping statistics for 193.226.61.45:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 3ms, Average = 2ms
```

New ARP table, showing correct entries:

```
IP address        HW type     Flags       HW address            Mask     Device
172.27.168.70     0x1         0x0         00:00:00:00:00:00     *        lan0
10.0.0.13         0x1         0x2         00:06:4f:02:15:82     *        br0
172.27.168.7      0x1         0x0         00:00:00:00:00:00     *        lan0
```

Or:



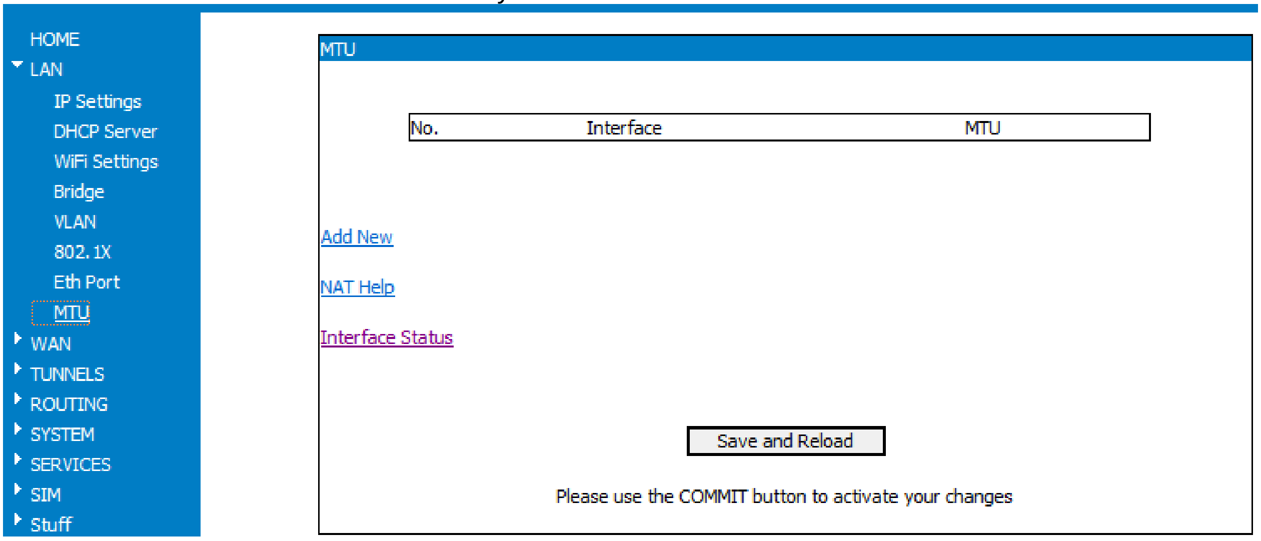
ARP Table

```
IP address       HW type     Flags      HW address          Mask
Device
192.168.177.1    0x1         0x2        d8:d3:85:b9:98:b8   *        wan
192.168.1.13     0x1         0x2        00:06:4f:02:15:82   *        br0
192.168.1.88     0x1         0x0        00:00:00:00:00:00   *        br0
192.168.1.8      0x1         0x2        b4:99:ba:a9:37:5c   *        wan
```

Figure 5-56: The “ARP Table” with multiple entries.

5.2.12 MTU

The last element of the LAN menu allows you to set the values for MTU.



No.	Interface	MTU

Please use the COMMIT button to activate your changes

Figure 5-57: The “MTU” window of the LAN configuration page.

Note:
*Although “MTU” shows up in the LAN section, it allows you to set the MTU values for **all** interfaces of Bytton LTE, including for WAN and Wan0, not just for the local Eth or wireless interfaces.*

Why is MTU important:

Generally MTU (Maximum Transmission Unit) is the largest physical packet size, measured in bytes, that a packet- or frame-based network (such as the Internet) can transmit unaltered.
All messages which are larger than the MTU will divided into smaller packets and only after fragmentation will be sent out through the network.

Every network has a different MTU, which is set by the network administrator. The minimum value that an MTU can be set to is 68. Also, for network protocols other than TCP, different MTU sizes may apply.

On your machine (PC computer or Bytton LTE) you must also set the MTU value in accordance with the specific settings of the data network you use. Ideally, you want the MTU to be the same as the smallest MTU of all the networks between your machine and a message's final destination.
Otherwise, if your messages are larger than **any one** of the intervening MTUs, they will get broken up (fragmented), which slows down considerably the transmission speeds.
When the large packet encounters a router that can't handle that large a packet, it will ask for retransmission – also reducing data rates.
On the other hand, if you set a too small MTU size “just to be sure”, this means relatively more overhead because of the header and more acknowledgements that must to be transmitted and handled – another cause of reduced throughput. Hence, there is always an optimal range of MTU values that you should try to observe!

Optimal values

Most Ethernet networks have an MTU of 1500, which is the default MTU setting for Windows 95 and later.
On the other hand, the link via point-to-point protocol has a negotiated MTU, which is usually between 500 and 2000 bytes.
In practice the MTU of many PPP connections is 576, so when you connect to the Internet via PPP1 link using the embedded modem, you should your Bytton's MTU value to 576 too.
ATM (asynchronous transfer mode) has a fixed MTU of 48 bytes only. Other types of high speed networks feature a much higher MTU value, for instance Token Ring uses 4096 and the fiber optics networks FDDI employs a value of 4352!

You should always bear in mind that the MTU is the **maximum physical value**. Thus, in many instances the net payload (logical size) must be smaller. For example, when you use tunnels, they add up specific headers to the packets, so you must reduce the MTU to achieve an overall length no greater that 1500! The same holds true for PPP over Ethernet, you must take into account the extra encapsulation, the actual length must be smaller, in order not to exceed the 1500 bytes limit!
The real MTU depends upon the actual carrier that you use to connect to Internet, for instance several ADSL providers have a MTU larger than 1500, so that the Ethernet packets that are transmitted via ADSL will not be over this limit.

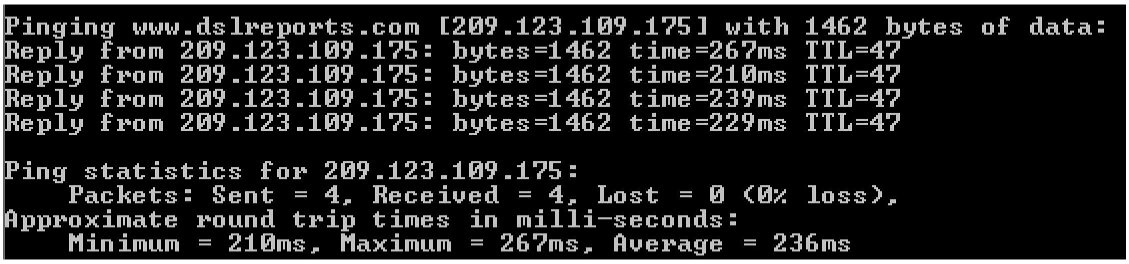
In practice, trial and error is the only sure way of finding the optimal MTU for each case. It works like this: you issue a PING command towards your Internet provider with the options "–f" (set Don't Fragment flag in the packet) and – l 1472 (specifies the size):

```
ping -f -l 1472 k.ro
```

or

```
ping –f –l 1462 209.123.109.175
```

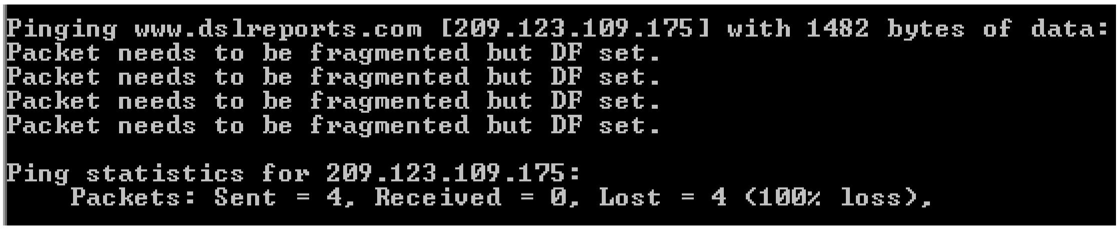
and watch for the results:



```
Pinging www.dslreports.com [209.123.109.175] with 1462 bytes of data:
Reply from 209.123.109.175: bytes=1462 time=267ms TTL=47
Reply from 209.123.109.175: bytes=1462 time=210ms TTL=47
Reply from 209.123.109.175: bytes=1462 time=239ms TTL=47
Reply from 209.123.109.175: bytes=1462 time=229ms TTL=47

Ping statistics for 209.123.109.175:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 210ms, Maximum = 267ms, Average = 236ms
```

If the answer is OK (O% loss), you can increase the MTU value (1472) by 10 and try again.
Continue with larger and larger values until you receive the error message:

"Packet needs to be fragmented."



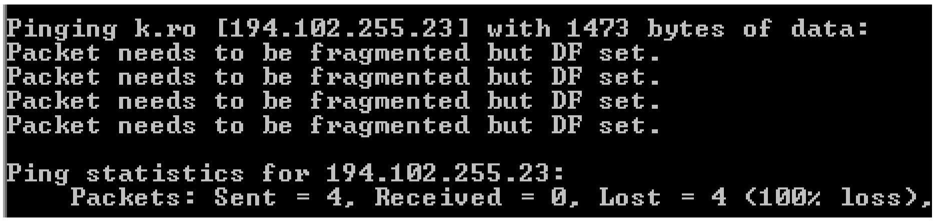
```
Pinging www.dslreports.com [209.123.109.175] with 1482 bytes of data:
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.

Ping statistics for 209.123.109.175:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

The message is quite clear: the value of 1482 is too high, the packets need to be fragmented, but you have set the flag "DF" (Do Not Fragment) so the packets cannot be transmitted.
You get "100% loss" for the PING data packets!

Repeat this step by decreasing your current MTU value by 10 and using the PING command again.

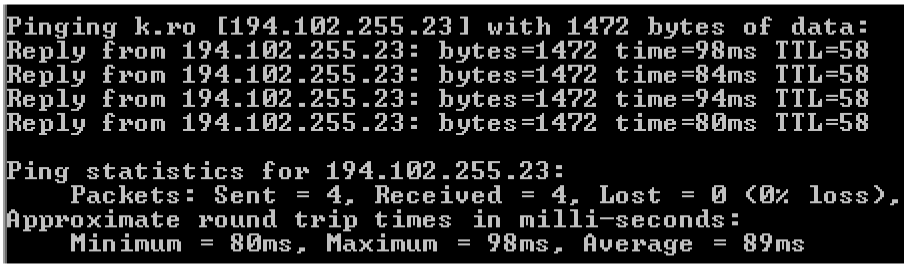
Continue until you no longer receive a message that the packets are fragmented.

Verify this by pinging with successive size increments / decrements smaller than ten, as shown:



```
Pinging k.ro [194.102.255.23] with 1473 bytes of data:
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.

Ping statistics for 194.102.255.23:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

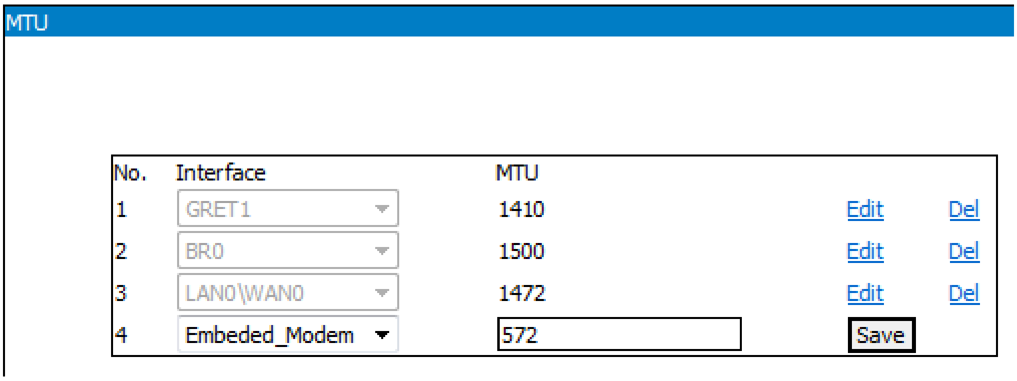
1473 is too large!



```
Pinging k.ro [194.102.255.23] with 1472 bytes of data:
Reply from 194.102.255.23: bytes=1472 time=98ms TTL=58
Reply from 194.102.255.23: bytes=1472 time=84ms TTL=58
Reply from 194.102.255.23: bytes=1472 time=94ms TTL=58
Reply from 194.102.255.23: bytes=1472 time=80ms TTL=58

Ping statistics for 194.102.255.23:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 80ms, Maximum = 98ms, Average = 89ms
```

“1472” seems to be just right!
The final result is that this is your best MTU value for the respective interface and provider.

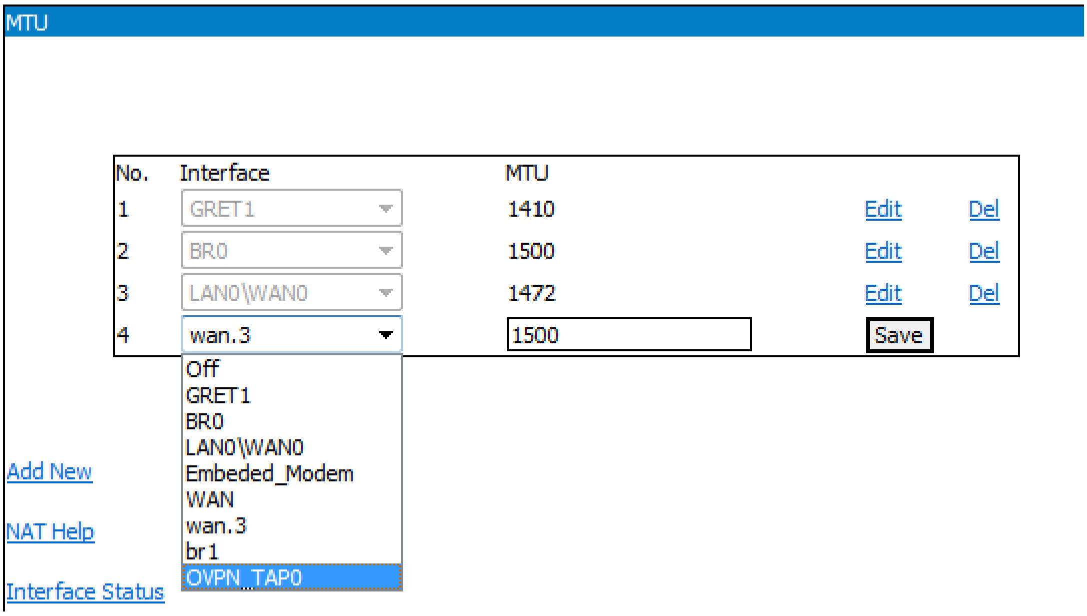
Bytton LTE lets you specify the optimal MTU value for each of the physical or logical interfaces of the equipment:



MTU

No.	Interface	MTU		
1	GRET1	1410	Edit	Del
2	BR0	1500	Edit	Del
3	LAN0\WAN0	1472	Edit	Del
4	Embeded_Modem	572	Save	

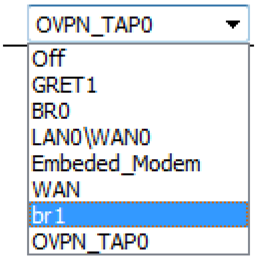
The drop list lets you choose from all the available interfaces of the equipment:



MTU

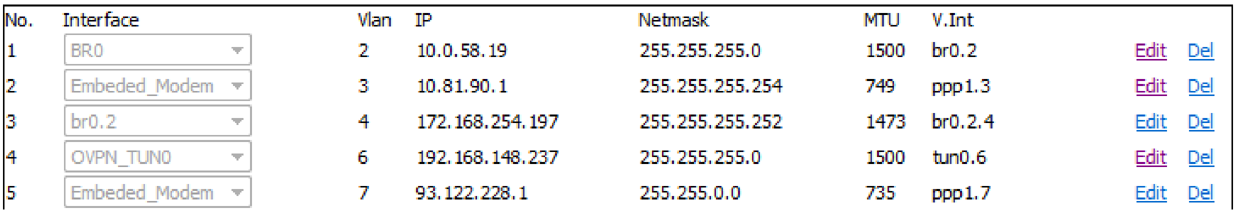
No.	Interface	MTU		
1	GRET1	1410	Edit	Del
2	BR0	1500	Edit	Del
3	LAN0\WAN0	1472	Edit	Del
4	wan.3	1500	Save	

Or:



Select the corresponding MTU value, save the individual entry, then use the button “Save and Reload” at the bottom of the page and the option Commit to make the changes permanent!

Note that the VLAN table also allows you to set the MTU value for each of the VLANs you create:



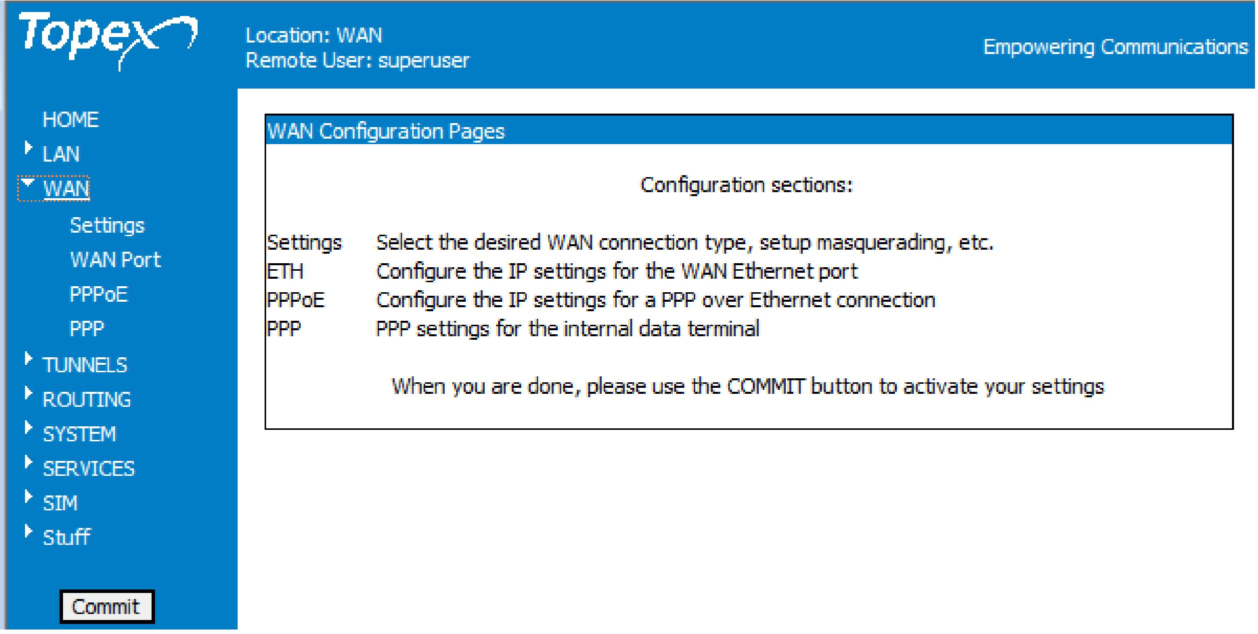
No.	Interface	Vlan	IP	Netmask	MTU	V.Int		
1	BR0	2	10.0.58.19	255.255.255.0	1500	br0.2	Edit	Del
2	Embeded_Modem	3	10.81.90.1	255.255.255.254	749	ppp1.3	Edit	Del
3	br0.2	4	172.168.254.197	255.255.255.252	1473	br0.2.4	Edit	Del
4	OVPN_TUN0	6	192.168.148.237	255.255.255.0	1500	tun0.6	Edit	Del
5	Embeded_Modem	7	93.122.228.1	255.255.0.0	735	ppp1.7	Edit	Del

The corresponding values set up for MTU over different interfaces can be seen in Iface Status:

```
br1        Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
           inet addr:10.0.58.39  Bcast:10.0.255.255  Mask:255.255.0.0
           UP BROADCAST RUNNING MULTICAST  MTU:1472  Metric:1
           RX packets:0 errors:0 dropped:0 overruns:0 frame:0
           TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:0
           RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

gret1      Link encap:UNSPEC  HWaddr 0A-00-3A-25-00-00-00-00-00-00-00-00-00-00-00-00
           inet addr:10.0.58.27  P-t-P:10.0.58.27  Mask:255.255.255.254
           UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1410  Metric:1
           RX packets:0 errors:0 dropped:0 overruns:0 frame:0
           TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:0
           RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan0       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
           inet addr:192.168.148.148  Bcast:192.168.148.151  Mask:255.255.255.252
           UP BROADCAST MULTICAST  MTU:1472  Metric:1
           RX packets:0 errors:0 dropped:0 overruns:0 frame:0
           TX packets:1 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:1000
           RX bytes:0 (0.0 B)  TX bytes:46 (46.0 B)
           Base address:0x2000

ppp1       Link encap:Point-to-Point Protocol
           inet addr:93.122.148.36  P-t-P:10.64.64.65  Mask:255.255.255.255
           UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
           RX packets:673 errors:0 dropped:0 overruns:0 frame:0
           TX packets:562 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:3
           RX bytes:489621 (478.1 KiB)  TX bytes:78692 (76.8 KiB)

wan        Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
           inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:50840 errors:13 dropped:0 overruns:0 frame:0
           TX packets:49 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:1000
           RX bytes:3121857 (2.9 MiB)  TX bytes:13690 (13.3 KiB)
           Base address:0x3000

wlan0      Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:0 errors:0 dropped:0 overruns:0 frame:0
           TX packets:147 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:1000
           RX bytes:0 (0.0 B)  TX bytes:16962 (16.5 KiB)
```

5.3 WAN

Here are the pages for configuring the WAN (remote network) side of the Bytton LTE router



WAN Configuration Pages

Configuration sections:

Settings	Select the desired WAN connection type, setup masquerading, etc.
ETH	Configure the IP settings for the WAN Ethernet port
PPPoE	Configure the IP settings for a PPP over Ethernet connection
PPP	PPP settings for the internal data terminal

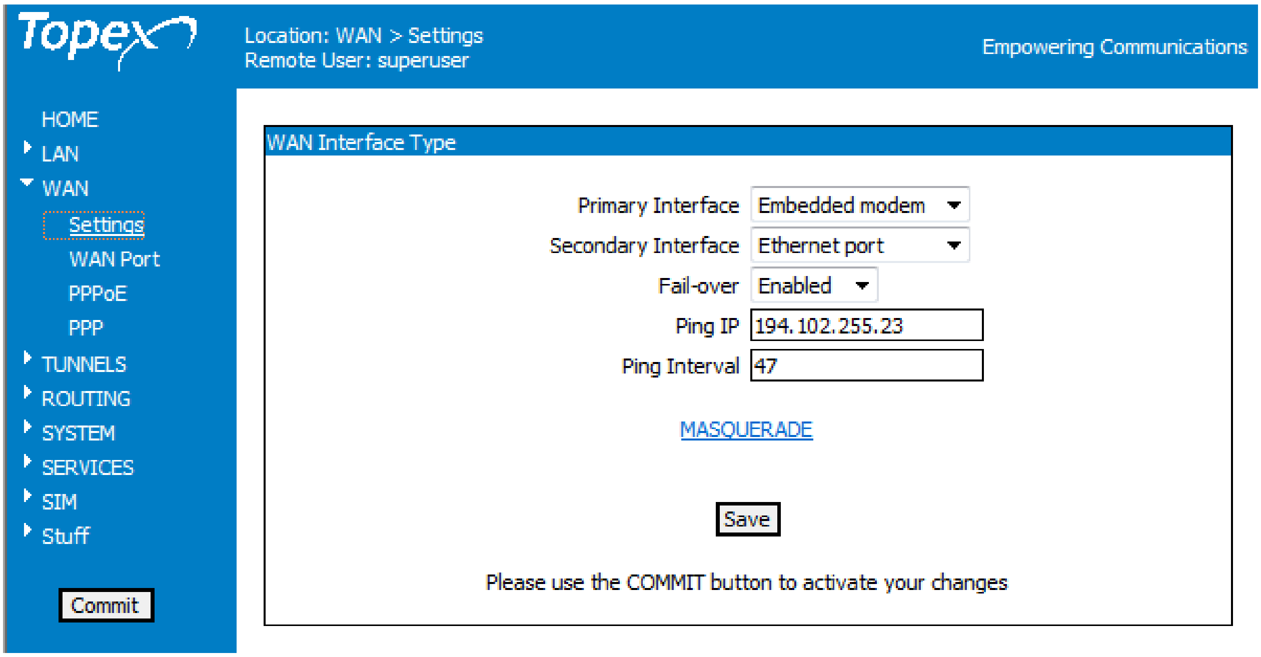
When you are done, please use the COMMIT button to activate your settings

Figure 5-58: The WAN webpage.

This WAN Home-page briefly describes your options in setting the WAN connection.

5.3.1. Settings

Allow you to select the type of the interface you use for WAN connection, the usage of fail-over and of masquerading:



WAN Interface Type

Primary Interface: Embedded modem

Secondary Interface: Ethernet port

Fail-over: Enabled

Ping IP: 194.102.255.23

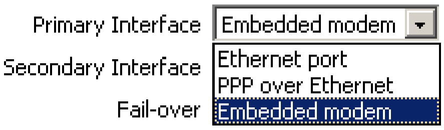
Ping Interval: 47

Please use the COMMIT button to activate your changes

Figure 5-59: Webpage for setting WAN Interface type and Failover.

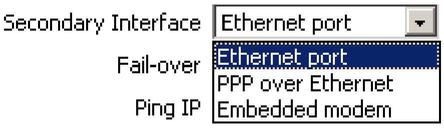
Primary Interface: You can select either:

11. Embedded modem (PPP link)
12. PPP over Ethernet (PPPoE)
13. Ethernet Port

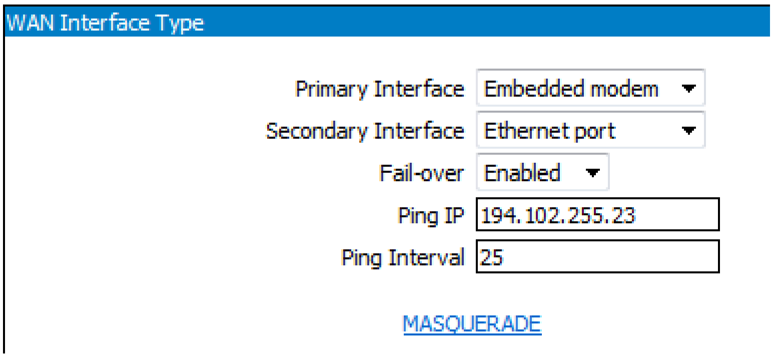

Primary Interface: Embedded modem
Secondary Interface
Fail-over

Secondary Interface: You can select either:

14. Embedded modem (PPP link)
15. PPP over Ethernet (PPPoE)
16. Ethernet Port


Secondary Interface: Ethernet port
Fail-over
Ping IP

As you can see, there are **two** options for interfaces, primary and secondary.
If the "Fail over" feature is enabled, when the primary WAN interface is no longer available, the Bytton LTE equipment automatically switches to the secondary interface.


WAN Interface Type

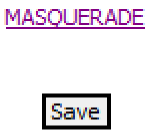
Primary Interface: Embedded modem
Secondary Interface: Ethernet port
Fail-over: Enabled
Ping IP: 194.102.255.23
Ping Interval: 25

Fail-over: When Enabled, the equipment will automatically switch from the primary WAN interface to the secondary interface, in case the main connection is broken . By default it is disabled.

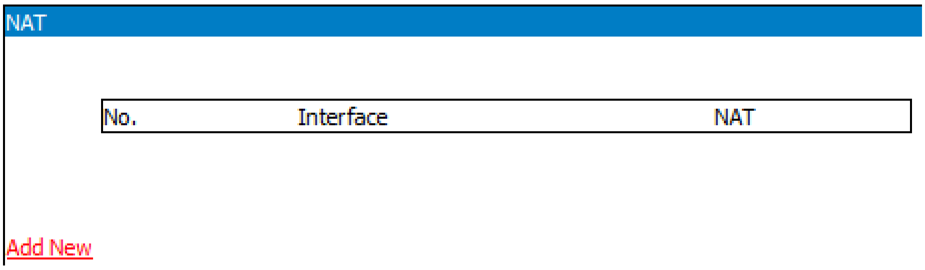
Ping IP: an external address that will be periodically pinged. If it does not answer, Rohde & Schwarz Topex S.A. Bytton will decide whether the primary interface for the Internet is unavailable and it will switch to the secondary interface.

Ping Interval: the time period for pinging the respective address, for example ten or 25 seconds in the above example.
If the interval is too small, even a momentary interruption will cause the unneeded switching from the primary WAN interface to the alternate one.
But if the period is too long, for some time there will be no Internet connection available (the primary WAN interface has failed but the secondary one has not yet been put in use).

Masquerade:
Enable or Disable masquerading.
Click the link located at the bottom, above the "Save" button, to go to the secondary page with settings for NAT (masquerade).

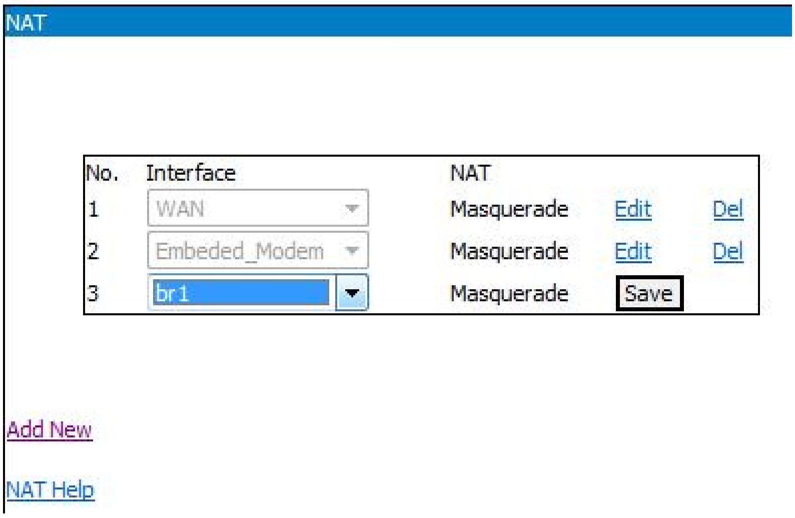


The NAT table is by default empty or contains just the most used outgoing interfaces, WAN and PPP, so in the beginning you should use Add New if you need new entries:


NAT

No.	Interface	NAT

You can define as many Masquerading rules as you need:



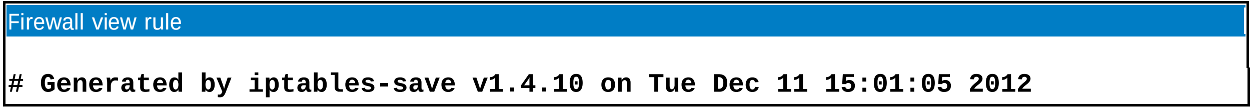
NAT

No.	Interface	NAT		
1	WAN	Masquerade	Edit	Del
2	Embeded_Modem	Masquerade	Edit	Del
3	br1	Masquerade	Save	

Add New

NAT Help

After applying a Commit, you can see the new masquerading rules as active in the automated Firewall of Bytton LTE:



Firewall view rule

```
# Generated by iptables-save v1.4.10 on Tue Dec 11 15:01:05 2012
*nat
:PREROUTING ACCEPT [973:87799]
:OUTPUT ACCEPT [226:13596]
:POSTROUTING ACCEPT [168:10080]
-A POSTROUTING -o ppp3 -j MASQUERADE
-A POSTROUTING -o ppp3 -j MASQUERADE
-A POSTROUTING -o wan -j MASQUERADE
-A POSTROUTING -o ppp1 -j MASQUERADE
COMMIT
# Completed on Tue Dec 11 15:01:05 2012
```

Note: *Although masquerading may be applied for **all interfaces** of the Bytton LTE device, it makes sense only for remote networks, this is why the "NAT" sub-page was places inside the WAN menu.*

NAT –what and why?

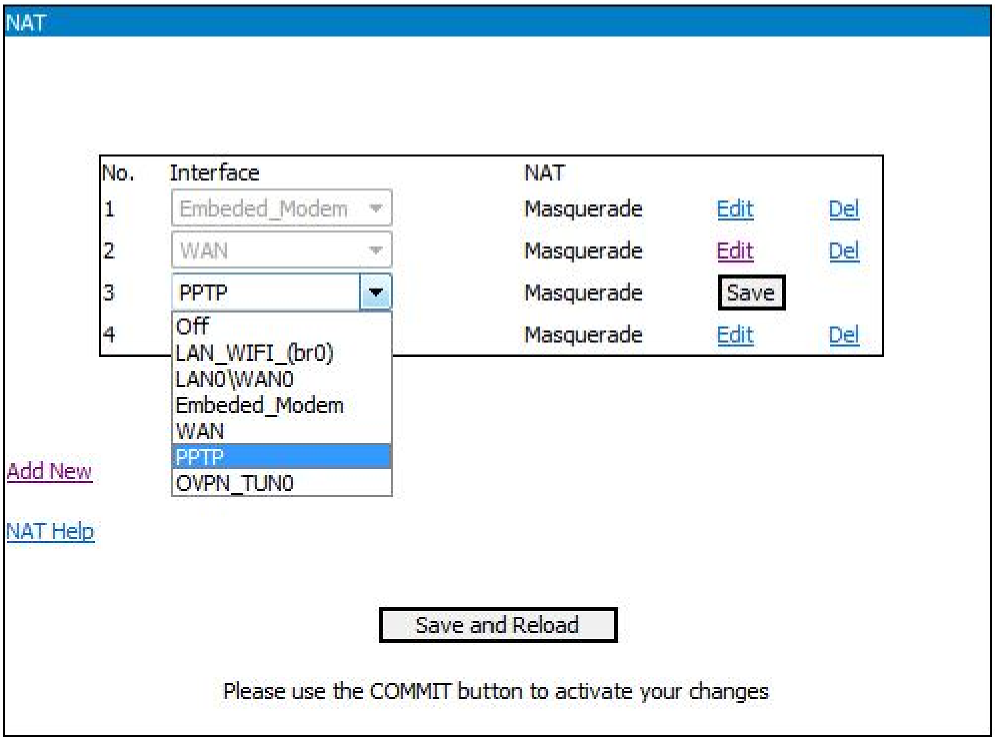
It performs IP Masquerading or NAT (translation of source and destination IP addresses and port numbers upon data packets).

Network Address Translation basically allows a single device, such as the Bytton LTE router, to act as agent between the a public network (such as the Internet) and one or several local (or private) networks. This means that for the representation of the entire group of local machines to anything outside their network just a single unique IP address is required!

Besides this "address range compression" feature, NAT is also used for Security and Administration. Implementation of dynamic NAT automatically creates a firewall between your internal network and outside networks or the Internet.

Dynamic NAT allows only connections that originate inside the stub domain. Another l benefit of NAT is simpler network administration. Changes to the internal networks may be performed easily since the only external IP address either belongs to the router or comes from a pool of global addresses. And in case of changing the host for various services, it is enough to change the inbound mapping with the new inside local address at the router to reflect the new host.

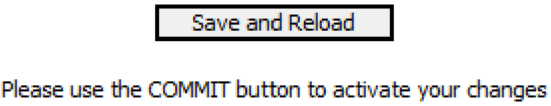
When the Internet provider that you connect to performs the masquerading at its location, you do not need to do NAT anymore, you should leave this option Disabled.
This is why the NAT table of Bytton LTE does allow **selective** masquerading, you can select to enable or not NAT for each of the interfaces:



No.	Interface	NAT		
1	Embeded_Modem	Masquerade	Edit	Del
2	WAN	Masquerade	Edit	Del
3	PPTP	Masquerade	Save	
4		Masquerade	Edit	Del

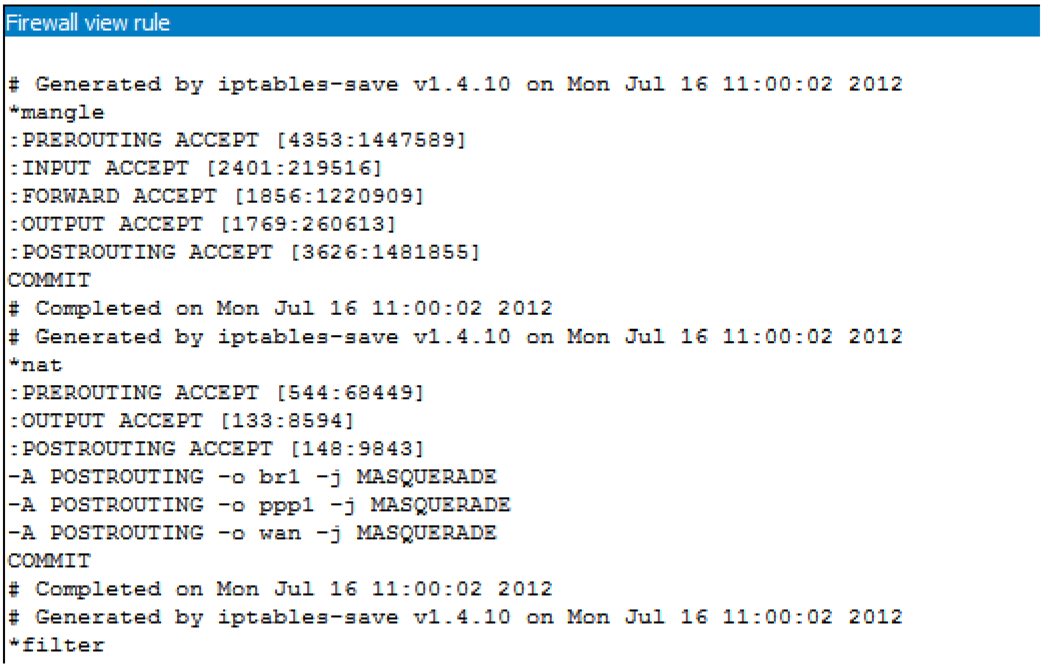
Please use the COMMIT button to activate your changes

Save each individual entry, then use the button “Save and Reload”



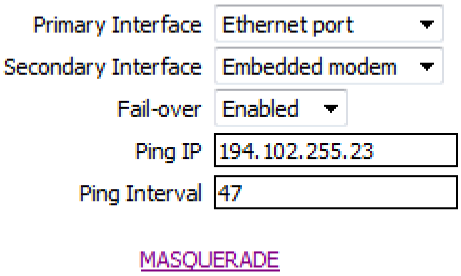
Please use the COMMIT button to activate your changes

The Firewall of Bytton LTE will automatically generate the corresponding NAT rules, in the example below, for enabling masquerading over **ppp1** and respectively **wan** interfaces:



```
# Generated by iptables-save v1.4.10 on Mon Jul 16 11:00:02 2012
*mangle
:PREROUTING ACCEPT [4353:1447589]
:INPUT ACCEPT [2401:219516]
:FORWARD ACCEPT [1856:1220909]
:OUTPUT ACCEPT [1769:260613]
:POSTROUTING ACCEPT [3626:1481855]
COMMIT
# Completed on Mon Jul 16 11:00:02 2012
# Generated by iptables-save v1.4.10 on Mon Jul 16 11:00:02 2012
*nat
:PREROUTING ACCEPT [544:68449]
:OUTPUT ACCEPT [133:8594]
:POSTROUTING ACCEPT [148:9843]
-A POSTROUTING -o br1 -j MASQUERADE
-A POSTROUTING -o ppp1 -j MASQUERADE
-A POSTROUTING -o wan -j MASQUERADE
COMMIT
# Completed on Mon Jul 16 11:00:02 2012
# Generated by iptables-save v1.4.10 on Mon Jul 16 11:00:02 2012
*filter
```

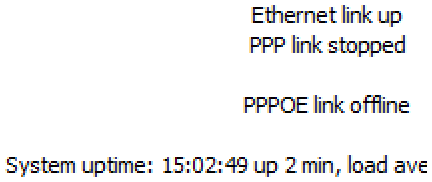
*Examples of **Failover** action:*
In your office you have a local network with cable or ADSL as WAN connection, which uses Bytton LTE as a backup link. You should set the Primary Interface to “Ethernet port” and the secondary one to the embedded mobile modem:


Primary Interface: Ethernet port
Secondary Interface: Embedded modem
Fail-over: Enabled
Ping IP: 194.102.255.23
Ping Interval: 47

MASQUERADE

Figure 5-60: Example of setting up primary and secondary WAN Interfaces, using Failover.

In normal operation all computers in your local network will reach the Internet via ETH port, so the Ethernet link is up and the PPP link (GPRS/EDGE or UMTS/HSPA modem) is disconnected:


Ethernet link up
PPP link stopped

PPPOE link offline

System uptime: 15:02:49 up 2 min, load ave

The routing is done via 192.168.1.8 gateway in the Ethernet WAN network using the interface “wan”:

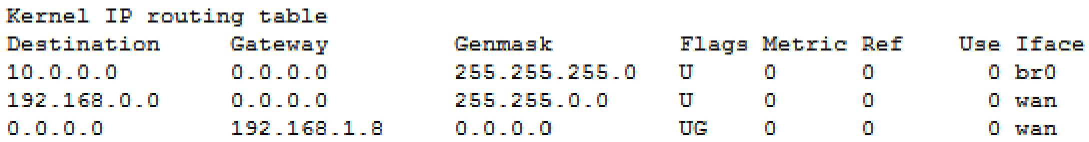
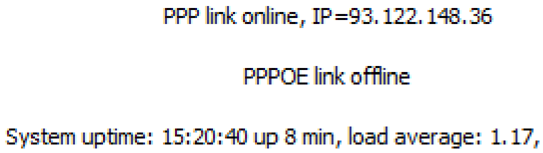

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

Figure 5-61: Output route via cabled Ethernet connection **wan**.

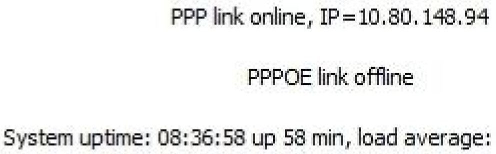
When the Ethernet link is broken, the PPP link goes up (online) automatically:


PPP link online, IP=93.122.148.36

PPPOE link offline

System uptime: 15:20:40 up 8 min, load average: 1.17,

or:


PPP link online, IP=10.80.148.94

PPPOE link offline

System uptime: 08:36:58 up 58 min, load average:

and the access to Internet is performed through the HSPA modem (the “ppp1” interface) via generic 10.64.64.65 gateway.

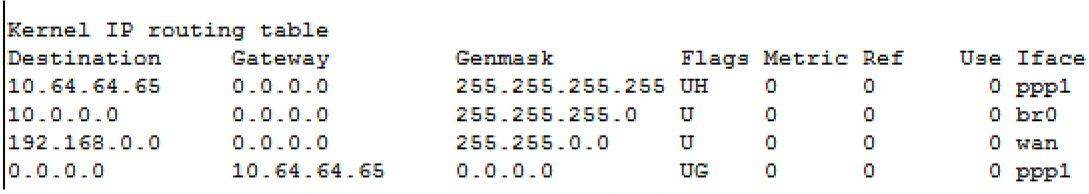

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

Figure 5-62: Output route via wireless connection **ppp1**.

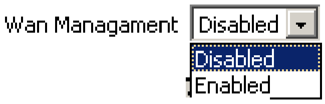
The Traceroute utility shows mobile connection to MobileCarrierB provider:

```
traceroute to topex.ro (193.226.61.45), 30 hops max, 38 byte packets
 1   * * *
 2   172.20.175.201 (172.20.175.201)  516.496 ms  211.253 ms  259.951 ms
 3   172.20.182.46 (172.20.182.46)  227.587 ms  250.843 ms  239.680 ms
 4   MobileCarrierB.RoNIX.Ro (217.156.113.33)  239.418 ms  206.806 ms  220.147 ms
 5   EuroWEB.RoNIX.Ro (217.156.113.6)  171.422 ms  211.237 ms  247.920 ms
 6   ewro-crli1.qrli2.buh.ew.ro (81.24.28.198)  179.884 ms  211.249 ms  179.924 ms
 7   ip4-81-24-28-213.euroweb.ro (81.24.28.213)  187.525 ms  199.069 ms  187.046 ms
 8   webhosting.euroweb.ro (193.226.61.45)  219.948 ms  179.375 ms  187.124 ms
```

5.3.2. WAN Management

Some firmware versions allow you to establish control over it, but the feature does exist in all Bytton equipments – *management of the machine via Web page from the remote, WAN side, as opposed to the local, LAN side.*

This control Enables of Disables the management of the Bytton LTE equipment over the WAN side. By default, the management from WAN is enabled (permitted).



Wan Managament Disabled

Disabled
Enabled

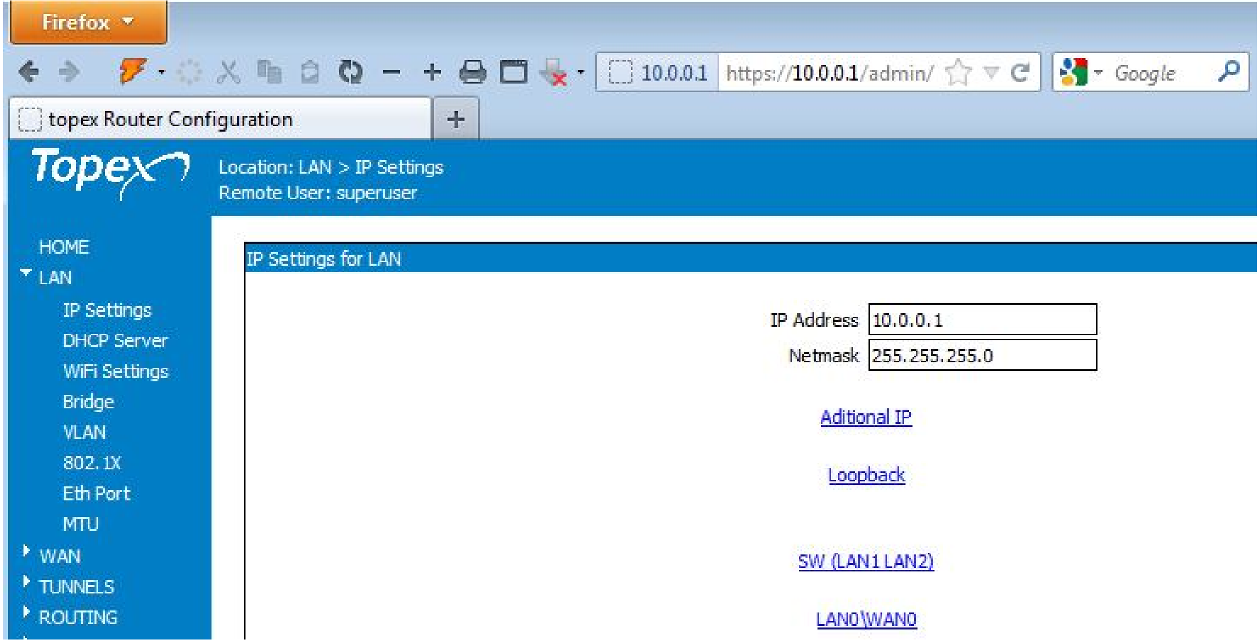
“Management” means the access to the Web configuration page of the equipment and of SSH from the WAN side. By default, it is **Enabled**, which means the you can access the web pages of Bytton not only form the local network, but also from the remote (WAN) side.

When you set it to Disabled instead, the configurations pages of Bytton LTE and SSH will be closed (no longer accessible) from the WAN side. In this case you will be able to access the Web configuration page of Bytton only form the BR0 (Ethernet and WiFi) side.

Note: *Here “WAN” refers to **all distant (as opposed to local) networks**, be they Ethernet connections, PPP link over the 3G+ mobile module, PPP over Ethernet, IPSEC or GRE secure tunnels for VPN, etc.*

The current firmware version (topex-3.0.1-FA-S) does **not** have this control, which means that Web management via WAN is <u>always enabled</u>!

As you can see in the following examples, the Web interface for configuring Bytton LTE is accessible both on the local side (addresses in range 10.0.0.xxx):

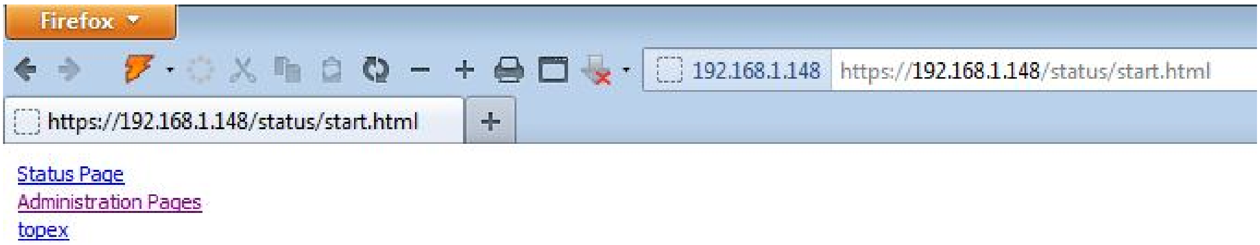


Location: LAN > IP Settings
Remote User: superuser

IP Settings for LAN

IP Address 10.0.0.1
Netmask 255.255.255.0

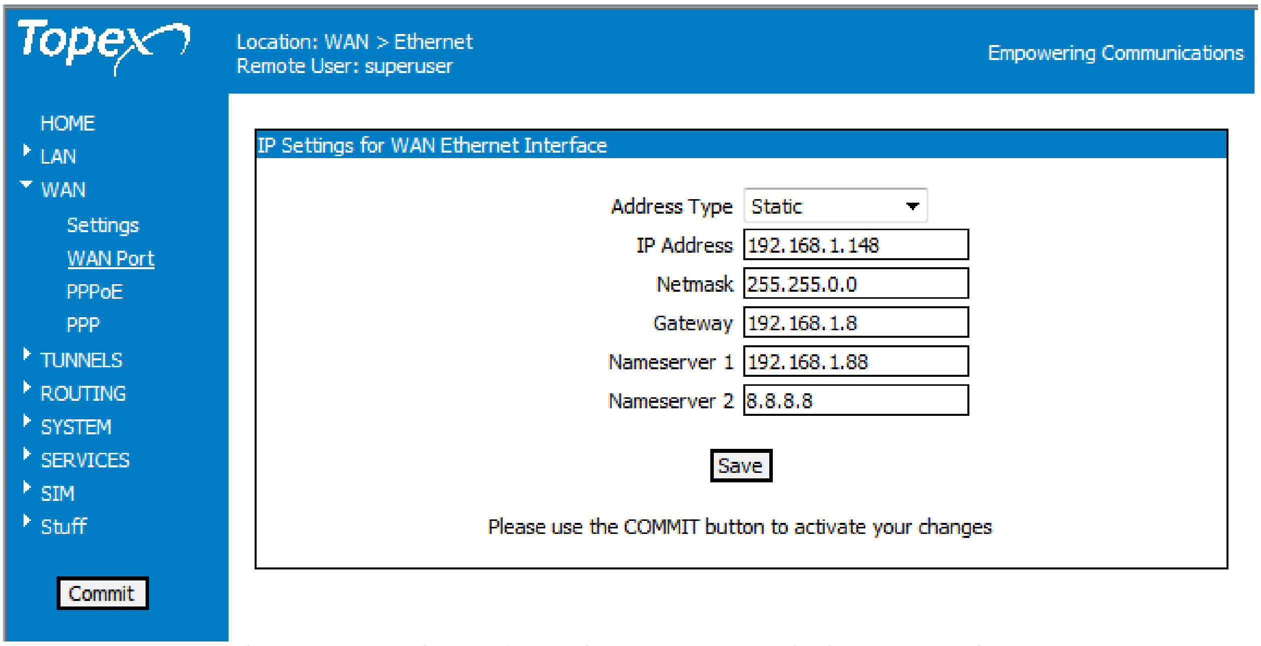
And also on the WAN side (addresses in class 192.168.1.yyy):



Firefox
192.168.1.148
https://192.168.1.148/status/start.html
https://192.168.1.148/status/start.html
Status Page
Administration Pages
topex

5.3.3. WAN Port

Whenever you use an Ethernet interface for WAN connection, you must fill in the settings “IP Settings for the WAN Ethernet Interface”.



IP Settings for WAN Ethernet Interface

Address Type: Static
IP Address: 192.168.1.148
Netmask: 255.255.0.0
Gateway: 192.168.1.8
Nameserver 1: 192.168.1.88
Nameserver 2: 8.8.8.8

Please use the COMMIT button to activate your changes

Figure 5-63: Webpage for setting up WAN Port in the WAN settings.

Address Type: options are Static or DHCP Assigned.

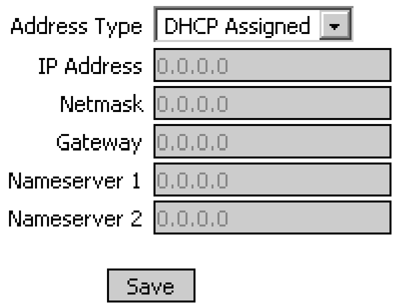
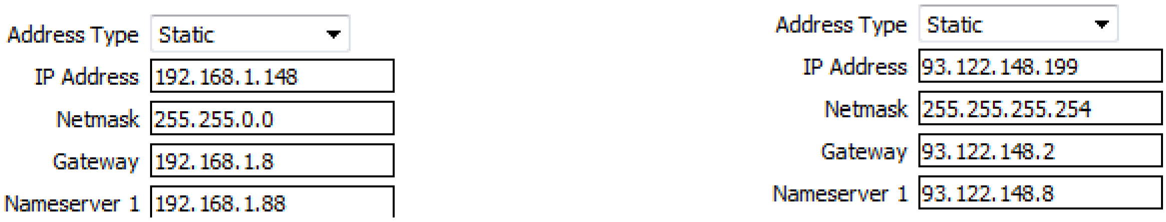
.Default is “**DHCP Assigned**”, which means that the IP address of the WAN Ethernet Interface will be automatically assigned by a DHCP server. Note that in this case the fields following this option are inactive, as shown below. They are colored in gray, because you **cannot** write values into them.	 Address Type: DHCP Assigned IP Address: 0.0.0.0 Netmask: 0.0.0.0 Gateway: 0.0.0.0 Nameserver 1: 0.0.0.0 Nameserver 2: 0.0.0.0

Figure 5-64: Selection of address type (Automatic) for WAN Port in the page for WAN.

See the corresponding Routing Table for Automatic WAN (the ppp1 link has been stopped)

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
172.27.0.0      0.0.0.0         255.255.0.0     U     0      0        0 lan0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
```

When you select ”Static” instead of DHCP, then you must also fill in the: **IP Address** value on the WAN side, **Netmask** for this address , and address of the **Gateway** used for routing.
You must also specify the name servers.



Address Type Static
IP Address 192.168.1.148
Netmask 255.255.0.0
Gateway 192.168.1.8
Nameserver 1 192.168.1.88

Address Type Static
IP Address 93.122.148.199
Netmask 255.255.255.254
Gateway 93.122.148.2
Nameserver 1 93.122.148.8

Figure 5-65: Examples of setting Static address for WAN Eth interface in the WAN pages.

Corresponding routing table for **Static** WAN address of 192.168.1.148 with 192.168.1.8 gateway:

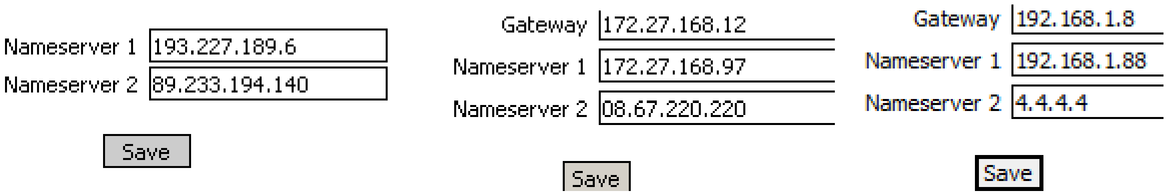
```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
172.27.0.0      0.0.0.0         255.255.0.0     U     0      0        0 lan0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

Name servers

When you use a static IP address for connection on the Wan side, you must also complete the fields for the name servers to be used.

The field nameserver1 is for the primary server and the nameserver 2 field for the optionally secondary (alternate) name server.

These name servers may be on the local network or on the Internet, as illustrated in the examples below:



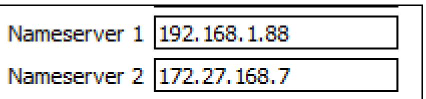
Nameserver 1 193.227.189.6
Nameserver 2 89.233.194.140

Gateway 172.27.168.12
Nameserver 1 172.27.168.97
Nameserver 2 08.67.220.220

Gateway 192.168.1.8
Nameserver 1 192.168.1.88
Nameserver 2 4.4.4.4

Figure 5-66: Setting the name servers for static IP on the ETH Interface for WAN.

Example:

When you set up these two nameservers to be used with the WAN port, as shown:	 Nameserver 1 192.168.1.88 Nameserver 2 172.27.168.7

The System Log will show accordingly how they are used when Bytton achieves a connection through the WAN port:

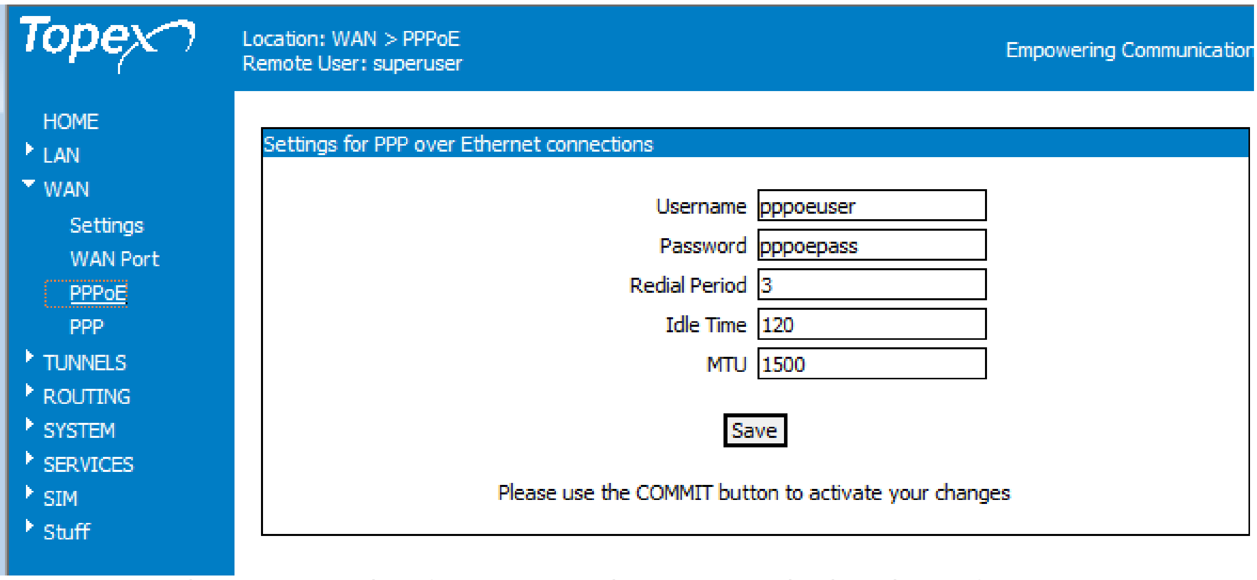
```
Jul  4 10:20:36 bytton daemon.info dnsmasq[1201]: reading /etc/resolv.conf
Jul  4 10:20:36 bytton daemon.info dnsmasq[1201]: using nameserver 172.27.168.7#53
Jul  4 10:20:36 bytton daemon.info dnsmasq[1201]: using nameserver 192.168.1.88#53
Jul  4 10:20:36 bytton daemon.info dnsmasq[1201]: DHCPREQUEST(br0) 10.0.0.13
00:06:4f:02:15:82
Jul  4 10:20:36 bytton daemon.info dnsmasq[1201]: DHCPACK(br0) 10.0.0.13
00:06:4f:02:15:82 VO000073
```

5.3.4. PPPoE

Settings for the connection used Point-to Point Protocol over the Ethernet.

PPPoE is a protocol for encapsulating the PPP link over Ethernet, thus providing the benefits of PPP, such as security (encryption) and control of connection (data rate) over an 802.3 network.

It is used for broadband Internet connections, such as DSL or ADSL, thus it is useful when the WAN connection of Bytton LTE is achieved by a cable or ADSL modem instead of the HSDPA network.



Location: WAN > PPPoE
Remote User: superuser

Settings for PPP over Ethernet connections

Username: pppoeuser
Password: pppoepass
Redial Period: 3
Idle Time: 120
MTU: 1500

Please use the COMMIT button to activate your changes

Figure 5-67: Settings for PPP over Ethernet connection in webpage for WAN.

Settings are the same as for “normal” PPP, except that the modem-related parameters and command strings are missing here.

Username: The user name used for log-in to the Internet account supplied by your ISP. Ask your Internet provider for details! Some Internet providers need the complete account name together with the hosting domain, the same as for an e-mail address: name@domain.eu, while other ISPs require that you type here just the name of your account.
Password: The password used for authenticating to your Internet account.
Redial Period: time in seconds until redialing a connection, if it was broken, such as 5 seconds.

Idle Time: Bytton LTE can disable the connection when there is no more data traffic. If no data packet is sent through the interface for a specified period of time, the Internet connection will be broken. This is useful in case of connections where you pay per connected time.
You can specify this time interval, in seconds.

When the interval is too short, even a momentary lack of activity (no data traffic) will cause the Internet connection to be interrupted.
If you set the time interval to 0 (zero), the connection will remain always on, even if there is no data traffic on the remote interface.
This feature is especially important for connections where you are charged for the total connection time, no matter the data traffic: to avoid unnecessary expenses, you should set BYTTON to disconnect when there is no data traffic.

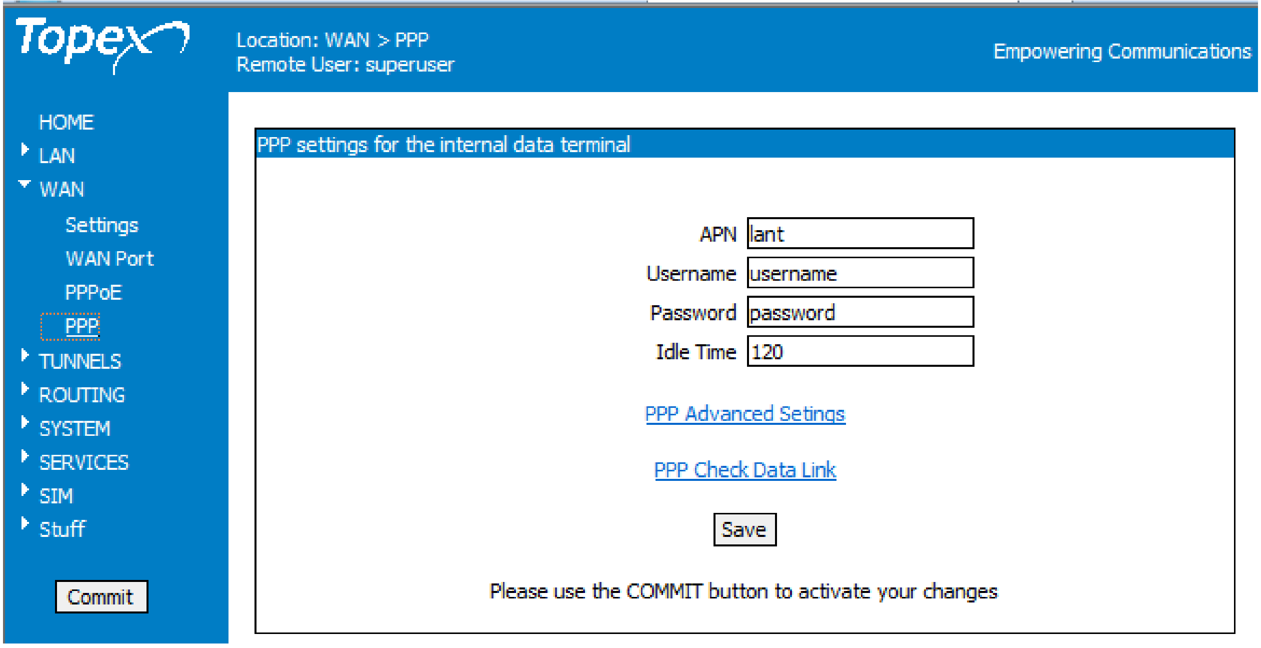
MTU: value for the Maximum Transmission Unit. MTU is the largest physical packet size, measured in bytes, which a network can transmit. Messages larger than this will be fragmented into several packets.
Different networks have different values for MTU, which is set by the network administrator.

It is important to set the optimal MTU value, if it is incorrectly set the data transfers will be slow.
The default MTU size is 576 for many PPP connections, 1024 for a modem connection, 1500 for Ethernet networks, etc. The same applies for MRU (maximum **receive** unit).

At the data level, the equivalent of MTU is MSS (see further on in the manual), so you should also set this parameter accordingly.

5.3.5. PPP

Settings for the PPP connections achieved via embedded radio modem.
To ensure high versatility together with ease of use, this page has just settings for the APN, username and password, while several specialized configurations, which are less often used - for modem, for connection and for routing - are located on the "PPP Advanced Settings" page (the first link at the bottom) :



PPP settings for the internal data terminal

APN: lant
Username: username
Password: password
Idle Time: 120

Please use the COMMIT button to activate your changes

Figure 5-68: Settings for PPP link for the embedded radio modem of Bytton ICR.

Note: *The single-Sim variant has, of course, a single entry for APN and a single username/password pair, but in case of Dual-SIM versions, there will be two, one for each SIM, so you will see, as detailed below, "APN Sim0" and respectively "APN Sim1", "Username Sim0" and so on.*

APN Sim0: Access Point Name, the name of an access point for the first mobile data network (GSM/GPRS/EDGE or UMTS/HSPA). The settings here must match with the instructions of your mobile service provider. Some mobile Internet carriers rely on authentication via SIM card (Caller ID, IMSI) and thus allow a blank user name and password while other mobile service providers require additional user name and password for authentication.

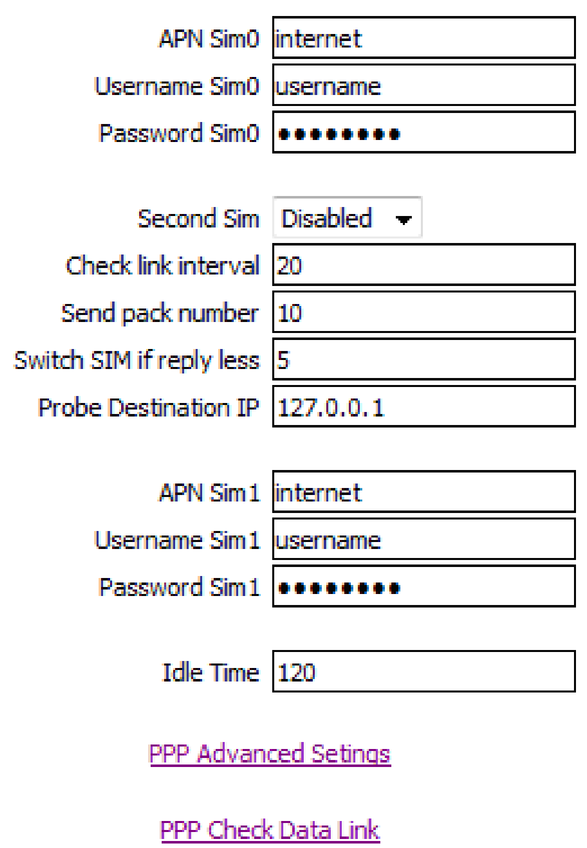
Username Sim0: The user name used for log-in to the first 3G (UMTS or HSPA) wireless network, such as "internet" or "mobileoperator"
Password Sim0: The password used for authentication for the respective carrier. You should ask your provider for these settings. Some network operators do not need username and password; log-in is allowed or not based upon Caller ID or other equipment-specific identification feature.

Examples:
The current SIM card works with APN "lant".
The carrier MobileCarrierB may have as APN internet, with the user "guest" and pass also "guest", while Vodafone provider has as APN of "internet.vodafone.ro" with user name "internet.vodafone" and password "vodafone".

---**Dual SIM operation**---

For the dual-SIM variant of the equipment, as shown in the illustration to the left, there are:

- **two** identical groups of settings, corresponding to the two SIM card, labeled Sim0 and respectively Sim1,
- and also parameters related to the switching form one mobile data carrier to another provider (the “Second Sim” group):



APN Sim0: internet
Username Sim0: username
Password Sim0: ●●●●●●●●●

Second Sim: Disabled
Check link interval: 20
Send pack number: 10
Switch SIM if reply less: 5
Probe Destination IP: 127.0.0.1

APN Sim1: internet
Username Sim1: username
Password Sim1: ●●●●●●●●●

Idle Time: 120

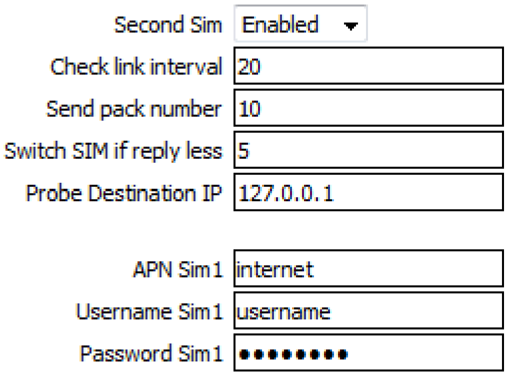
PPP Advanced Setings

PPP Check Data Link

Figure 5-69a: Settings for PPP link in case of Dual-SIM Bytton equipment.

For single-SIM equipments, or for dual-SIM devices where only one SIM is used, the settings explained previously are enough.

Second Sim: Disabled



Second Sim: Enabled
Check link interval: 20
Send pack number: 10
Switch SIM if reply less: 5
Probe Destination IP: 127.0.0.1

APN Sim1: internet
Username Sim1: username
Password Sim1: ●●●●●●●●●

But when you have two SIM cards, and want to use both, you must **Enable** the usage of the second SIM, then you must also fill in the conditions for switching (how Bytton decides that the link is broken) and the above SIM parameters for the second subscriber card, “Sim1”. The values are different, since the second SIM is used precisely for connecting to a different wireless data network.

Second SIM: In case of **dual-SIM** equipments, it Enables or disable usage of the second SIM cad as backup for the data connection. The default is **Disabled.**

Figure 5-69b: Settings for the second SIM of the PPP wireless link, in case of dual-SIM Bytton LTE device.

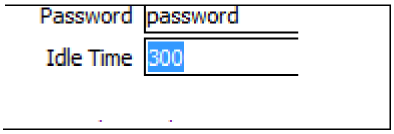
Parameters for switching between SIM cards

Check link interval: time interval that Bytton expects reply for the IP destination of the probe (the delay between successive pings, in second)s. Suggested value is about 20 (default).

Send pack number: number of data packets sent as probe to verify the link. Default is 10.

Switch SIM if reply less than: minimum number for probe packets that must be answered. With the above settings, when Bytton LTE pings the destination of the probe and receives only four replies or less, it will decide that the current PPP link is unavailable, so it will switch to the second SIM card.

Probe Destination IP: the IP address of the destination of the probe. Bytton sends out PING probes to the address you have specified in this field, and if it receives no answer from it, BYTTON concludes that the primary data connection is broken and it must switch to the secondary, Sim1.



Password password

Idle Time 300

Idle Time: Bytton LTE can disable the dial-up connection when there is no more data traffic. If no data packet is sent through the mobile data link, the Internet connection will be broken. You can specify this time interval, in seconds.
If you set the time interval to 0 (zero), the dial-up connection will remain always on, even if there is no data traffic on the remote interface. When it detects outgoing data traffic, Bytton LTE automatically performs dial-up, in order to connect to the Internet.

This feature is especially useful in case of mobile date networks where you must pay for the connection time, so the bill goes up while the PPP link is on, even if there is no data traffic over it!

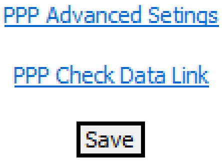
When you need to set or modify the detailed modem-related parameters, click the link “**PPP Advanced Settings**” located towards the bottom of the PPP settings page.

The second link, located right at the bottom of the PPP settings page is “PPP Check Data Link”, which establishes how the verification of the PPP data link works.

The sub-pages for these links are explained next:

5.3.6. PPP Advanced Settings

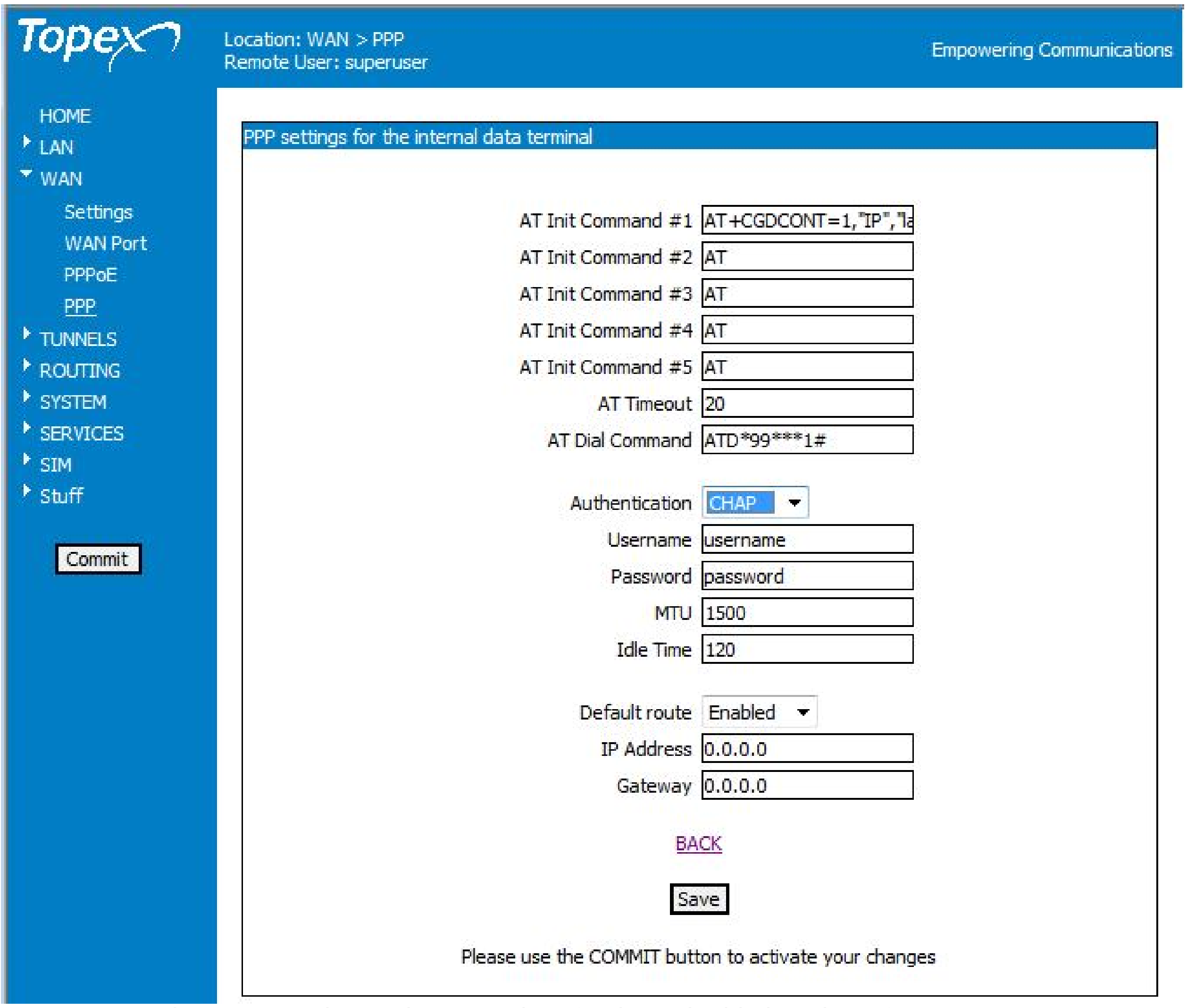
Click the link "PPP Advanced Settings" located at the bottom of the PPP web page.
This "advanced" section controls the parameters of the Point-to-Point Protocol for the internal data terminal, in this case the embedded GSM/HSPA+ or LTE modem.



PPP Advanced Setings

PPP Check Data Link

Save



PPP settings for the internal data terminal

AT Init Command #1: AT+CGDCONT=1,"IP","la
AT Init Command #2: AT
AT Init Command #3: AT
AT Init Command #4: AT
AT Init Command #5: AT
AT Timeout: 20
AT Dial Command: ATD*99***1#

Authentication: CHAP
Username: username
Password: password
MTU: 1500
Idle Time: 120

Default route: Enabled
IP Address: 0.0.0.0
Gateway: 0.0.0.0

BACK

Save

Please use the COMMIT button to activate your changes

Figure 5-70: Advanced PPP Settings for the embedded modem of Bytton LTE.

You need to change these *advanced settings* when you go to a region with different settings, if you use a different network operator or when you replace the embedded HSPA modem with another, external 3G modem that requires special parameters.

AT Commands:
Here you can enter commands to be sent to the modem that connects to the mobile carrier.

AT Init Command #1, 2, 3:
Enter the character strings for the AT commands used to initialize the modem, such as:

AT+CGDCONT=1,"IP","lant".

Depending on the specifications of the mobile module and of your 3G provider, you may need only one AT command or several.

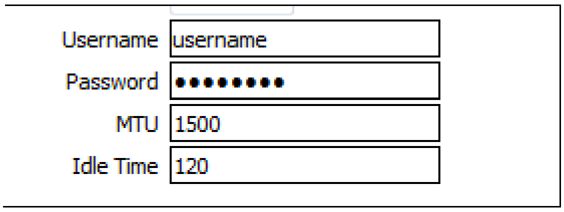
There are five “AT Init Command” fields, if there is no need to use all of them, fill the remaining with “AT”. You should **not** leave empty fields in this section!

AT Dial Command: Dial String, the AT command used to dial to the ISP, which includes the mobile phone number to be dialed.

The AT command for dialing is ATD, and the telephone number for most mobile data operators is a short one, such as *99# or *99#***1. This is a formal number, the command tells the modem to dial the data carrier. When using up-to-date modems, this phone number is no longer required, the intelligent modem already “knows” which number to dial for the data connection.

Connection settings

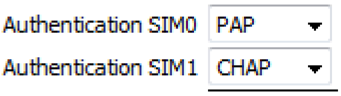
Here you may set up the parameters for the PPP connection to the mobile Internet provider.



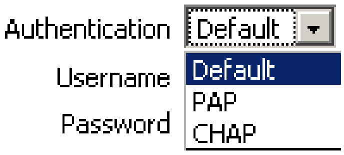
Username username
Password ••••••••
MTU 1500
Idle Time 120

Figure 5-71: PPP Advanced settings –parameters for the wireless Data Link.

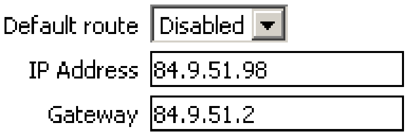
Authentication – allows you to select the method of authentication - since the two SIM cards may be for different carriers, you can select authentication method separately for SIM0 and SIM1.
.



Authentication SIM0 PAP
Authentication SIM1 CHAP

 Authentication Default Username Password 	Default means it will authenticate upon request from the server, it accepts both PAP and CHAP, while **PAP** means it will force accepting only PAP (password authentication), refusing CHAP, and respectively **CHAP** means it will accept only CHAP (challenge authentication) and refuse PAP

PAP, Password Authentication Protocol, the most basic form of authentication, used by Basic Authentication feature built into the HTTP protocol. Here your users name and password are transmitted over a network and compared to a table of name-password pairs (passwords stored in the table are typically encrypted). It is simple but does not ensure security.
CHAP, Challenge Handshake Authentication Protocol, is a more advanced method, type challenge/response. Here the authentication agent (typically a network server) sends to the client program a key to be used to encrypt the username and password. This enables the username and password to be transmitted in an encrypted form to protect them against eavesdroppers. The ID value is increased with each CHAP dialogue to protect against replay attacks, so CHAP provides a moderate degree of security.

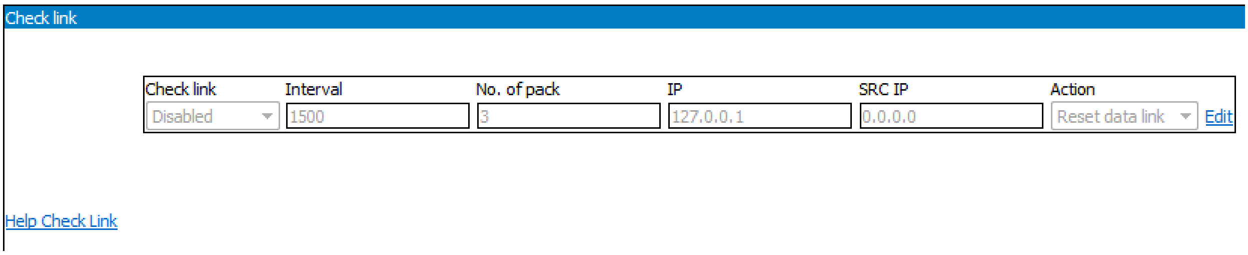
 Default route Disabled IP Address 84.9.51.98 Gateway 84.9.51.2	***Route:*** **Default route**: Disabled or Enabled. This is a new feature, allows you to ask the Internet provider for a static address. Usually, the ISP assigns you the first available address each time you connect.

Now you have the options either to accept the dynamic address assigned by DHCP or to ask for a specific static address. In this case should Disable the default route, and then you must fill the other parameters too the **IP Address**, and **Gateway.**
When you finish with the setting of advanced parameters, click on the link “BACK” located at the bottom to return to the WAN > PPP page.

PPP Check Data Link

Here you can set how the verification of the PPP data link will be performed.

By default, this feature is disabled – its fields are colored in gray, to show that you cannot edit them.

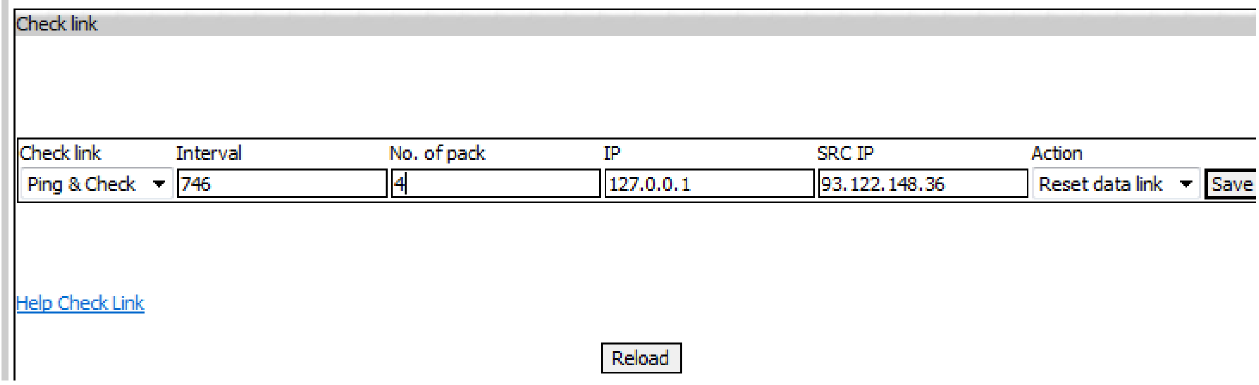


Check link

Check link	Interval	No. of pack	IP	SRC IP	Action
Disabled	1500	3	127.0.0.1	0.0.0.0	Reset data link Edit

Figure 5-72: PPP Check Data Link settings Bytton LTE.

First you must Enable it, then use **Edit** to perform changes of the way how Bytton LTE checks the data link and finally **Save.**



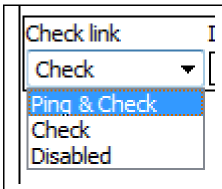
Check link

Check link	Interval	No. of pack	IP	SRC IP	Action
Ping & Check	746	4	127.0.0.1	93.122.148.36	Reset data link Save

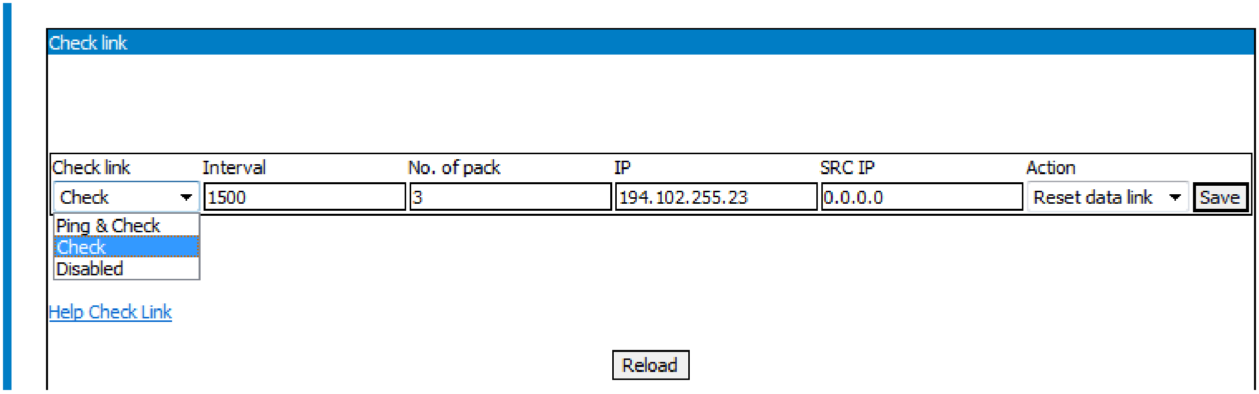
Figure 5-73: Enabling the "PPP Check Data Link" feature:

For verification of the link, the Bytton LTE equipment sends out a specified number of ping packets, at certain time interval, to a destination IP.

You can also specify the source (SRC) IP or the source outgoing interface.

 Check link Check Ping & Check Check Disabled	**Check link -** Enable or disable the verification of the link. If you enable this feature, it only will work for PPP > IDLE TIME "0" (as explained previous, when idle time is set to zero, the PPP connection will be always on, so there is no more need for verification). **Ping & Check** sends out PING (probing) packets and listens for reply to them, while the **Check** option only listens for verification packets form an active source.

Interval - Time interval, in seconds, to check the status of the data link, default is 1500.



Check link

Check link	Interval	No. of pack	IP	SRC IP	Action
Check	1500	3	194.102.255.23	0.0.0.0	Reset data link Save

Figure 5-74: Example of editing settings for "PPP Check Data Link" and explanation of parameters.

No. of pack - Number of ping packet to be send after time Interval, such as 3, 4 or 5 packets.

IP - remote IP address that Bytton will response at ping command. This must be a IP address that will either answer to the ping command issued by Bytton, or generate PING packets for Bytton LTE to listen to.

SRC IP – The source IP for PING packets. You can send ping with a “source IP”. This can be LAN, Loopback or Tunnel IP. If this IP is left with the default to 0.0.0.0 value, the Bytton equipment will ping with source IP of the outgoing interface.

Action - the last field defines the action to be taken when ping replay is not received.
By default it is disabled, but you can set the Bytton equipment to restart the PPP data connection when it detects a broken link.

In the System Log you can see this feature in operation, look for the messages which say “Link is Up” or respectively “ Link is Down”:

```
Jul 16 11:37:25 bytton user.info kernel: PHY: mdio@e0102120:05 - Link is Down
Jul 16 11:38:01 bytton cron.err crond[1865]: USER root pid 3289 cmd net_moni
Jul 16 11:38:18 bytton daemon.info dnsmasq[1244]: DHCPREQUEST(br0) 10.0.0.13
00:06:4f:02:15:82
Jul 16 11:38:18 bytton daemon.info dnsmasq[1244]: DHCPACK(br0) 10.0.0.13
00:06:4f:02:15:82 VO000073
Jul 16 11:38:34 bytton daemon.info hostapd: wlan0: STA 60:fb:42:39:48:86 IEEE
802.11: authenticated
Jul 16 11:39:01 bytton cron.err crond[1865]: USER root pid 3579 cmd net_moni
Jul 16 11:39:04 bytton user.info kernel: PHY: mdio@e0102120:05 - Link is Up -
100/Full
Jul 16 11:39:06 bytton daemon.info dnsmasq[1244]: DHCPINFORM(br0) 10.0.0.13
00:06:4f:02:15:82
Jul 16 11:39:06 bytton daemon.info dnsmasq[1244]: DHCPACK(br0) 10.0.0.13
00:06:4f:02:15:82 VO000073
Jul 16 11:39:53 bytton user.notice root: SAVE CONFIG DONE
Jul 16 11:39:58 bytton user.info kernel: PHY: mdio@e0102120:05 - Link is Down
Jul 16 11:40:01 bytton cron.err crond[1865]: USER root pid 3949 cmd net_moni
Jul 16 11:40:21 bytton user.info kernel: PHY: mdio@e0102120:05 - Link is Up -
100/Full
Jul 16 11:42:01 bytton cron.err crond[1865]: USER root pid 4604 cmd net_moni
```

```
Jul 16 12:11:39 bytton user.info kernel: PHY: mdio@e0102120:05 - Link is Down
Jul 16 12:11:52 bytton user.info kernel: PHY: mdio@e0102120:05 - Link is Up -
100/Full
Jul 16 12:14:47 bytton user.info kernel: PHY: mdio@e0102120:04 - Link is Up -
100/Full
Jul 16 12:14:47 bytton user.info kernel: br1: port 1(lan0) entering learning
state
Jul 16 12:14:51 bytton user.info kernel: PHY: mdio@e0102120:04 - Link is Down
Jul 16 12:14:51 bytton user.info kernel: br1: port 1(lan0) entering disabled
state
Jul 16 12:15:01 bytton cron.err crond[1864]: USER root pid 3709 cmd net_moni
Jul 16 12:15:38 bytton user.info kernel: PHY: mdio@e0102120:05 - Link is Up -
100/Full
```

Examples:

Check link	**Enabled**
Interval	**3600**
No. of pack	**3**
IP	**74.125.87.106**
SRC IP	**0.0.0.0 (default)**
Action	**Reset data link**

Figure 5-75: Example with values of settings for the “PPP Check Data Link” feature.

With the above settings, Bytton will send every hour (3600 seconds) a number of three ping packets to the remote IP address "74.125.87.106", with IP source the IP of the SIM connection.
When Bytton LTE does no longer receive a reply to the PING issued, it will restart (reset) the SIM data connection.

Warning!
The number of ping packets must not be excessively large, and the checking interval must not be too small, because this could generate a heavy traffic over the data link. See below calculations of the traffic load for different settings.

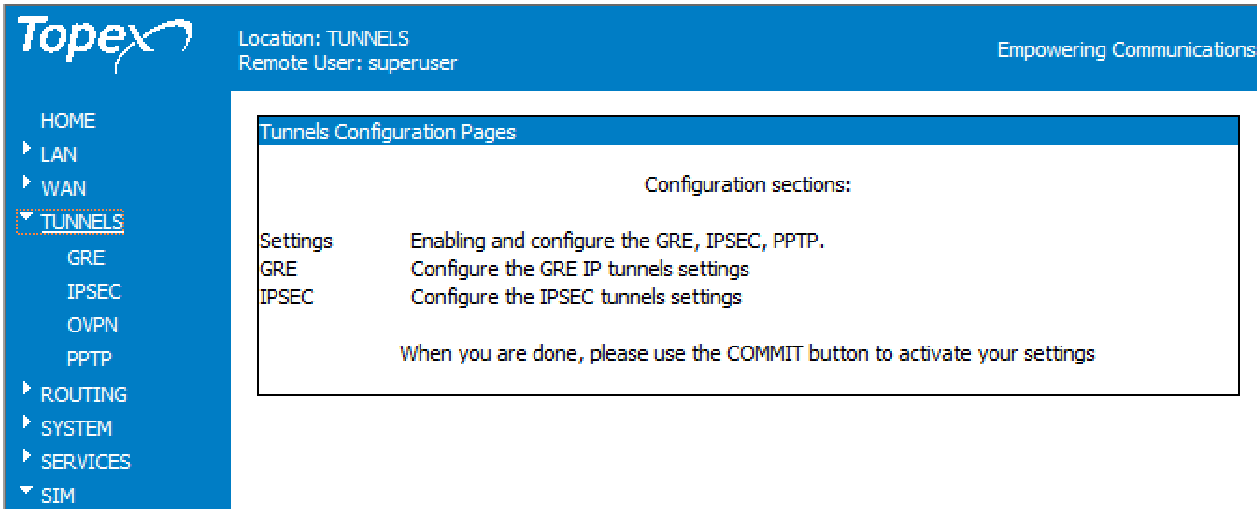
Traffic load calculation:

60 bytes for one ping packet * 3 packets = 180 bytes for one hour
180 * 24 = 4320 bytes for one day
4320 * 31 = 133920 bytes per months
133920 * 12 = 1607040 bytes per year

1607040 / 1024 = 1569.37 KB per year
1569.375 /1024 = 1.53 MB per year.

5.4. TUNNELS

Settings for the IP tunneling, which allow building of secure virtual private networks over public data networks.



Tunnels Configuration Pages

Configuration sections:

Settings Enabling and configure the GRE, IPSEC, PPTP.
GRE Configure the GRE IP tunnels settings
IPSEC Configure the IPSEC tunnels settings

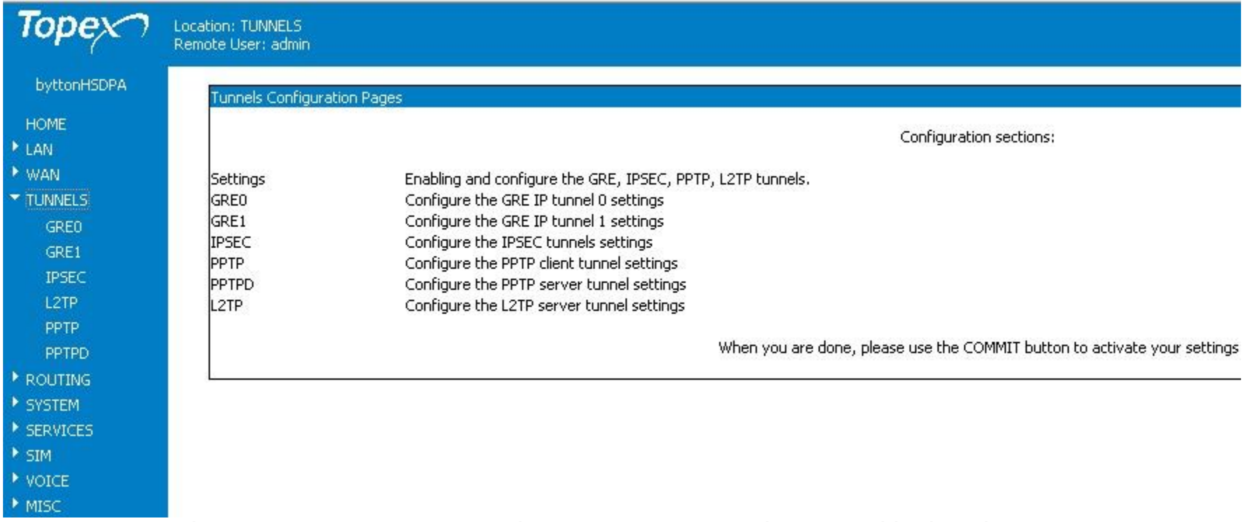
When you are done, please use the COMMIT button to activate your settings

Figure 5-76: Aspect of the "TUNNELS" web configuration page.

These "Tunnels Configuration Pages" has several sections, according to the type of tunnels you want to use: GRE, IPSEC, PPTP, Open VNP and so on.

Depending upon the actual firmware revision running on your Bytton LTE, the Tunnels web page may contain several types of tunnels, form three to six sub-pages.

For instance, besides GRE and IPSEC which are present in **all** software revisions, you may have also PPTP, PPTPD, OVPN and respectively L2TP, as shown below:



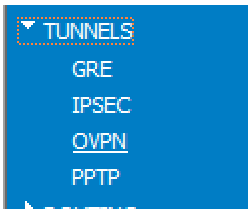
Tunnels Configuration Pages

Configuration sections:

Settings Enabling and configure the GRE, IPSEC, PPTP, L2TP tunnels.
GRE0 Configure the GRE IP tunnel 0 settings
GRE1 Configure the GRE IP tunnel 1 settings
IPSEC Configure the IPSEC tunnels settings
PPTP Configure the PPTP client tunnel settings
PPTPD Configure the PPTP server tunnel settings
L2TP Configure the L2TP server tunnel settings

When you are done, please use the COMMIT button to activate your settings

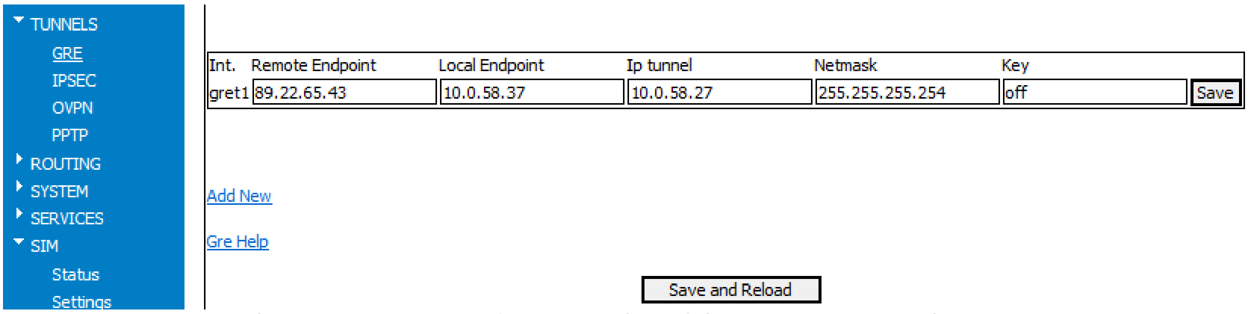
Figure 5-77: Example of maximal "TUNNELS" Web page, with six sub-pages.



The current version of Bytton LTE has available configuring pages for the GRE, IPSEC, Open VPN and respectively PPTP tunnels .

5.4.1 GRE

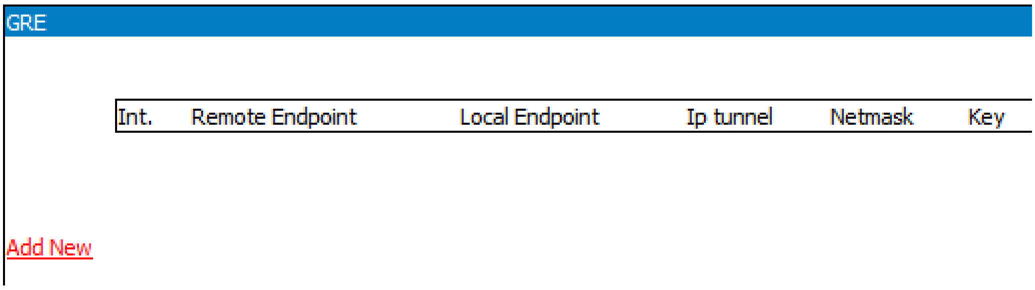
Settings for the GRE IP Tunnels, which is used when you need to perform IP tunneling in order to achieve a Virtual Private Network using several Bytton LTE devices interconnected over the 3G mobile communications network.



Int.	Remote Endpoint	Local Endpoint	Ip tunnel	Netmask	Key	
gret1	89.22.65.43	10.0.58.37	10.0.58.27	255.255.255.254	off	Save

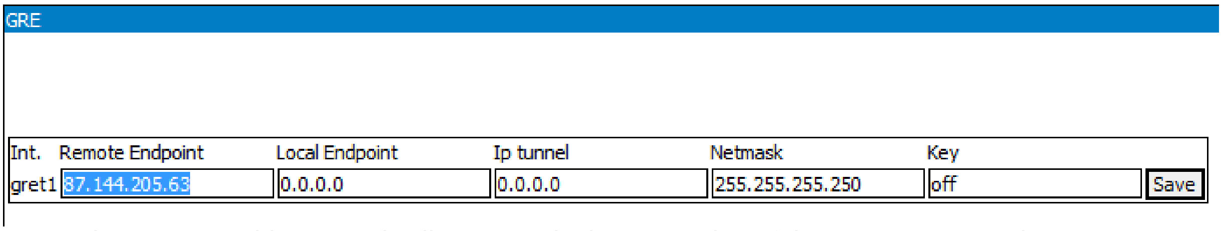
Figure 5-78: Aspect of GRE section of the “TUNNELS” Web page.

Setting GRE tunnels.
At fist, the table for GRE tunnels is empty.



Int.	Remote Endpoint	Local Endpoint	Ip tunnel	Netmask	Key

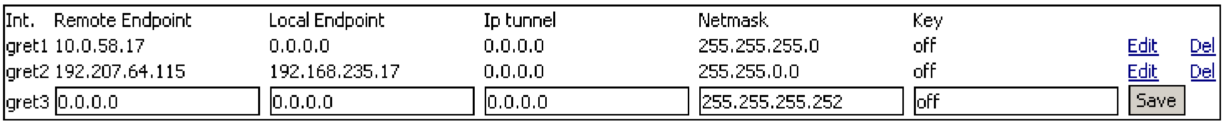
Use Add New to add new records into the table, then **Edit** to enter the required parameters:



Int.	Remote Endpoint	Local Endpoint	Ip tunnel	Netmask	Key	
gret1	87.144.205.63	0.0.0.0	0.0.0.0	255.255.255.250	off	Save

Figure 5-79: Add New and Edit an entry in the GRE table of the “TUNNELS” Web page.

Save each entry with the button to the right of the respective row:.



Int.	Remote Endpoint	Local Endpoint	Ip tunnel	Netmask	Key		
gret1	10.0.58.17	0.0.0.0	0.0.0.0	255.255.255.0	off	Edit	Del
gret2	192.207.64.115	192.168.235.17	0.0.0.0	255.255.0.0	off	Edit	Del
gret3	0.0.0.0	0.0.0.0	0.0.0.0	255.255.255.252	off	Save	

Figure 5-80: Saving a complete entry into the GRE table.

And finally use the “Save and Reload” button at the bottom of the screen.

Int. - it lists the name of the GRE tunnel interface that will be configured: gret1, 2, 3 and so on.
Remote Endpoint - IP of the Remote device that will host the distant endpoint of the GRE tunnel.

Local Endpoint - IP Local of the interface that will host local endpoint of the GRE tunnel. If this is set to 0.0.0.0, the IP of local interface that have route to Remote endpoint IP will be used.

IP tunnel - GRE tunnel is a point to point tunnel, thus each tunnel must have a IP. This is Local IP on the tunnel interface.

Netmask - Netmask for IP tunnel.

Key - a “Key” for the GRE tunnel. It is a 32 bit number (values from 0 to 4294967295).
This Key field is intended to be used for identifying an individual traffic flow within a tunnel.
Note that this Key field **is not involved in any sort of sec**urity (despite its name.)

Examples:

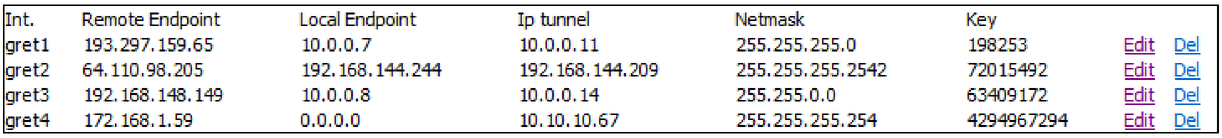
When you will set:

```
Int.      Remote Endpoint  Local Endpoint  IP tunnel      Netmask        Key
gret1  172.168.1.10        0.0.0.0         10.10.10.2   255.255.255.252   off
```

This will create a GRE tunnel with interface "gret1" from any local interface IP with remote 172.168.1.10.
The local gret1 interface will have IP: 10.10.10.2 and net mask 255.255.255.252
Also, this will automatically add a route towards this interface, that you will be able to see in see it in Routing > Routes, in this example you will have:

```
Destination    Gateway      Genmask          Flags  Metric  Ref   Use Iface
10.10.10.0     0.0.0.0      255.255.255.252 U   0      0     0       gret1
```

Depending upon the actual requirements of your application, you may use a single GRE tunnel, or several, with different parameters for each tunnel gret1, gret2, gret3 and so on.

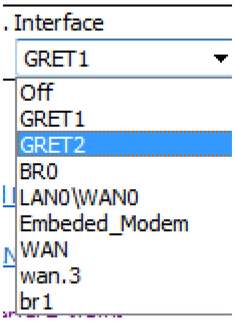


Int.	Remote Endpoint	Local Endpoint	Ip tunnel	Netmask	Key		
gret1	193.297.159.65	10.0.0.7	10.0.0.11	255.255.255.0	198253	Edit	Del
gret2	64.110.98.205	192.168.144.244	192.168.144.209	255.255.255.2542	72015492	Edit	Del
gret3	192.168.148.149	10.0.0.8	10.0.0.14	255.255.0.0	63409172	Edit	Del
gret4	172.168.1.59	0.0.0.0	10.10.10.67	255.255.255.254	4294967294	Edit	Del

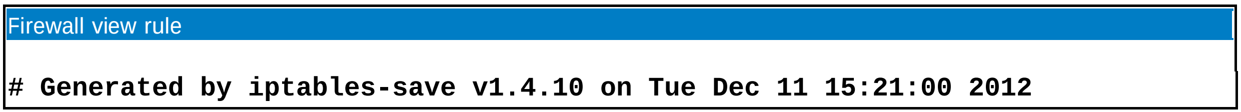
See the first two gre tunnels now present in the routing table of Bytton LTE:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.144.208 0.0.0.0         255.255.255.254 U     0      0        0 gret2
10.10.10.0      0.0.0.0         255.255.255.252 U     0      0        0 gret1
```

In the “Interfaces” drop list, together with the physical interfaces and the other logical interfaces of the equipment:



And also in the firewall rules:

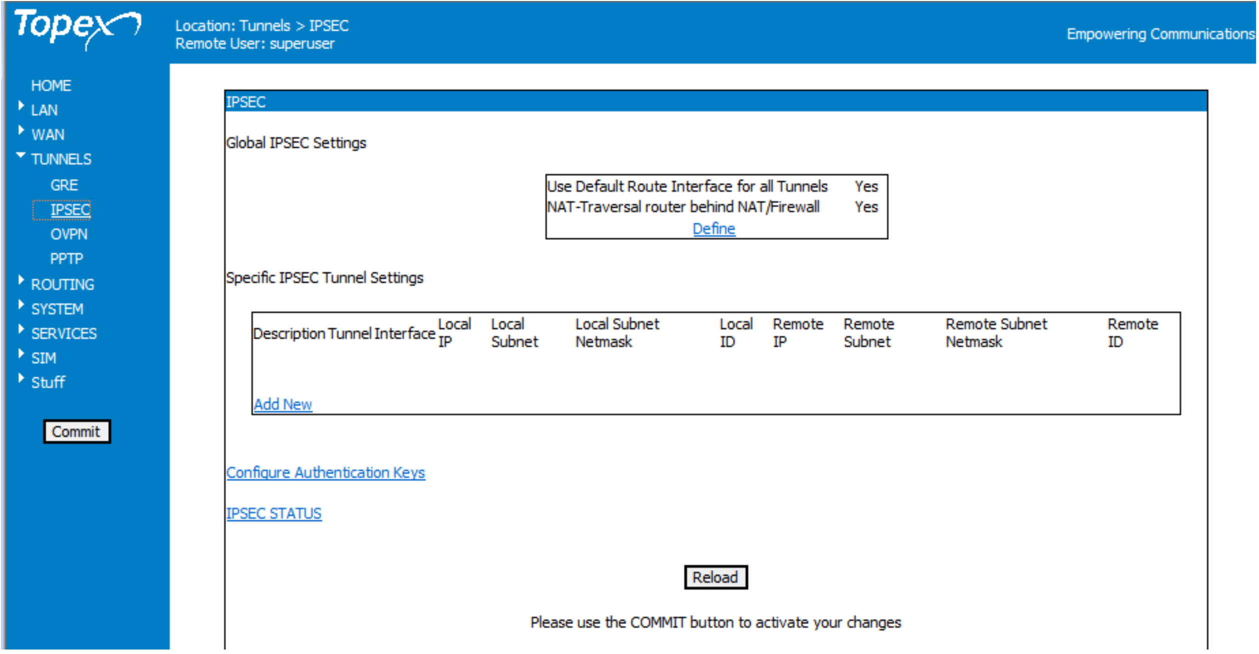


Firewall view rule

```
# Generated by iptables-save v1.4.10 on Tue Dec 11 15:21:00 2012
:OUTPUT ACCEPT [175:31270]
-A INPUT -i lo -j ACCEPT
-A INPUT -p gre -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -i ppp3 -j ACCEPT
-A FORWARD -i br0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
COMMIT
# Completed on Tue Dec 11 15:21:00 2012
```

5.4.2 IPSEC

The IPSEC page allows you to configure the three types of IPSEC tunnels available, to configure the keys used for authentication and to see the current status of the IPSEC tunnels that are active.
At first, the table is empty:



Location: Tunnels > IPSEC
Remote User: superuser

IPSEC

Global IPSEC Settings

Use Default Route Interface for all Tunnels	Yes
NAT-Traversal router behind NAT/Firewall	Yes

Specific IPSEC Tunnel Settings

Description	Tunnel Interface	Local IP	Local Subnet	Local Subnet Netmask	Local ID	Remote IP	Remote Subnet	Remote Subnet Netmask	Remote ID

Configure Authentication Keys

IPSEC STATUS

Please use the COMMIT button to activate your changes

Figure 5-81: The IPSEC configuration table, empty.

You may configure the IPSEC tunnel in three different situations:

- between two different networks, “Network to Network”, assures communication between any hosts situated in two separate networks, the data will be encrypted; This can be accomplished only when both gateways over which the tunnel is configured have public and sstatic IP addresses;

- between two gateways, one being your Bytton device and the other a remote equipment, “Gateway to Gateway “. Only the communication between the two gateways will be encrypted. This kind of IPSE tunnel also can be accomplished only when both gateways over which the tunnel is configured have public and static IP addresses;

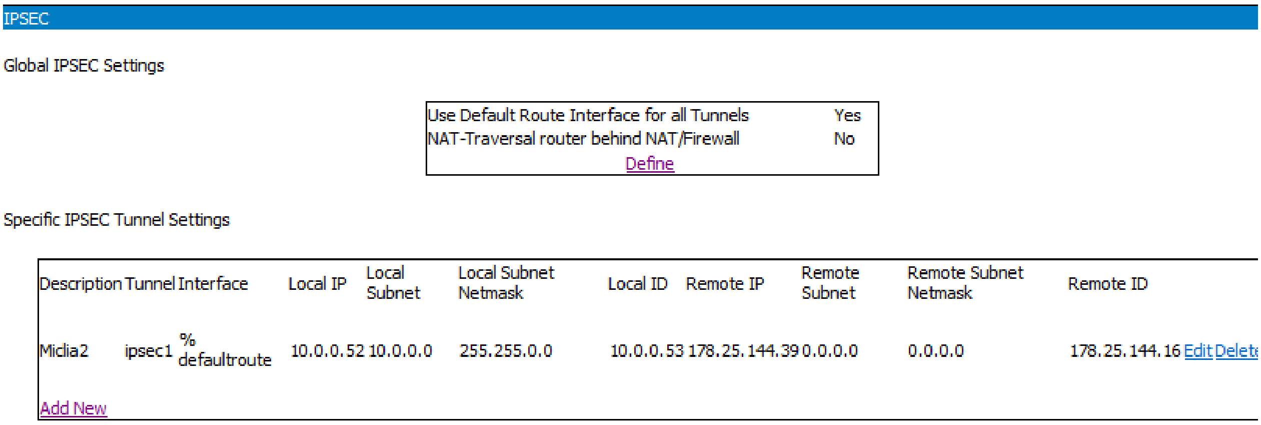
- between a gateway in the field (the Bytton LTE unit) and the remote network of the company. This kind of application is called “road warrior”, because the agent is on the road and he must connect safely to the company’s network over a public network such as the Internet.This kind of IPSEC tunnel is used to accomplish secure communication between the company's gateway/network (which has a static IP address) and a remote user in the field, the road warrior, who’s IP address changes(he gets dynamic IP addresses from the Mobile data carrier)

For each of the situations described above, the IPSEC tunnel must be configured accordingly.

There are two kinds of settings for the IPSEC tunnels, **global** and **specific** to each tunnel.

Global IPSEC Settings

These settings will apply to all tunnels configured on the Bytton machine.They are located in the upper part of the page:



IPSEC

Global IPSEC Settings

Use Default Route Interface for all Tunnels	Yes
NAT-Traversal router behind NAT/Firewall	No
Define	

Specific IPSEC Tunnel Settings

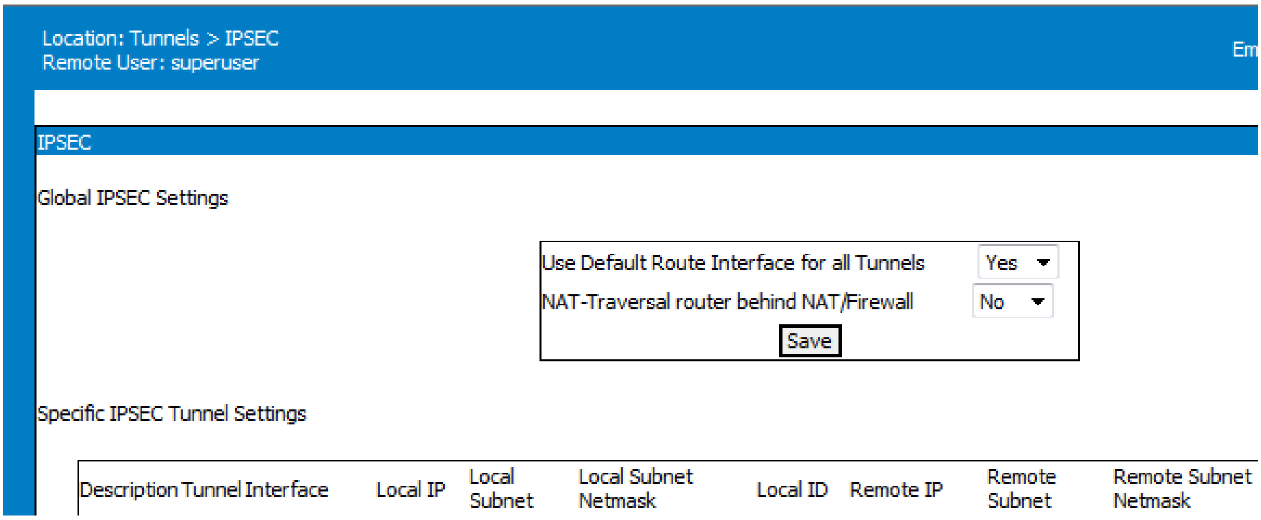
Description	Tunnel	Interface	Local IP	Local Subnet	Local Subnet Netmask	Local ID	Remote IP	Remote Subnet	Remote Subnet Netmask	Remote ID	
Midia2	ipsec1	%defaultroute	10.0.0.52	10.0.0.0	255.255.0.0	10.0.0.53	178.25.144.39	0.0.0.0	0.0.0.0	178.25.144.16	Edit Delet
Add New											

Figure 5-82: Global IPSEC settings, on top of the IPSEC configuration table.

The Global IPSEC settings inlude using the default route interface for all tunnels, and respectively using NAT for traversing the routes through a firewall.

Use Default Route Interface for all Tunnels - the interface with the default route will be used for bringing up all the tunnels

NAT Traversal - router is behind NAT - specifies whether or not the router is behind a NAT/Firewall



Location: Tunnels > IPSEC
Remote User: superuser

IPSEC

Global IPSEC Settings

Use Default Route Interface for all Tunnels	Yes
NAT-Traversal router behind NAT/Firewall	No

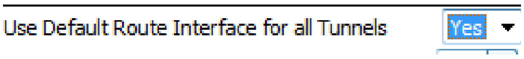
Specific IPSEC Tunnel Settings

Description	Tunnel	Interface	Local IP	Local Subnet	Local Subnet Netmask	Local ID	Remote IP	Remote Subnet	Remote Subnet Netmask

Figure 5-83: Configuring the Global IPSEC settings.

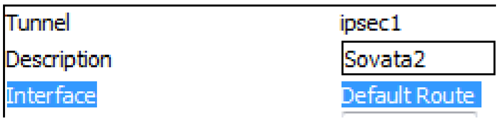
Or each option, select Yes of No , then press Save.

When you choose YES for usage of the default route interface (this is the default setting), this will override any other "Interface" setting defined in each "Specific Tunnel Configuration".



Use Default Route Interface for all Tunnels Yes

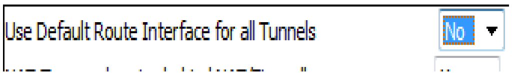
This means that when you define an individual GRE tunnel, the filed “Interface” will not be editable, it will show “Default Route”, since it is the same for all tunnels of Bytton LTE.



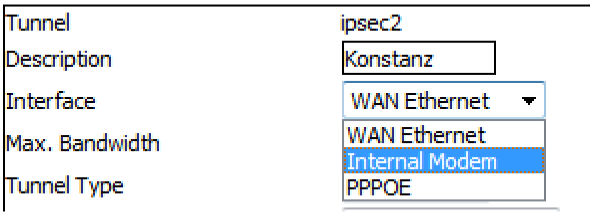
Tunnel	ipsec1
Description	Sovata2
Interface	Default Route

Specific IPSEC Tunnel Settings

When you select NO instead for usage of the default route interface for al tunnels, then "Interface" setting can / must be defined in each "Specific Tunnel Configuration".



Use Default Route Interface for all Tunnels: No

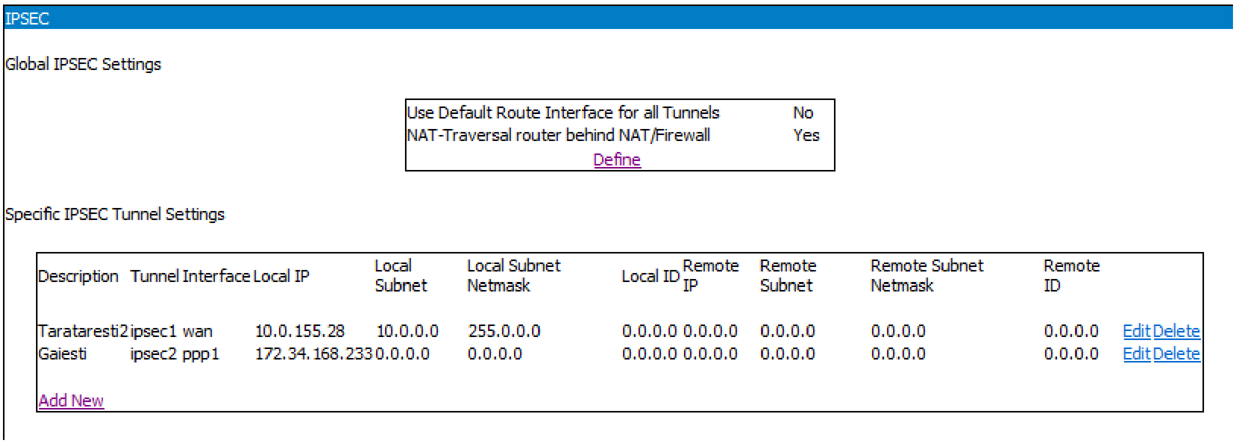


Tunnel	ipsec2
Description	Konstanz
Interface	WAN Ethernet
Max. Bandwidth	
Tunnel Type	

Now the field “Interface” shows a drop list, allowing you to choose for each tunnel one of the physical interfaces of the Bytton LTE equipment.

Set up specific IPSEC Tunnel Settings:

Here are set the parameters that are specific for each tunnel, which are located at the bottom of the page:



IPSEC

Global IPSEC Settings

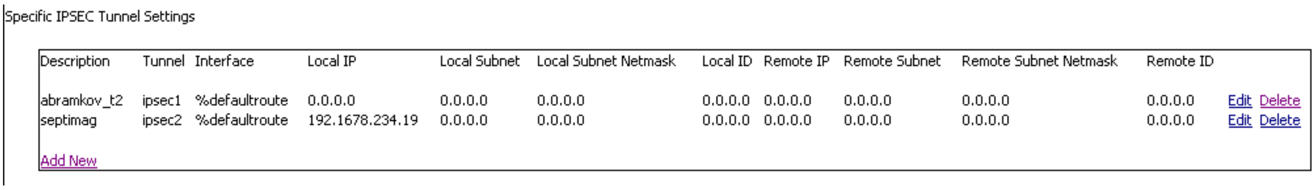
Use Default Route Interface for all Tunnels	No
NAT-Traversal router behind NAT/Firewall	Yes

Specific IPSEC Tunnel Settings

Description	Tunnel	Interface	Local IP	Local Subnet	Local Subnet Netmask	Local ID	Remote IP	Remote Subnet	Remote Subnet Netmask	Remote ID	
Tarataresti2	ipsec1	wan	10.0.155.28	10.0.0.0	255.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	Edit Delete
Gaiesti	ipsec2	ppp1	172.34.168.233	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	Edit Delete

Figure 5-84: Specific IPSEC settings.

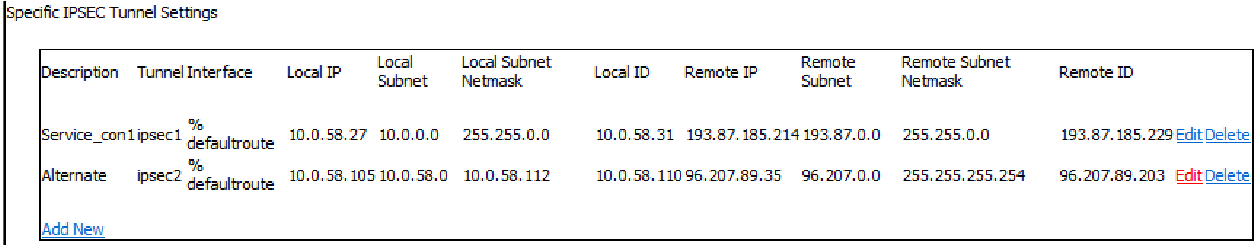
At fist the table is empty, as shown above, so you must use **Add new** to define each IPSEC tunnel:



Specific IPSEC Tunnel Settings

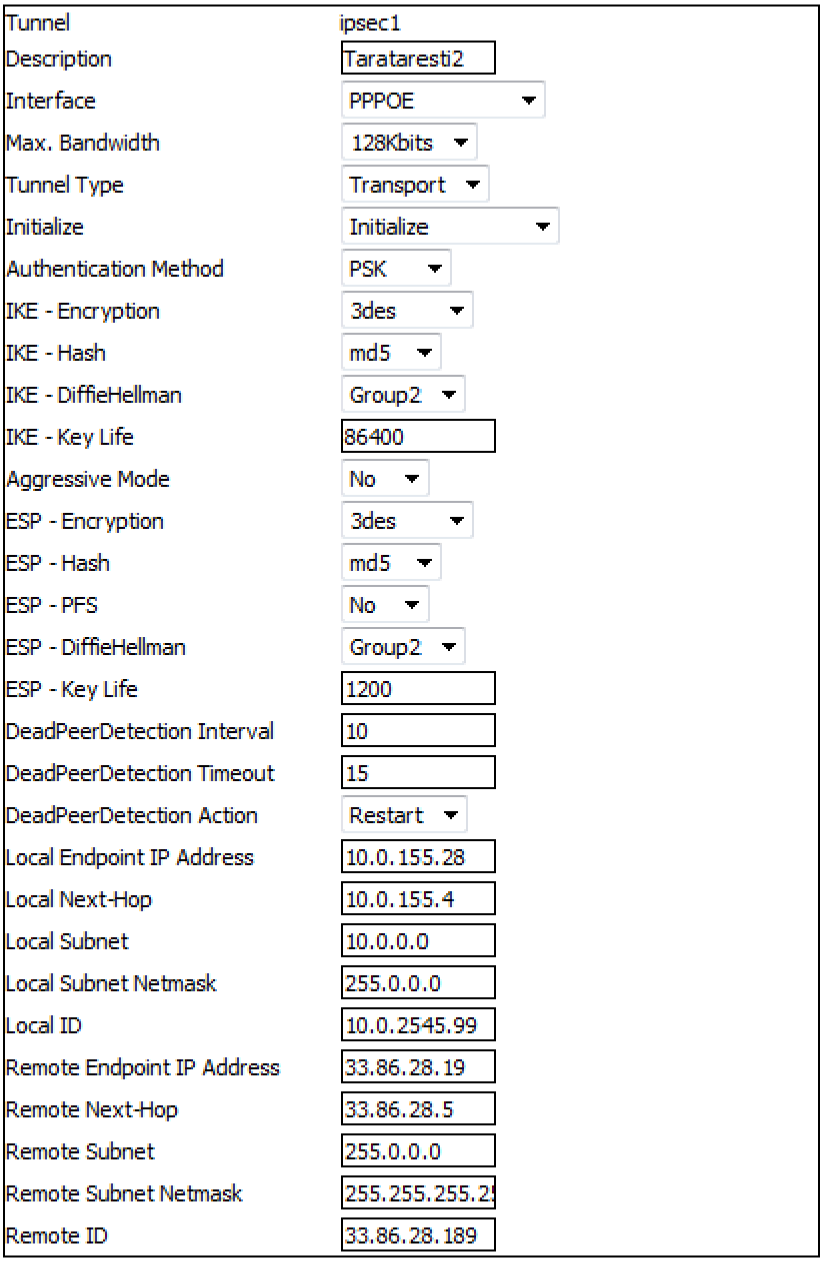
Description	Tunnel	Interface	Local IP	Local Subnet	Local Subnet Netmask	Local ID	Remote IP	Remote Subnet	Remote Subnet Netmask	Remote ID	
abramkov_t2	ipsec1	%defaultroute	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	Edit Delete
septimag	ipsec2	%defaultroute	192.1678.234.19	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0	Edit Delete

Use **Del** to erase an existing tunnel definition, or **Edit** to open up the large window for defining the parameters for each IPSEC tunnel:



Specific IPSEC Tunnel Settings

Description	Tunnel	Interface	Local IP	Local Subnet	Local Subnet Netmask	Local ID	Remote IP	Remote Subnet	Remote Subnet Netmask	Remote ID	
Service_con1	ipsec1	%defaultroute	10.0.58.27	10.0.0.0	255.255.0.0	10.0.58.31	193.87.185.214	193.87.0.0	255.255.0.0	193.87.185.229	Edit Delete
Alternate	ipsec2	%defaultroute	10.0.58.105	10.0.58.0	10.0.58.112	10.0.58.110	96.207.89.35	96.207.0.0	255.255.255.254	96.207.89.203	Edit Delete



Tunnel	ipsec1
Description	Tarataresti2
Interface	PPPOE ▾
Max. Bandwidth	128Kbits ▾
Tunnel Type	Transport ▾
Initialize	Initialize ▾
Authentication Method	PSK ▾
IKE - Encryption	3des ▾
IKE - Hash	md5 ▾
IKE - DiffieHellman	Group2 ▾
IKE - Key Life	86400
Aggressive Mode	No ▾
ESP - Encryption	3des ▾
ESP - Hash	md5 ▾
ESP - PFS	No ▾
ESP - DiffieHellman	Group2 ▾
ESP - Key Life	1200
DeadPeerDetection Interval	10
DeadPeerDetection Timeout	15
DeadPeerDetection Action	Restart ▾
Local Endpoint IP Address	10.0.155.28
Local Next-Hop	10.0.155.4
Local Subnet	10.0.0.0
Local Subnet Netmask	255.0.0.0
Local ID	10.0.2545.99
Remote Endpoint IP Address	33.86.28.19
Remote Next-Hop	33.86.28.5
Remote Subnet	255.0.0.0
Remote Subnet Netmask	255.255.255.2
Remote ID	33.86.28.189

Figure 5-85: Define or modify the Specific IPSEC settings.

Description - is an optional setting, it only helps identifying the tunnel.
Interface - when global setting "Use default route interface for all tunnels" is set to *yes,* the specific *interface* won't be available for modification
Max. Bandwidth – you can choose from three availble values to limit the bandwidth on the tunnel. When set to *no limit* the tunnel will use all the bandwidth it needs from the available bandwidth
Tunnel Type - this setting is scenario dependent. Default value is "tunnel"

Tunnel mode is most commonly used to encrypt traffic between secure IPSec gateways or to connect an end-station running IPSec software to an IPSec gateway.

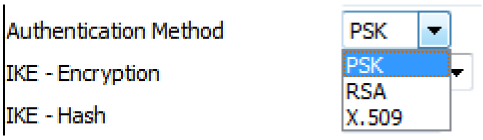
Transport mode is used between end-stations supporting IPSec, or between an end-station and a gateway, when the gateway is being treated as a host.

Initialize

Initialize – when you choose this option, upon bootup Bytton will automatically bring up the tunnel interface and it will send initialization message to the remote party

Wait Initialization - Upon bootup iBytton will automatically bring up the tunnel interface then it will wait for initialization message from the remote party

Authentication Method – Select either PSK, RSA or x.509 certificate. based on the authentication method chosen, the **Authentication Keys** will have to be configured accordingly.



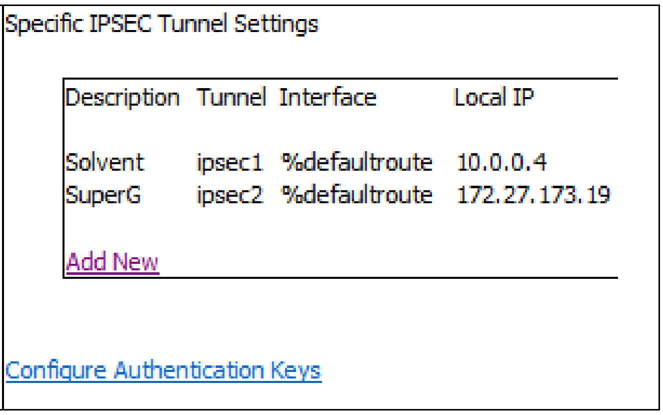
Authentication Method: PSK

IKE - Encryption

IKE - Hash

To configure the **Authentication Keys** go back to the IPSEC main page and select the link **Configure Authentication Keys** located towards the bottom:

Figure 5-86: Using the link “Configure Authentication Keys”.



Specific IPSEC Tunnel Settings

Description	Tunnel	Interface	Local IP
Solvent	ipsec1	%defaultroute	10.0.0.4
SuperG	ipsec2	%defaultroute	172.27.173.19

IKE (Internet Key Exchange) Settings - phase 1 parameters, negotiation of the keying channel.

The Internet Key Exchange (IKE) is an IPsec (Internet Protocol Security) standard protocol used to ensure security for virtual private network (VPN) negotiation and remote host or network access. In fact, IKE protocol is the main part of the IPSEC implementation, and is used to negotiate secret key material between two parties, called the initiator and responder. IKE also provides mutual authentication by authenticating both of the parties to each other. It was first time specified in IETF Request for Comments (RFC) 2409.

IKE defines an automatic means of negotiation and authentication for IPsec security associations (SA). Security associations are security policies defined for communication between two or more entities; the relationship between the entities is represented by a key. KE builds upon the Oakley protocol and ISAKMP. It uses X.509 certificates for authentication which are either pre-shared or distributed using DNS and a Diffie–Hellman key exchange to set up a shared session secret from which cryptographic keys are derived.

IKE Encryption - encryption algorithm must be the same as the one configured on the remote party

IKE Hash - hashing algorithm must be the same as the one configured on the remote party

IKE Diffie-Hellmann – also the Diffie-Hellmann group must be the same as the one configured on the remote party

IKE Key Life – time value for the IKE key, must be same value as set on the remote party.

Aggressive Mode

Two modes are available for negotiating the IKE: either "Main" or "Aggressive". The Main Mode usesa a six step negotiation so it is slower but more secure. The Aggressive mode is faster but less secure. Choose either:

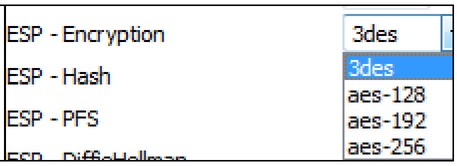
Yes - Aggressive Mode negotiation will be used (3-steps negotiation)

No - Main Mode negotiation will be used (6 steps negotiation) – safer

ESP (Encapsulating Security Payload) Settings - phase 2 parameters, nogotiation of the data channel

ESP Encryption - encryption algorithm, of course it must be the same as the one configured on the remote party

The default value is 3DES.
You can choose AES instead, and select the variant for 128, 192 or 256 bits.



ESP - Encryption: 3des

ESP - Hash

ESP - PFS

ESP - DiffieHellman

ESP Hash - hashing algorithm, md5 os sha1. It must be the same as the one configured on the remote party

ESP PFS - Yes/No - Enables/Disables the use of DiffieHelmann Group in data channel negotiation

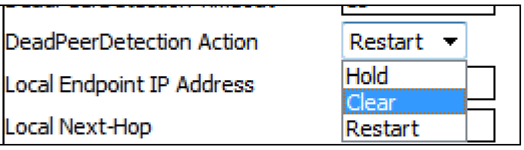
ESP DiffieHellman - Diffie-Hellmann group, eithr 2 or 5, it also must be the same as the one configured on the remote party

ESP Key Life – duration of validity of the ESP key, must be same value as on the remote party

Dead Peer Detection Settings

Dead Peer Detection is used to detect whether the peer is alive or not. When the peer is detected as dead, the IPSec and IKE Security Association are deleted.

Dead peer detection , defined in RFC 3706, is an alternative mechanism that is more scalable than the IKE “keepalives” in detecting dead IPSec peers. DPD specifies that when traffic is occurring between the peers; there is no need to send a keepalive to check for liveliness of the peer, proof of the availability of the peer is considered the IPSec traffic itself.

Set up PDP parameters: **Interval** **Timeout** **Action**	

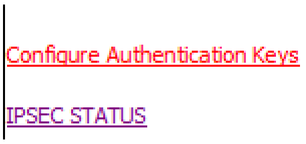
DeadPeerDetection Action: Restart

Local Endpoint IP Address
Local Next-Hop

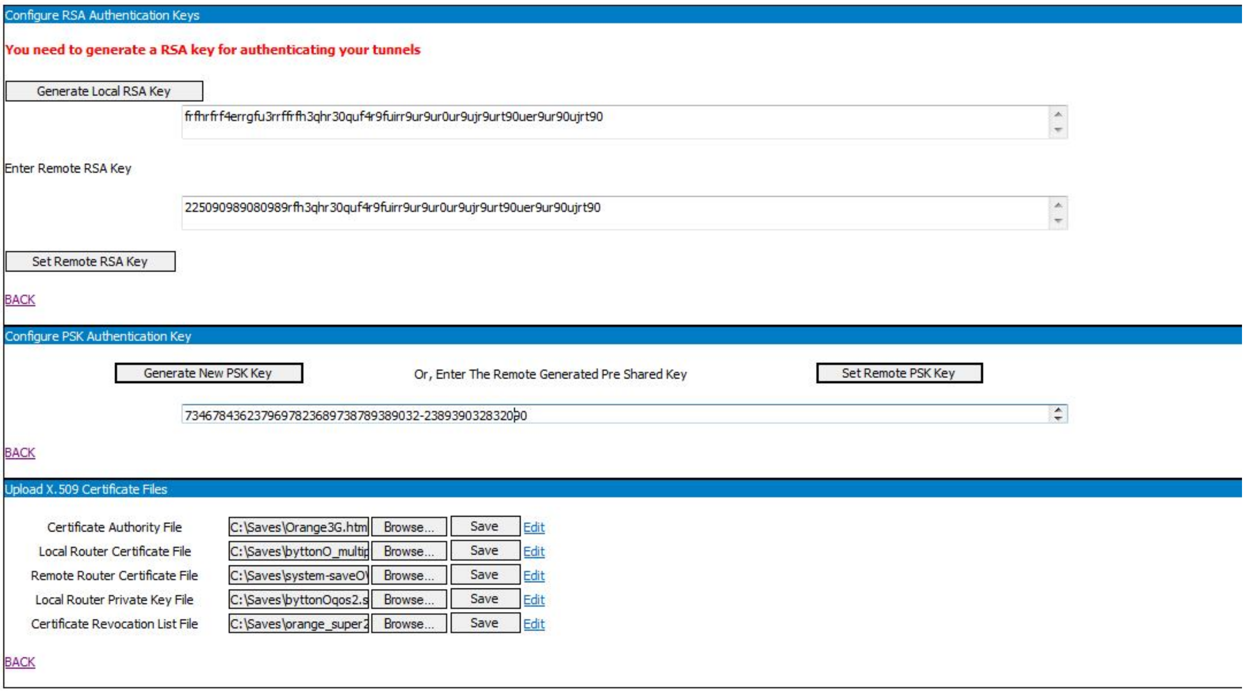
DPD Features:

Dead Peer Detection tries to solve the shortcomings of IKE keepalive or heartbeat schemes. While keepalives and heartbeats methods mandate exchange of messagess at regular intervals, when using DPD, each peer's DPD state is largely independent of the other's. A peer is free to request proof of liveliness from the other party when it needs it - not atpre-esteblished, periodical intervals. This asynchronous property of DPD exchanges allows fewer messages to be sent, and this is how DPD achieves greater scalability. However, the send/receive of periodic keepalive messages has the advantage of earlier detection of dead peers.

After you finished defining the individual settings for each IPSEC tunnel, you must configure the authentication keys for RSA, PSK and upload the X.509 certificate files. Click the link “Configure Authentication Keys” shown here:



The fields shown in red indicate that you need to enter or generate a key:



Configure RSA Authentication Keys

You need to generate a RSA key for authenticating your tunnels

frfhrfrf4errgfu3rrffrfh3qhr30quf4r9fuirr9ur9ur0ur9ujr9urt90uer9ur90ujrt90

Enter Remote RSA Key

225090989080989rfh3qhr30quf4r9fuirr9ur9ur0ur9ujr9urt90uer9ur90ujrt90

Configure PSK Authentication Key

Or, Enter The Remote Generated Pre Shared Key

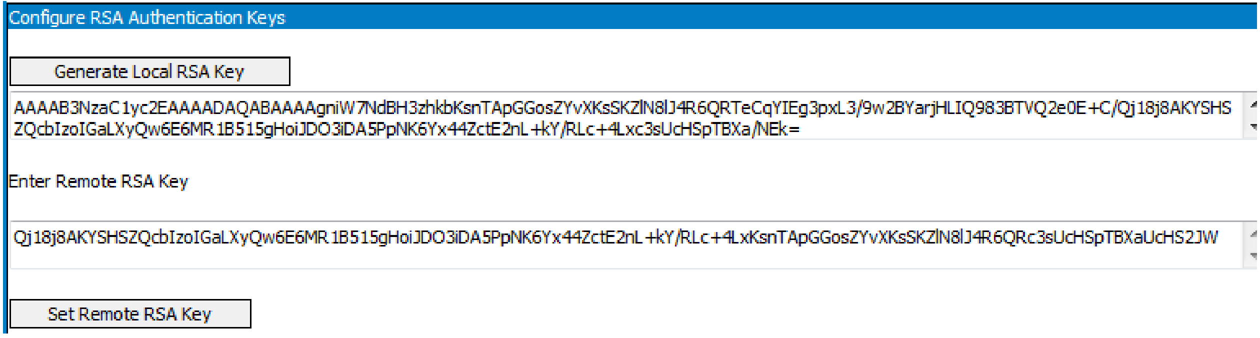
7346784362379697823689738789389032-2389390328320‌90

Upload X.509 Certificate Files

Certificate Authority File	C:\Saves\Orange3G.htm	Browse...	Save	Edit
Local Router Certificate File	C:\Saves\byttonO_multip	Browse...	Save	Edit
Remote Router Certificate File	C:\Saves\system-saveO\	Browse...	Save	Edit
Local Router Private Key File	C:\Saves\byttonOqos2.s	Browse...	Save	Edit
Certificate Revocation List File	C:\Saves\orange_super2	Browse...	Save	Edit

Figure 5-87: IPSEC Web page for managing RSA and PSK keys, and x.509 certificates.

Generate the local keys or enter the remote keys:



Configure RSA Authentication Keys

Generate Local RSA Key

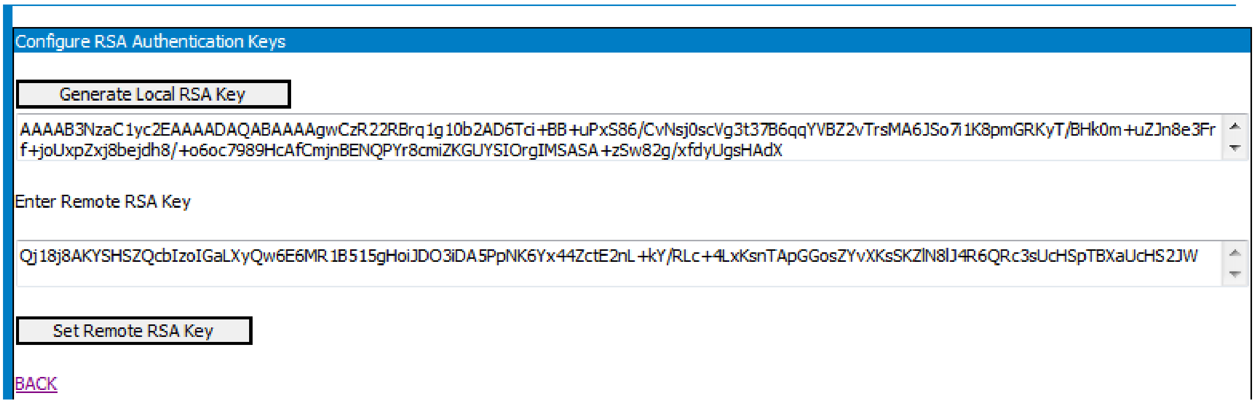
AAAAB3NzaC1yc2EAAAADAQABAAAAgniW7NdBH3zhkbKsnTApGGosZYvXKsSKZlN8lJ4R6QRTeCqYIEg3pxL3/9w2BYarjHLIQ983BTVQ2e0E+C/Qj18j8AKYSHSZQcbIzoIGaLXyQw6E6MR1B515gHoiJDO3iDA5PpNK6Yx44ZctE2nL+kY/RLc+4Lxc3sUcHSpTBXa/NEk=

Enter Remote RSA Key

Qj18j8AKYSHSZQcbIzoIGaLXyQw6E6MR1B515gHoiJDO3iDA5PpNK6Yx44ZctE2nL+kY/RLc+4LxKsnTApGGosZYvXKsSKZlN8lJ4R6QRc3sUcHSpTBXaUcHS2JW

Set Remote RSA Key

Or:



Configure RSA Authentication Keys

Generate Local RSA Key

AAAAB3NzaC1yc2EAAAADAQABAAAAgwCzR22RBrq1g10b2AD6Tci+BB+uPxS86/CvNsj0scVg3t37B6qqYVBZ2vTrsMA6JSo7i1K8pmGRKyT/BHk0m+uZJn8e3Frf+joUxpZxj8bejdh8/+o6oc7989HcAfCmjnBENQPYr8cmiZKGUYSIOrgIMSASA+zSw82g/xfdyUgsHAdX

Enter Remote RSA Key

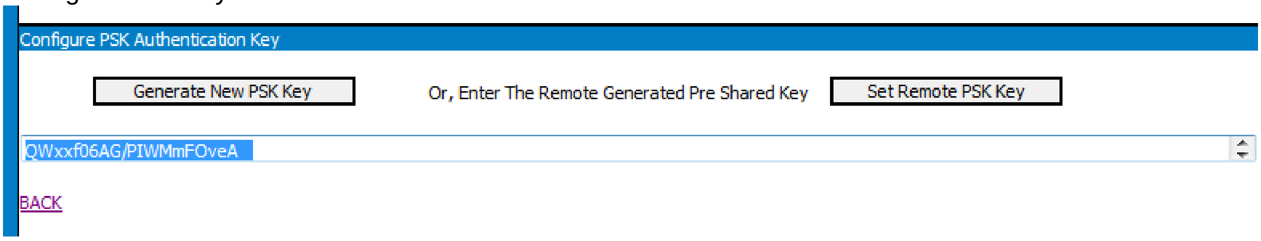
Qj18j8AKYSHSZQcbIzoIGaLXyQw6E6MR1B515gHoiJDO3iDA5PpNK6Yx44ZctE2nL+kY/RLc+4LxKsnTApGGosZYvXKsSKZlN8lJ4R6QRc3sUcHSpTBXaUcHS2JW

Set Remote RSA Key

BACK

Figure 5-88: Generate local RSA key and set or generate remote PSK key.

Configure PSK key:



Configure PSK Authentication Key

Generate New PSK Key

Or, Enter The Remote Generated Pre Shared Key

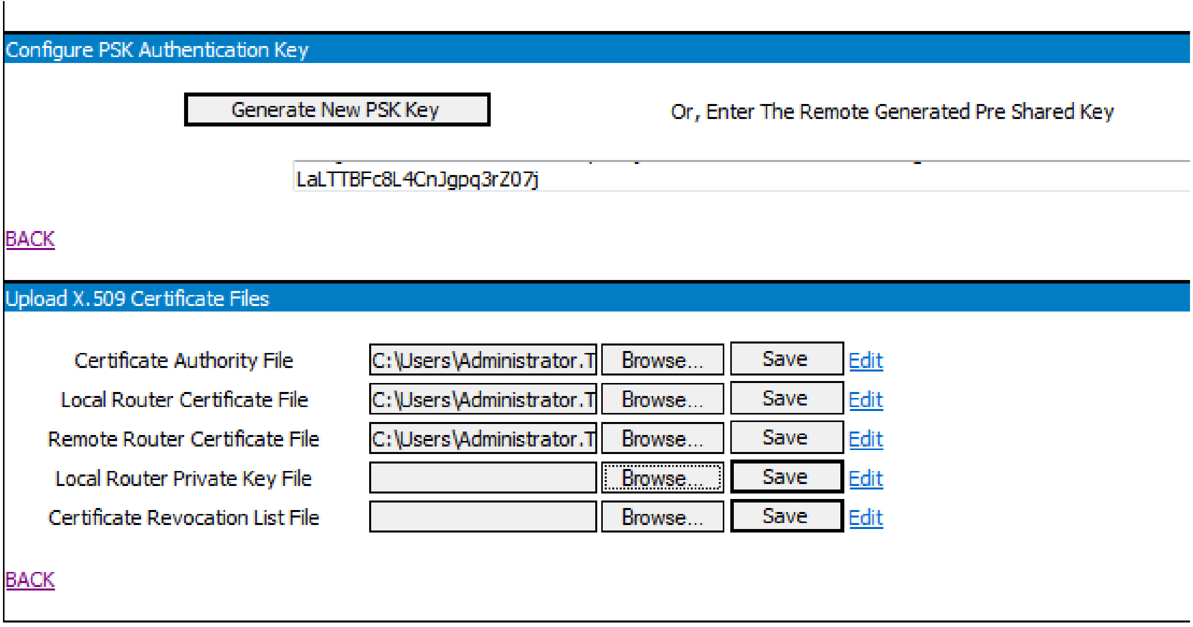
Set Remote PSK Key

QWxxf06AG/PIWMmFOveA

BACK

Setting the X.509 Certificates:
For secure connections, the web browsers use SSL authentication with "X.509" certificates.
This "Digital Certificate Standard" was issued by ITU-T for the secure management and distribution of digitally signed certificates across secure Internet networks. The strong authentication goes beyond a simple password to verify user identity, using instead advanced credentials, which are created by cryptographic means.

Upload the certificate files for X.509:



Configure PSK Authentication Key

Or, Enter The Remote Generated Pre Shared Key

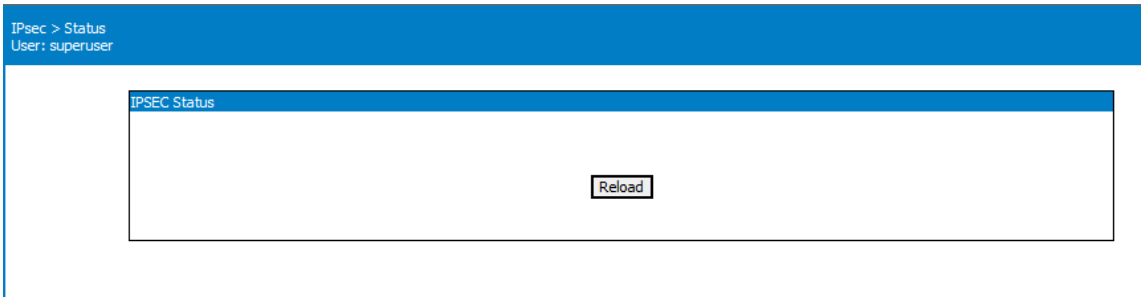
LaLTTBFc8L4CnJgpq3rZ07j

Upload X.509 Certificate Files

Certificate Authority File	C:\Users\Administrator.T	Browse...	Save	Edit
Local Router Certificate File	C:\Users\Administrator.T	Browse...	Save	Edit
Remote Router Certificate File	C:\Users\Administrator.T	Browse...	Save	Edit
Local Router Private Key File		Browse...	Save	Edit
Certificate Revocation List File		Browse...	Save	Edit

Figure 5-98: Upload the certificate files for X.509.

Finally, the link “IPSEC STATUS” opens a window that displays the current state of the IPSEC tunnels.

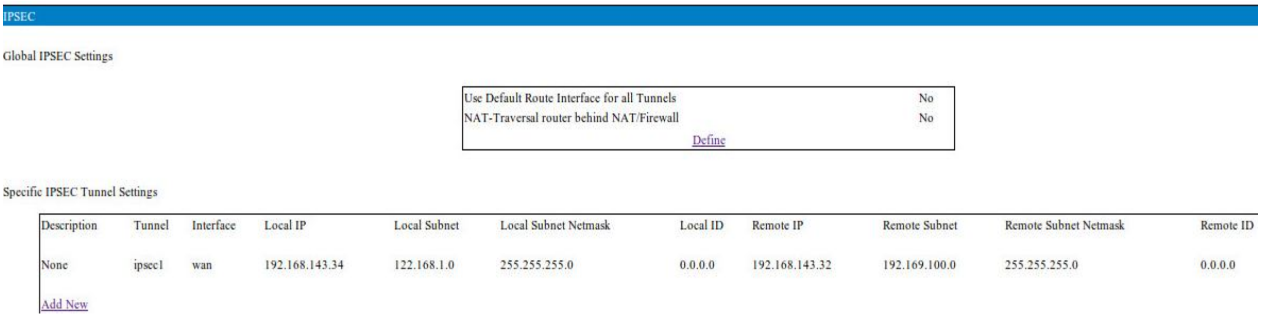


IPsec > Status
User: superuser

IPSEC Status

Figure 5-90a: “IPSEC STATUS” when no tunnel is raised.

IP Sec Status shows information about the IPSEC tunnels which are up on the Bytton equipment. For instace, for this IP Sec tunnel:



IPSEC

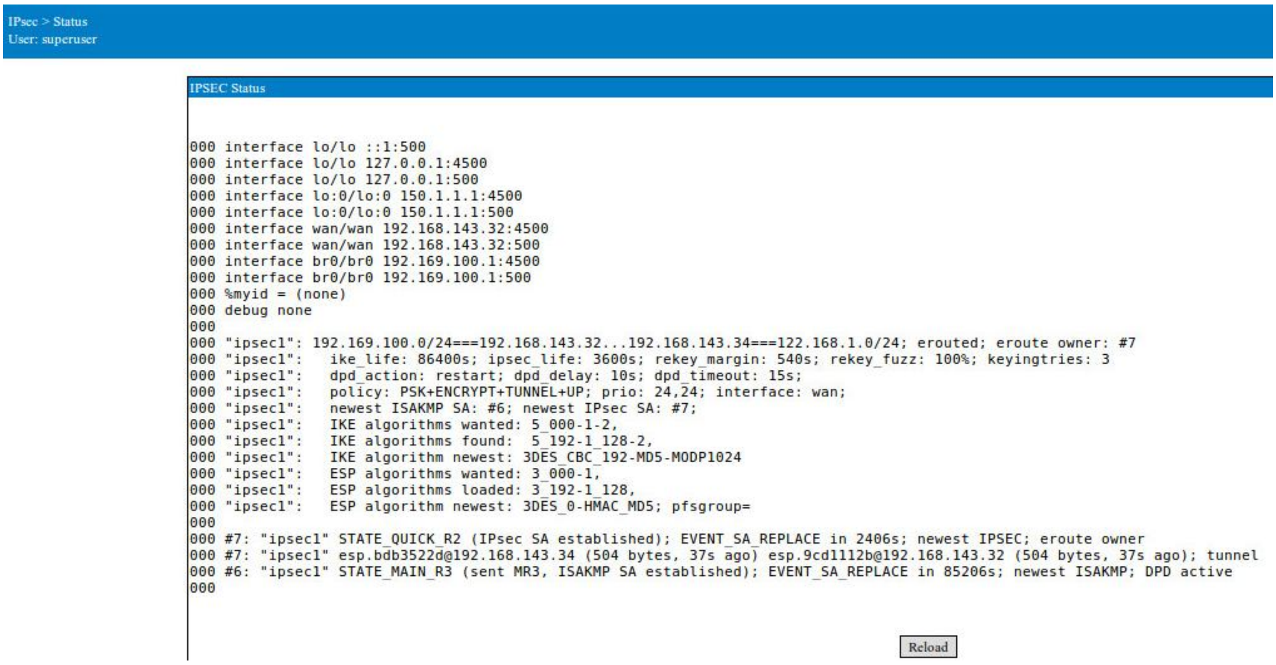
Global IPSEC Settings

Use Default Route Interface for all Tunnels	No
NAT-Traversal router behind NAT/Firewall	No

Specific IPSEC Tunnel Settings

Description	Tunnel	Interface	Local IP	Local Subnet	Local Subnet Netmask	Local ID	Remote IP	Remote Subnet	Remote Subnet Netmask	Remote ID
None	ipsec1	wan	192.168.143.34	122.168.1.0	255.255.255.0	0.0.0.0	192.168.143.32	192.169.100.0	255.255.255.0	0.0.0.0

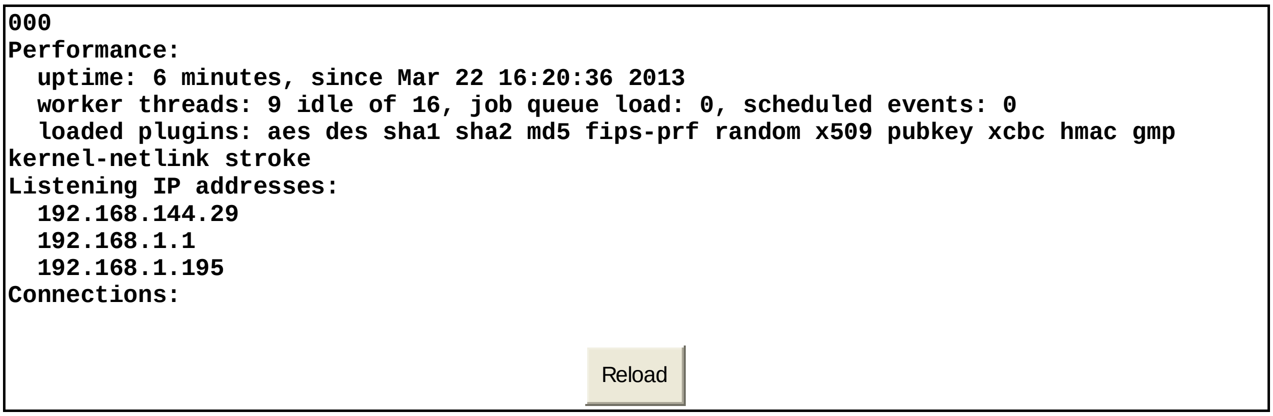
IP Sec Status will display this information



```
000 interface lo/lo ::1:500
000 interface lo/lo 127.0.0.1:4500
000 interface lo/lo 127.0.0.1:500
000 interface lo:0/lo:0 150.1.1.1:4500
000 interface lo:0/lo:0 150.1.1.1:500
000 interface wan/wan 192.168.143.32:4500
000 interface wan/wan 192.168.143.32:500
000 interface br0/br0 192.169.100.1:4500
000 interface br0/br0 192.169.100.1:500
000 %myid = (none)
000 debug none
000
000 "ipsec1": 192.169.100.0/24===192.168.143.32...192.168.143.34===122.168.1.0/24; erouted; eroute owner: #7
000 "ipsec1":   ike_life: 86400s; ipsec_life: 3600s; rekey_margin: 540s; rekey_fuzz: 100%; keyingtries: 3
000 "ipsec1":   dpd_action: restart; dpd_delay: 10s; dpd_timeout: 15s;
000 "ipsec1":   policy: PSK+ENCRYPT+TUNNEL+UP; prio: 24,24; interface: wan;
000 "ipsec1":   newest ISAKMP SA: #6; newest IPsec SA: #7;
000 "ipsec1":   IKE algorithms wanted: 5_000-1-2,
000 "ipsec1":   IKE algorithms found:  5_192-1_128-2,
000 "ipsec1":   IKE algorithm newest: 3DES_CBC_192-MD5-MODP1024
000 "ipsec1":   ESP algorithms wanted: 3_000-1,
000 "ipsec1":   ESP algorithms loaded: 3_192-1_128,
000 "ipsec1":   ESP algorithm newest: 3DES_0-HMAC_MD5; pfsgroup=
000
000 #7: "ipsec1" STATE_QUICK_R2 (IPsec SA established); EVENT_SA_REPLACE in 2406s; newest IPSEC; eroute owner
000 #7: "ipsec1" esp.bdb3522d@192.168.143.34 (504 bytes, 37s ago) esp.9cd1112b@192.168.143.32 (504 bytes, 37s ago); tunnel
000 #6: "ipsec1" STATE_MAIN_R3 (sent MR3, ISAKMP SA established); EVENT_SA_REPLACE in 85206s; newest ISAKMP; DPD active
000
```

Figure 5-90b: “IPSEC STATUS” for one IP Sec tunnel.

```
000 interface lo/lo ::1:500
000 interface lo/lo 127.0.0.1:500
000 interface wan/wan 192.168.144.29:500
000 interface br0/br0 192.168.1.1:500
000 interface br0:0/br0:0 192.168.1.195:500
000 %myid = (none)
000 debug none
000
000 "ipsec1": 122.168.1.0/24===192.168.143.34...192.168.143.32===192.169.100.0/24;
unrouted; eroute owner: #0
000 "ipsec1":   ike_life: 7900s; ipsec_life: 1500s; rekey_margin: 540s; rekey_fuzz:
100%; keyingtries: 3
000 "ipsec1":   dpd_action: restart; dpd_delay: 10s; dpd_timeout: 15s;
000 "ipsec1":   policy: PSK+ENCRYPT+TUNNEL; prio: 24,24; interface: ;
000 "ipsec1":   newest ISAKMP SA: #0; newest IPsec SA: #0;
000 "ipsec1":   IKE algorithms wanted: 5_000-1-2,
000 "ipsec1":   IKE algorithms found:  5_192-1_128-2,
000 "ipsec1":   ESP algorithms wanted: 3_000-1,
000 "ipsec1":   ESP algorithms loaded: 3_192-1_128,
000 "ipsec2": 122.100.0.0/16===193.227.143.35...193.227.173.9===193.0.0.0/8; unrouted;
eroute owner: #0
000 "ipsec2":   ike_life: 9155s; ipsec_life: 1150s; rekey_margin: 540s; rekey_fuzz:
100%; keyingtries: 3
000 "ipsec2":   dpd_action: restart; dpd_delay: 40s; dpd_timeout: 25s;
000 "ipsec2":   policy: RSASIG+ENCRYPT+TUNNEL+PFS; prio: 16,8; interface: ;
000 "ipsec2":   newest ISAKMP SA: #0; newest IPsec SA: #0;
000 "ipsec2":   IKE algorithms wanted: 5_000-2-5,
000 "ipsec2":   IKE algorithms found:  5_192-2_160-5,
000 "ipsec2":   ESP algorithms wanted: 3_000-1, ; pfsgroup=5;
000 "ipsec2":   ESP algorithms loaded: 3_192-1_128,
000 "ipsec3":
122.168.0.0/16===192.168.144.253...117.115.83.92[117.115.83.205]===127.27.0.0/16;
unrouted; eroute owner: #0
000 "ipsec3":   ike_life: 43200s; ipsec_life: 3600s; rekey_margin: 540s; rekey_fuzz:
100%; keyingtries: 3
000 "ipsec3":   dpd_action: restart; dpd_delay: 8s; dpd_timeout: 12s;
000 "ipsec3":   policy: RSASIG+ENCRYPT+PFS; prio: 16,16; interface: ;
000 "ipsec3":   newest ISAKMP SA: #0; newest IPsec SA: #0;
000 "ipsec3":   IKE algorithms wanted: 7_256-2-2,
000 "ipsec3":   IKE algorithms found:  7_256-2_160-2,
000 "ipsec3":   ESP algorithms wanted: 12_256-2, ; pfsgroup=2;
000 "ipsec3":   ESP algorithms loaded: 12_256-2_160,
```

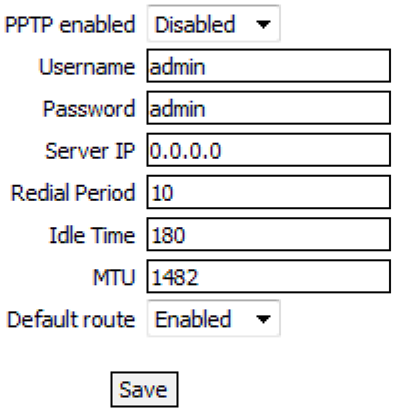


```
000
Performance:
  uptime: 6 minutes, since Mar 22 16:20:36 2013
  worker threads: 9 idle of 16, job queue load: 0, scheduled events: 0
  loaded plugins: aes des sha1 sha2 md5 fips-prf random x509 pubkey xcbc hmac gmp
kernel-netlink stroke
Listening IP addresses:
  192.168.144.29
  192.168.1.1
  192.168.1.195
Connections:
```

Figure 5-90c: “IPSEC STATUS” for three IP Sec tunnels.

5.4.3 PPTP

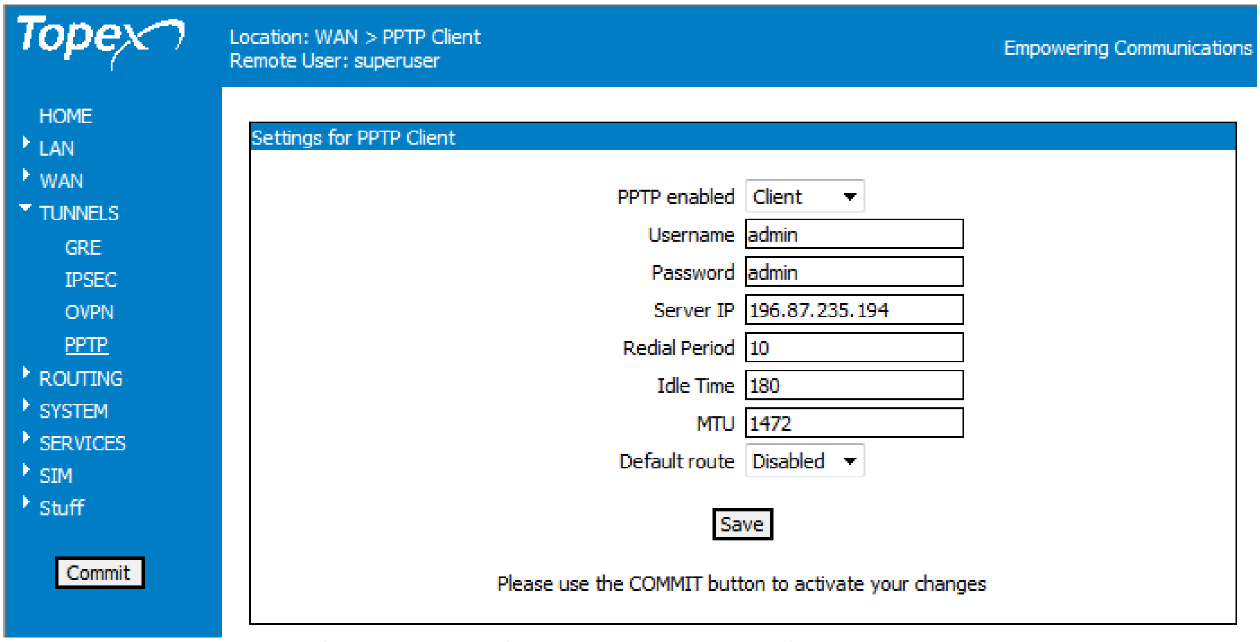
This allows you to define a Point-to-Point Tunnel, which will be used to securely transmit data packets from one VPN node to another over a public network such as the Internet. By default, it is disabled:



PPTP enabled	Disabled
Username	admin
Password	admin
Server IP	0.0.0.0
Redial Period	10
Idle Time	180
MTU	1482
Default route	Enabled

Figure 5-91 Web configuration page for PPTP, disabled.

Bytton LTE can be set up to operate as a **Client** for the PTP tunneling protocol.



Settings for PPTP Client

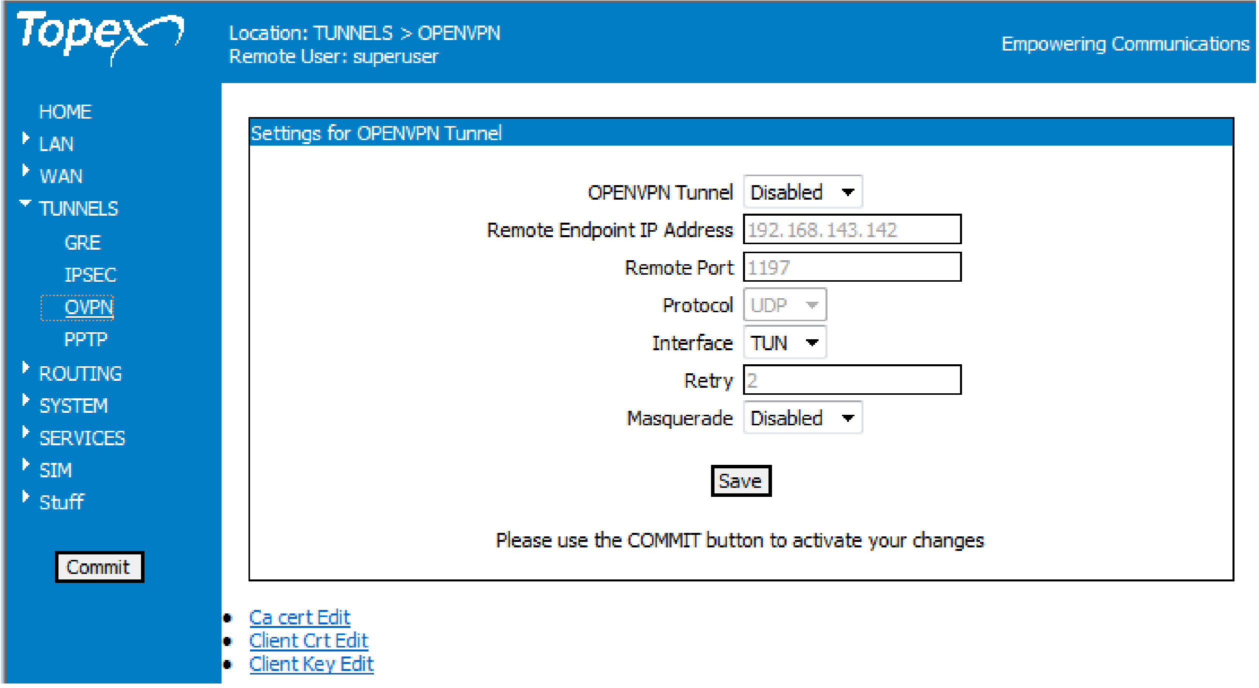
PPTP enabled	Client
Username	admin
Password	admin
Server IP	196.87.235.194
Redial Period	10
Idle Time	180
MTU	1472
Default route	Disabled

Please use the COMMIT button to activate your changes

Figure 5-92: Setting up parameters as Client for PPTP.

5.4.4 OVPN

Here are the settings for the Open VPN tunnel of Bytton:



Settings for OPENVPN Tunnel

OPENVPN Tunnel	Disabled
Remote Endpoint IP Address	192.168.143.142
Remote Port	1197
Protocol	UDP
Interface	TUN
Retry	2
Masquerade	Disabled

Please use the COMMIT button to activate your changes

Figure 5-93: OVPN page for secure Tunnels.

Why Open VPN?

OVPN is a recent addition to the range of secure IP tunnels supported by Bytton for the purpose of securely tunnel the data through a single TCP/UDP port over an unsecured network such as mobile Internet and thus establish VPNs. OVPN is simple, easy to set up and use, and still powerful. GRE and IPSec have been implemented previously, but now you can use OpenVPN too, on the Bytton LTE equipments!

While other VPN solutions often use proprietary or non-standard mechanisms, OpenVPN has a modular concept, both for underlying security and for networking.

OPN does not suffer from the complexity that characterizes other VPN implementations like the market leader IPSec.

However, it is versatile and powerful - it provides features which that go beyond the scope of every other VPN implementations.

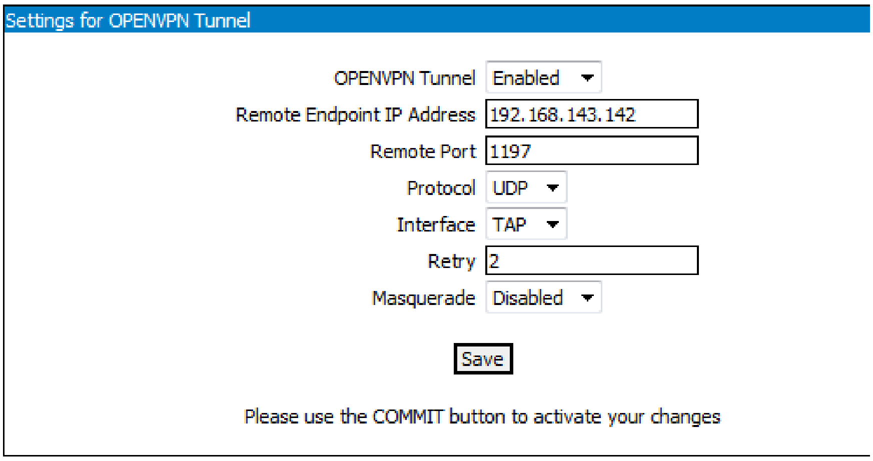
For instance, OpenVPN offers two different basic modes, which run either as Layer 2 or Layer 3 VPN. Thus, OpenVPN tunnels on Layer 2 can also transport Ethernet frames, IPX packets, and Windows Network Browsing packets (NETBIOS), all of which are problems in most other VPN solutions. It extends the protection of the central firewall in the company's main office to all users out in the field, which are connected via OVPN tunnels.

OpenVPN connections can be tunneled through almost every firewall and proxy. The OVPN Server running on Bytton LTE can be configured to run either as a TCP, or as UDP.

As can bee seen from the configuration page, just a single port in the firewall must be opened to allow incoming connections. Its masquerading feature means there are no problems with NAT - Both OpenVPN server and clients can be within a network using only private IP addresses. Every firewall can be used to send the tunnel traffic to the other tunnel endpoint. It also provide Transparent, high-performance support for dynamic IPs, Both tunnel endpoints can have low-cost broadband access with dynamic IPs. The changes of IP on either side will be seldom seen by the users.

OVPN can be configures either as TUN or TAP interface – TAP operates at layer 2 level and simulates Ethernet frames, while the Tunnel interface operates with layer 3 packets, like IP packets. Tap can be used to create a network bridge, while TAB is used with routing. But finally, the biggest advantage of OpenVPN is that it seems to be extremely easy to install and configure – compare its Web configuration page to the ones for GRE or IPSEC!

To use OVPN, fist Enable this feature, the set up the parameters:



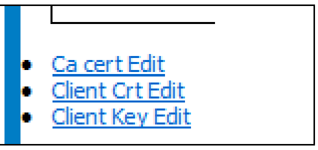
Settings for OPENVPN Tunnel

OPENVPN Tunnel	Enabled
Remote Endpoint IP Address	192.168.143.142
Remote Port	1197
Protocol	UDP
Interface	TAP
Retry	2
Masquerade	Disabled

Please use the COMMIT button to activate your changes

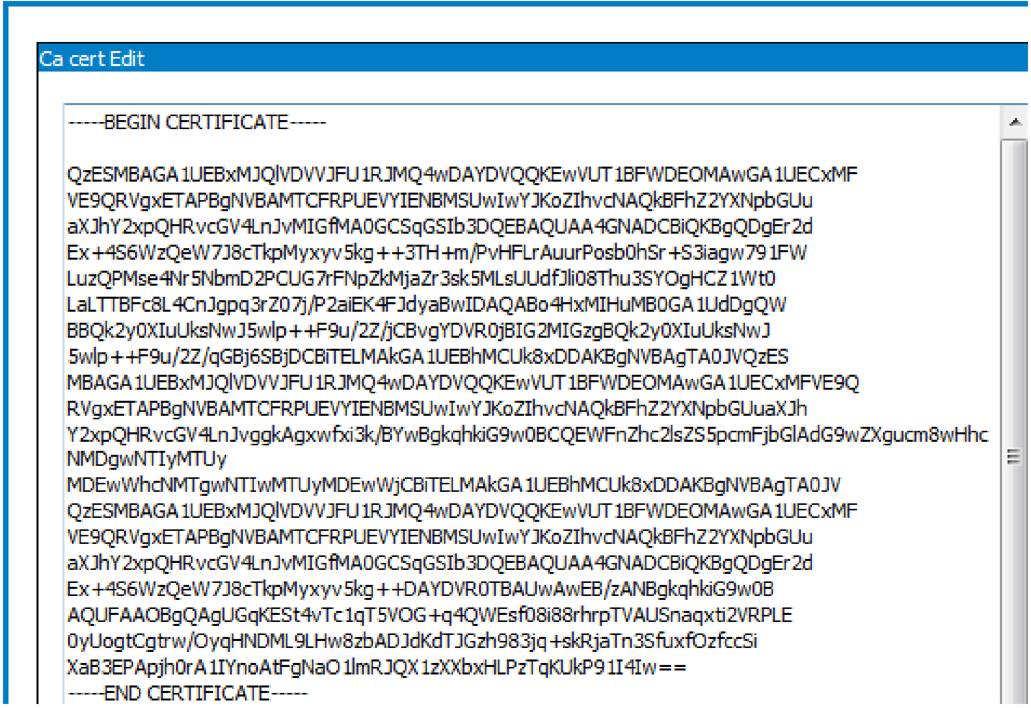
Figure 5-94: Configure the parameters for Open VPN.

Use the blue clickable links at the bottom to edit accordingly the certificates and keys for Open VPN:



- Ca cert Edit
- Client Crt Edit
- Client Key Edit

Of course, you will need to define and edit suitable Certificates: for Certification Authority,

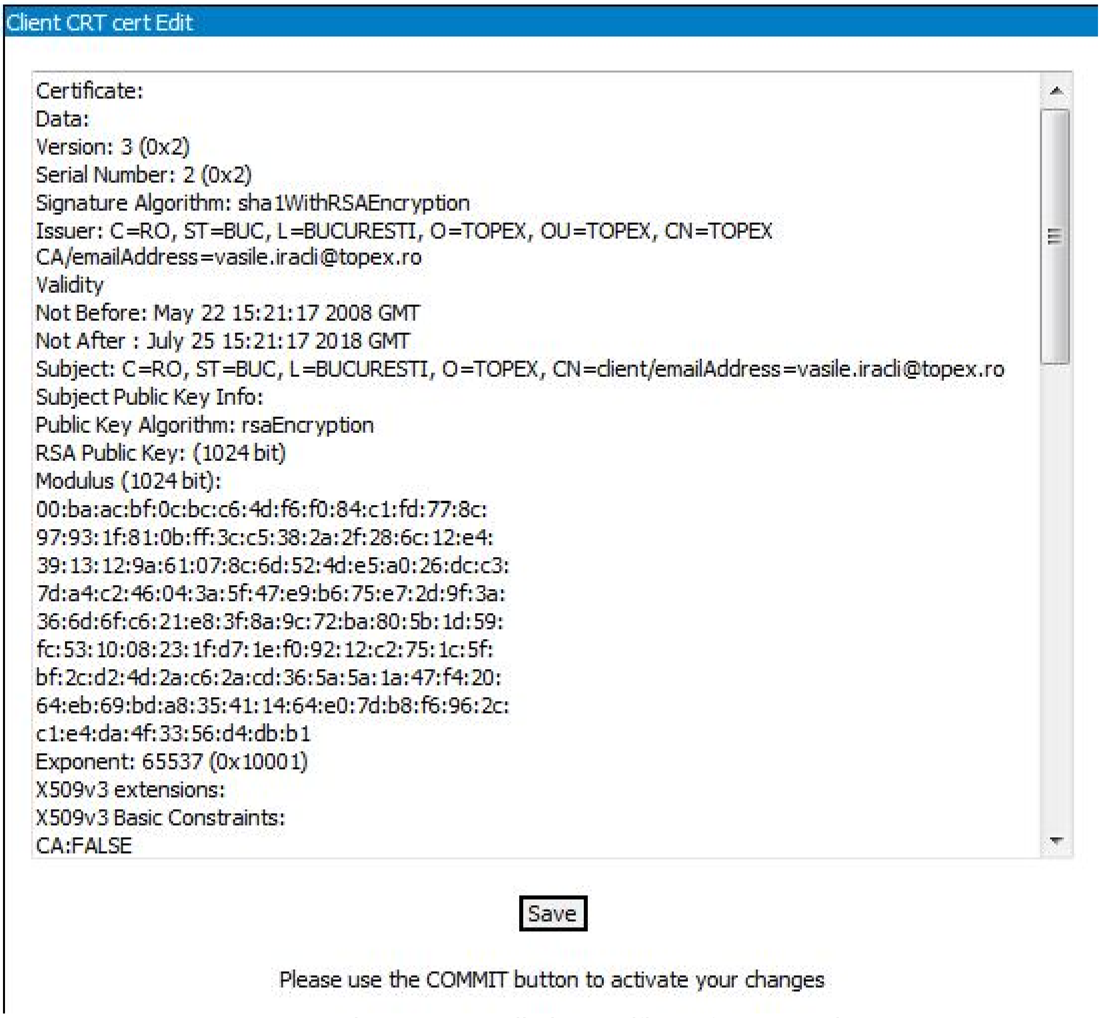


Ca cert Edit

```
-----BEGIN CERTIFICATE-----

QzESMBAGA1UEBxMJQlVDVVJFU1RJMQ4wDAYDVQQKEwVUT1BFWDEOMAwGA1UECxMF
VE9QRVgxETAPBgNVBAMTCFRPUEVYIENBMSUwIwYJKoZIhvcNAQkBFhZ2YXNpbGUu
aXJhY2xpQHRvcGV4LnJvMIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQDgEr2d
Ex+4S6WzQeW7J8cTkpMyxyv5kg++3TH+m/PvHFLrAuurPosb0hSr+S3iagw791FW
LuzQPMse4Nr5NbmD2PCUG7rFNpZkMjaZr3sk5MLsUUdfJli08Thu3SYOgHCZ1Wt0
LaLTTBFc8L4CnJgpq3rZ07j/P2aiEK4FJdyaBwIDAQABo4HxMIHuMB0GA1UdDgQW
BBQk2y0XIuUksNwJ5wlp++F9u/2Z/jCBvgYDVR0jBIG2MIGzgBQk2y0XIuUksNwJ
5wlp++F9u/2Z/qGBj6SBjDCBiTELMAkGA1UEBhMCUk8xDDAKBgNVBAgTA0JVQzES
MBAGA1UEBxMJQlVDVVJFU1RJMQ4wDAYDVQQKEwVUT1BFWDEOMAwGA1UECxMFVE9Q
RVgxETAPBgNVBAMTCFRPUEVYIENBMSUwIwYJKoZIhvcNAQkBFhZ2YXNpbGUuaXJh
Y2xpQHRvcGV4LnJvggkAgxwfxi3k/BYwBgkqhkiG9w0BCQEWFnZhc2lsZS5pcmFjbGlAdG9wZXgucm8wHhc
NMDgwNTIyMTUy
MDEwWhcNMTgwNTIwMTUyMDEwWjCBiTELMAkGA1UEBhMCUk8xDDAKBgNVBAgTA0JV
QzESMBAGA1UEBxMJQlVDVVJFU1RJMQ4wDAYDVQQKEwVUT1BFWDEOMAwGA1UECxMF
VE9QRVgxETAPBgNVBAMTCFRPUEVYIENBMSUwIwYJKoZIhvcNAQkBFhZ2YXNpbGUu
aXJhY2xpQHRvcGV4LnJvMIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQDgEr2d
Ex+4S6WzQeW7J8cTkpMyxyv5kg++DAYDVR0TBAUwAwEB/zANBgkqhkiG9w0B
AQUFAAOBgQAgUGqKESt4vTc1qT5VOG+q4QWEsf08i88rhrpTVAUSnaqxti2VRPLE
0yUogtCgtrw/OyqHNDML9LHw8zbADJdKdTJGzh983jq+skRjaTn3SfuxfOzfccSi
XaB3EPApjh0rA1IYnoAtFgNaO1lmRJQX1zXXbxHLPzTqKUkP91I4Iw==
-----END CERTIFICATE-----
```

Figure 5-94: Edit the certificate for Certified Authority.

Then for CRT Client :

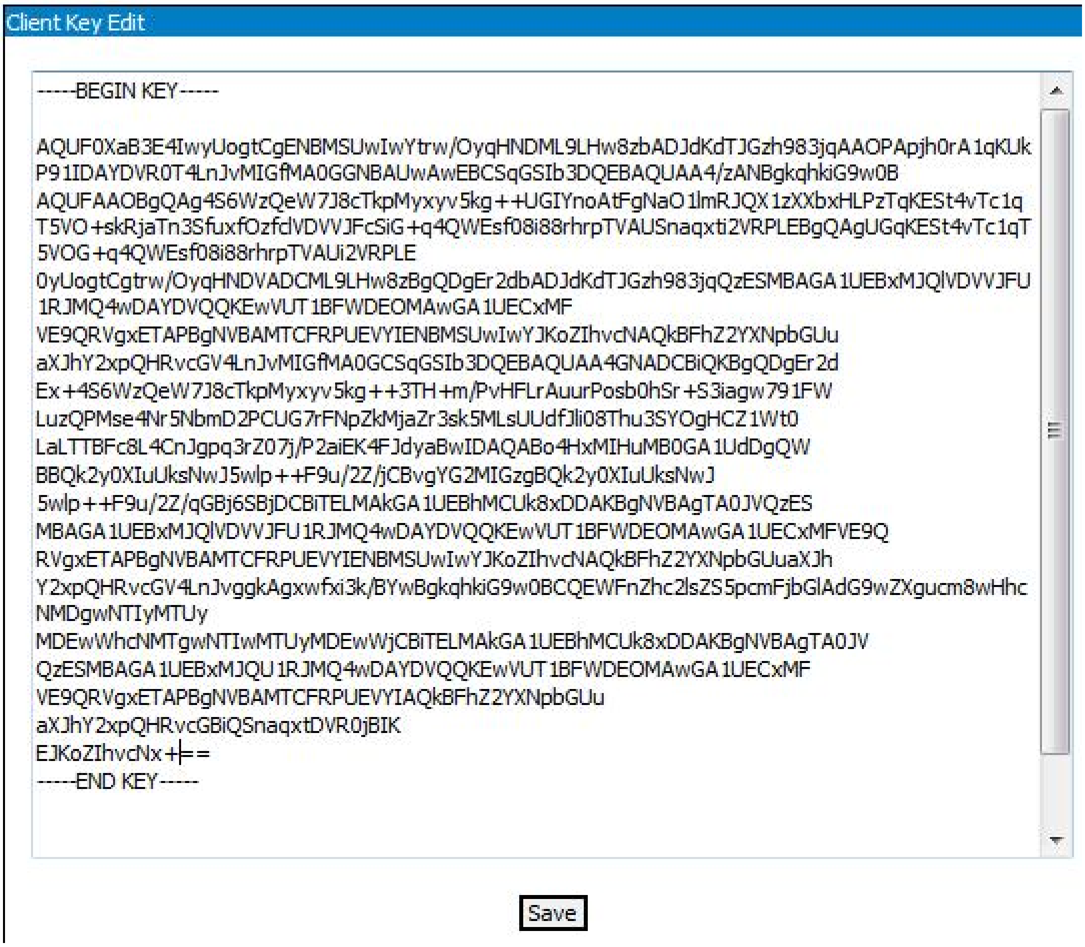


```
Certificate:
Data:
Version: 3 (0x2)
Serial Number: 2 (0x2)
Signature Algorithm: sha1WithRSAEncryption
Issuer: C=RO, ST=BUC, L=BUCURESTI, O=TOPEX, OU=TOPEX, CN=TOPEX
CA/emailAddress=vasile.iradi@topex.ro
Validity
Not Before: May 22 15:21:17 2008 GMT
Not After : July 25 15:21:17 2018 GMT
Subject: C=RO, ST=BUC, L=BUCURESTI, O=TOPEX, CN=client/emailAddress=vasile.iradi@topex.ro
Subject Public Key Info:
Public Key Algorithm: rsaEncryption
RSA Public Key: (1024 bit)
Modulus (1024 bit):
00:ba:ac:bf:0c:bc:c6:4d:f6:f0:84:c1:fd:77:8c:
97:93:1f:81:0b:ff:3c:c5:38:2a:2f:28:6c:12:e4:
39:13:12:9a:61:07:8c:6d:52:4d:e5:a0:26:dc:c3:
7d:a4:c2:46:04:3a:5f:47:e9:b6:75:e7:2d:9f:3a:
36:6d:6f:c6:21:e8:3f:8a:9c:72:ba:80:5b:1d:59:
fc:53:10:08:23:1f:d7:1e:f0:92:12:c2:75:1c:5f:
bf:2c:d2:4d:2a:c6:2a:cd:36:5a:5a:1a:47:f4:20:
64:eb:69:bd:a8:35:41:14:64:e0:7d:b8:f6:96:2c:
c1:e4:da:4f:33:56:d4:db:b1
Exponent: 65537 (0x10001)
X509v3 extensions:
X509v3 Basic Constraints:
CA:FALSE
```

Please use the COMMIT button to activate your changes

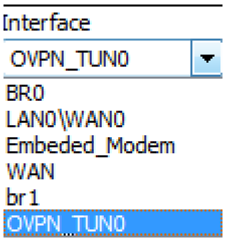
Figure 5-96: Edit the certificate for CRT Client.

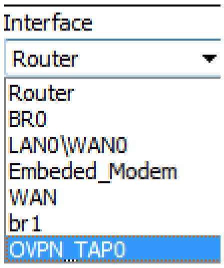
and respectively for the Client’s Key:



```
-----BEGIN KEY-----

AQUF0XaB3E4IwyUogtCgENBMSUwIwYtrw/OyqHNDML9LHw8zbADJdKdTJGzh983jqAAOPApjh0rA1qKUk
P91IDAYDVR0T4LnJvMIGfMA0GGNBAUwAwEBCSqGSIb3DQEBAQUAA4/zANBgkqhkiG9w0B
AQUFAAOBgQAg4S6WzQeW7J8cTkpMyxyv5kg++UGIYnoAtFgNaO1lmRJQX1zXXbxHLPzTqKESt4vTc1q
T5VO+skRjaTn3SfuxfOzfdVDVVJFcSiG+q4QWEsf08i88rhrpTVAUSnaqxti2VRPLEBgQAgUGqKESt4vTc1qT
5VOG+q4QWEsf08i88rhrpTVAUi2VRPLE
0yUogtCgtrw/OyqHNDVADCML9LHw8zBgQDgEr2dbADJdKdTJGzh983jqQzESMBAGA1UEBxMJQlVDVVJFU
1RJMQ4wDAYDVQQKEwVUT1BFWDEOMAwGA1UECxMF
VE9QRVgxETAPBgNVBAMTCFRPUEVYIENBMSUwIwYJKoZIhvcNAQkBFhZ2YXNpbGUu
aXJhY2xpQHRvcGV4LnJvMIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQDgEr2d
Ex+4S6WzQeW7J8cTkpMyxyv5kg++3TH+m/PvHFLrAuurPosb0hSr+S3iagw791FW
LuzQPMse4Nr5NbmD2PCUG7rFNpZkMjaZr3sk5MLsUUdfJli08Thu3SYOgHCZ1Wt0
LaLTTBFc8L4CnJgpq3rZ07j/P2aiEK4FJdyaBwIDAQABo4HxMIHuMB0GA1UdDgQW
BBQk2y0XIuUksNwJ5wlp++F9u/2Z/jCBvgYG2MIGzgBQk2y0XIuUksNwJ
5wlp++F9u/2Z/qGBj6SBjDCBiTELMAkGA1UEBhMCUk8xDDAKBgNVBAgTA0JVQzES
MBAGA1UEBxMJQlVDVVJFU1RJMQ4wDAYDVQQKEwVUT1BFWDEOMAwGA1UECxMFVE9Q
RVgxETAPBgNVBAMTCFRPUEVYIENBMSUwIwYJKoZIhvcNAQkBFhZ2YXNpbGUuaXJh
Y2xpQHRvcGV4LnJvggkAgxwfxi3k/BYwBgkqhkiG9w0BCQEWFnZhc2lsZS5pcmFjbGlAdG9wZXgucm8wHhc
NMDgwNTIyMTUy
MDEwWhcNMTgwNTIwMTUyMDEwWjCBiTELMAkGA1UEBhMCUk8xDDAKBgNVBAgTA0JV
QzESMBAGA1UEBxMJQU1RJMQ4wDAYDVQQKEwVUT1BFWDEOMAwGA1UECxMF
VE9QRVgxETAPBgNVBAMTCFRPUEVYIAQkBFhZ2YXNpbGUu
aXJhY2xpQHRvcGBiQSnaqxtDVR0jBIK
EJKoZIhvcNx+==
-----END KEY-----
```

Figure 5-97: Edit the certificate for Client’ KEY for OVPN.





Accordingly, the Open VPN interface will show up in the Interfaces drop list either with TUN or TAP as suffix!

The corresponding routing rules will also be automatically inserted in the iptables table, look for the “tap0” entries:

```
# Generated by iptables-save v1.4.10 on Wed Jul  4 10:43:48 2012
*filter
:INPUT ACCEPT [235:26609]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [662:105191]
-A INPUT -i lo -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -i tap0 -j ACCEPT
-A FORWARD -i br0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
-A FORWARD -i tap0 -j ACCEPT
-A OUTPUT -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
COMMIT
# Completed on Wed Jul  4 10:43:48 2012
# Generated by iptables-save v1.4.10 on Wed Jul  4 10:43:48 2012
```

```
*mangle
:PREROUTING ACCEPT [1021:95186]
:INPUT ACCEPT [917:80339]
:FORWARD ACCEPT [87:14031]
:OUTPUT ACCEPT [664:105325]
:POSTROUTING ACCEPT [751:119356]
COMMIT
# Completed on Wed Jul  4 10:43:48 2012.

*filter
:INPUT ACCEPT [58:3040]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [1165:98890]
-A INPUT -i lo -j ACCEPT
-A INPUT -i br0 -j ACCEPT
-A INPUT -p gre -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -p tcp -m tcp --dport 2601 -j ACCEPT
-A INPUT -p tcp -m tcp --dport 2604 -j ACCEPT
-A INPUT -p udp -m udp --dport 161 -j ACCEPT
-A INPUT -p udp -m udp --dport 162 -j ACCEPT
-A INPUT -i tap0 -j ACCEPT
-A INPUT -p udp -m udp --dport 4500 -j ACCEPT
-A INPUT -p ipv6-auth -j ACCEPT
-A INPUT -p udp -m udp --sport 500 --dport 500 -j ACCEPT
-A INPUT -p ipv6-crypt -j ACCEPT
-A INPUT -p tcp -m tcp --dport 0 -j ACCEPT
-A INPUT -p tcp -m tcp --dport 0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
-A FORWARD -d 193.76.244.115/32 -p tcp -m tcp --dport 47 -j ACCEPT
-A FORWARD -i tap0 -j ACCEPT
-A OUTPUT -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
COMMIT
# Completed on Mon Jul 16 13:57:06 2012
```

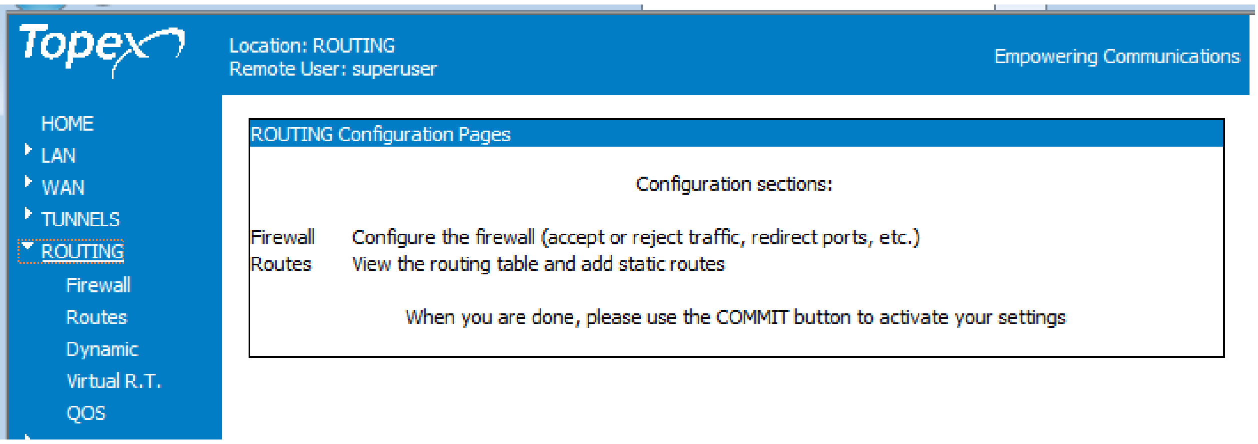
An example of System>Logs where, because of incorrect open VPN settings, the OVPN tunnel could non be achieved:

```
Jul 23 07:26:46 bytton daemon.warn openvpn[1852]: NOTE: OpenVPN 2.1 requires '--script-security 2' or higher to call user-defined scripts or executables
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: Re-using SSL/TLS context
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: LZO compression initialized
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: Control Channel MTU parms [ L:1542 D:138 EF:38 EB:0 ET:0 EL:0 ]
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: Socket Buffers: R=[112640->131072] S=[112640->131072]
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: Data Channel MTU parms [ L:1542 D:1450 EF:42 EB:135 ET:0 EL:0 AF:3/1 ]
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: Local Options hash (VER=V4): '41690919'
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: Expected Remote Options hash (VER=V4): '530fdded'
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: UDPv4 link local: [undef]
Jul 23 07:26:46 bytton daemon.notice openvpn[1852]: UDPv4 link remote: 192.168.143.142:1194
Jul 23 07:26:49 bytton daemon.err openvpn[1852]: read UDPv4 [EHOSTUNREACH|EHOSTUNREACH]: No route to host (code=113)
Jul 23 07:27:46 bytton daemon.err openvpn[1852]: TLS Error: TLS key negotiation failed to occur within 60 seconds (check your network connectivity)
Jul 23 07:27:46 bytton daemon.err openvpn[1852]: TLS Error: TLS handshake failed
Jul 23 07:27:46 bytton daemon.notice openvpn[1852]: TCP/UDP: Closing socket
Jul 23 07:27:46 bytton daemon.notice openvpn[1852]: SIGUSR1[soft,tls-error] received, process restarting
Jul 23 07:27:46 bytton daemon.notice openvpn[1852]: Restart pause, 2 second(s).
```

5.5 ROUTING

As can be seen in the image below, the section about “ROUTING” includes several sub-sections:

- Firewall (see and define both packet filtering and port or address redirection)
- Routes (display and configure the static routes)
- Dynamic (selects OSPF, RIP or BGP for dynamic routing, access to VTY shell)
- Virtual R.T (Routing table) - allows multiple instances of a routing table to exist and work at the same time in Bytton acting as a route
- QoS - marking and prioritizing packets for different types of traffic



ROUTING Configuration Pages

Configuration sections:

Firewall Configure the firewall (accept or reject traffic, redirect ports, etc.)
Routes View the routing table and add static routes

When you are done, please use the COMMIT button to activate your settings

Figure 5-98 The ROUTING web page for Bytton LTE.

Examples:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
172.27.0.0      0.0.0.0         255.255.0.0     U     0      0        0 lan0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

```
# Generated by iptables-save v1.4.10 on Tue Dec 11 15:26:39 2012
*mangle
:PREROUTING ACCEPT [1073:84945]
:INPUT ACCEPT [998:80489]
:FORWARD ACCEPT [66:4168]
:OUTPUT ACCEPT [1198:174430]
:POSTROUTING ACCEPT [1264:178598]
-A PREROUTING -s 10.65.0.0/16 -i br0 -p udp -m udp --sport 4057 -m tos --tos
0x22/0xff -j TOS --set-tos 0x20/0xff
-A POSTROUTING -d 44.229.72.0/22 -o lan0 -p tcp -m tcp --sport 4057 -m tos --
tos 0x00/0xff -j TOS --set-tos 0x38/0xff
COMMIT
# Completed on Tue Dec 11 15:26:40 2012
# Generated by iptables-save v1.4.10 on Tue Dec 11 15:26:40 2012
*nat
:PREROUTING ACCEPT [78:5376]
:OUTPUT ACCEPT [98:5864]
:POSTROUTING ACCEPT [119:7092]
-A POSTROUTING -o ppp3 -j MASQUERADE
-A POSTROUTING -o ppp1 -j MASQUERADE
COMMIT
# Completed on Tue Dec 11 15:26:40 2012
# Generated by iptables-save v1.4.10 on Tue Dec 11 15:26:40 2012
```

```
*filter
-A INPUT -i lo -j ACCEPT
-A INPUT -i br0 -j ACCEPT
-A INPUT -p gre -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -i ppp3 -j ACCEPT
-A INPUT -p udp -m udp --dport 161 -j ACCEPT
-A INPUT -p udp -m udp --dport 162 -j ACCEPT
-A INPUT -i tun0 -j ACCEPT
-A FORWARD -i br0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
-A FORWARD -i ppp3 -j ACCEPT
-A FORWARD -i tun0 -j ACCEPT
-A OUTPUT -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
COMMIT
# Completed on Tue Dec 11 15:26:40 2012
```

Or:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
195.74.234.12   0.0.0.0         255.255.255.254 U     0      0        0 br2
10.0.58.44      0.0.0.0         255.255.255.252 U     0      0        0 br3
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
192.168.144.0   0.0.0.0         255.255.255.0   U     0      0        0 wan.3
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
109.73.221.0    0.0.0.0         255.255.255.0   U     0      0        0 br4
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
10.0.0.0        0.0.0.0         255.0.0.0       U     0      0        0 br1
0.0.0.0         10.0.58.1       0.0.0.0         UG    0      0        0 br1
```

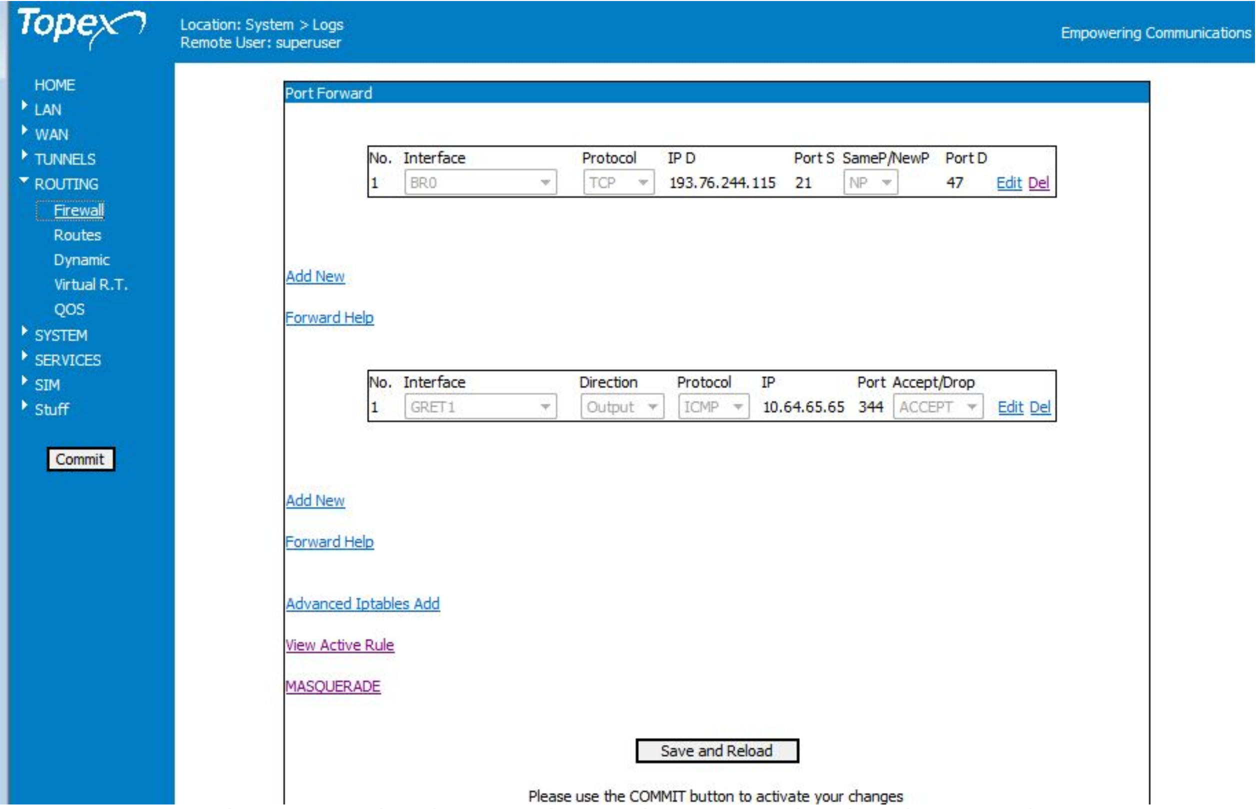
And respectively:

```
# Generated by iptables-save v1.4.10 on Mon Jul 16 14:10:41 2012
*mangle
:PREROUTING ACCEPT [1467:112797]
:INPUT ACCEPT [1204:85519]
:FORWARD ACCEPT [68:7025]
:OUTPUT ACCEPT [1922:278113]
:POSTROUTING ACCEPT [2057:287583]
COMMIT
# Completed on Mon Jul 16 14:10:41 2012
# Generated by iptables-save v1.4.10 on Mon Jul 16 14:10:41 2012
*nat
:PREROUTING ACCEPT [290:28646]
:OUTPUT ACCEPT [224:14409]
:POSTROUTING ACCEPT [240:16782]
-A PREROUTING -i br0 -p tcp -m tcp --dport 21 -j DNAT --to-destination
193.76.244.115:47
-A POSTROUTING -o ppp1 -j MASQUERADE
-A POSTROUTING -o wan -j MASQUERADE
COMMIT
# Completed on Mon Jul 16 14:10:41 2012
# Generated by iptables-save v1.4.10 on Mon Jul 16 14:10:41 2012
*filter
:INPUT ACCEPT [51:1632]
:FORWARD ACCEPT [68:7025]
:OUTPUT ACCEPT [1725:267192]
-A INPUT -i lo -j ACCEPT
-A INPUT -i br0 -j ACCEPT
-A INPUT -p gre -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
```

```
-A INPUT -p tcp -m tcp --dport 2601 -j ACCEPT
-A INPUT -p tcp -m tcp --dport 2604 -j ACCEPT
-A INPUT -p udp -m udp --dport 161 -j ACCEPT
-A INPUT -p udp -m udp --dport 162 -j ACCEPT
-A INPUT -i tap0 -j ACCEPT
-A INPUT -p udp -m udp --dport 4500 -j ACCEPT
-A INPUT -p ipv6-auth -j ACCEPT
-A INPUT -p udp -m udp --sport 500 --dport 500 -j ACCEPT
-A INPUT -p ipv6-crypt -j ACCEPT
-A INPUT -p tcp -m tcp --dport 0 -j ACCEPT
-A INPUT -p tcp -m tcp --dport 0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
-A FORWARD -d 193.76.244.115/32 -p tcp -m tcp --dport 47 -j ACCEPT
-A FORWARD -i tap0 -j ACCEPT
-A OUTPUT -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
COMMIT
# Completed on Mon Jul 16 14:10:41 2012
```

5.4.1 Firewall

Bytton ICR comes with a default firewall configuration, which ensures the security of your local network. Thus the Firewall table is at first empty, here you should define **additiona**l forwarding and filtering rules:



Location: System > Logs
Remote User: superuser

Port Forward

No.	Interface	Protocol	IP D	Port S	SameP/NewP	Port D		
1	BR0	TCP	193.76.244.115	21	NP	47	Edit	Del

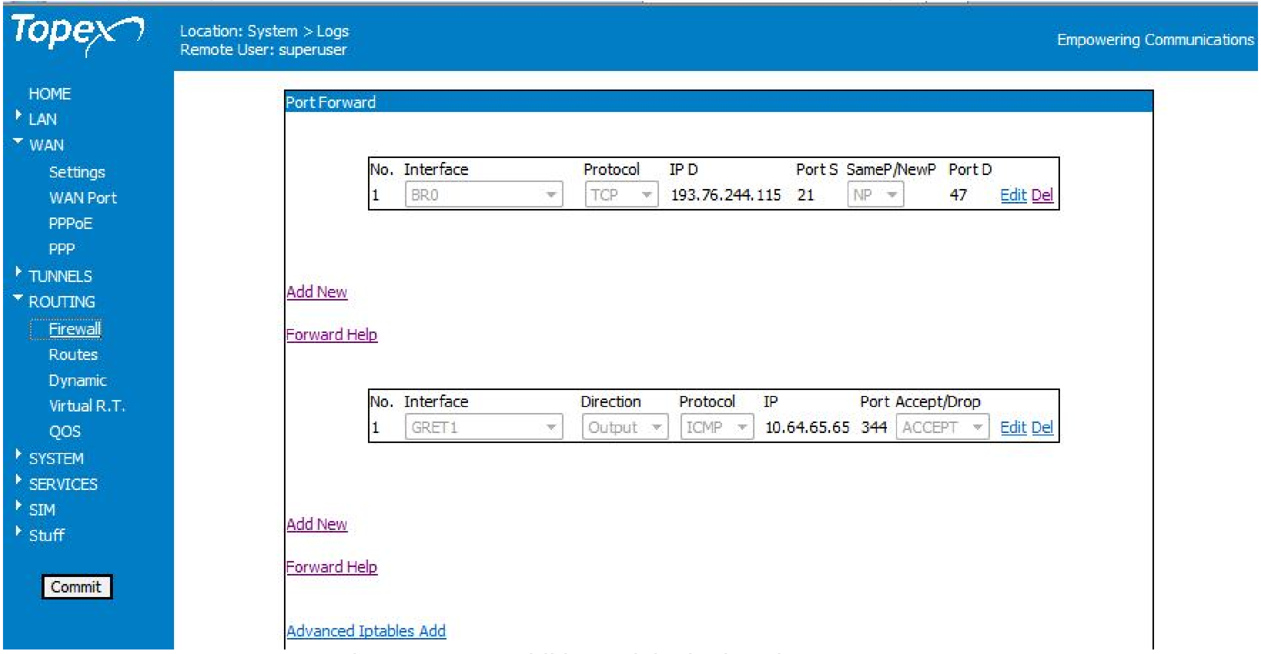
No.	Interface	Direction	Protocol	IP	Port	Accept/Drop		
1	GRET1	Output	ICMP	10.64.65.65	344	ACCEPT	Edit	Del

Please use the COMMIT button to activate your changes

Figure 5-99: The Firewall web page (Port Froward and Iptables Rules).

The “Firewall” page section includes both NAT (redirecting addresses), port forwarding (PAT) and Firewall (accepts or rejects data packets).

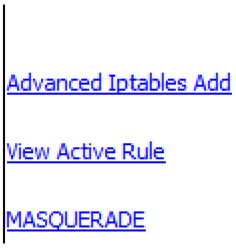
Thus the Bytton ICR Firewall configuration page features two distinct sections: upper pane “Port Forward” and lower pane “Iptables Rules”, each one with its own “Add new” and “Help” links:



No.	Interface	Protocol	IP D	Port S	SameP/NewP	Port D		
1	BR0	TCP	193.76.244.115	21	NP	47	Edit	Del

No.	Interface	Direction	Protocol	IP	Port	Accept/Drop		
1	GRET1	Output	ICMP	10.64.65.65	344	ACCEPT	Edit	Del

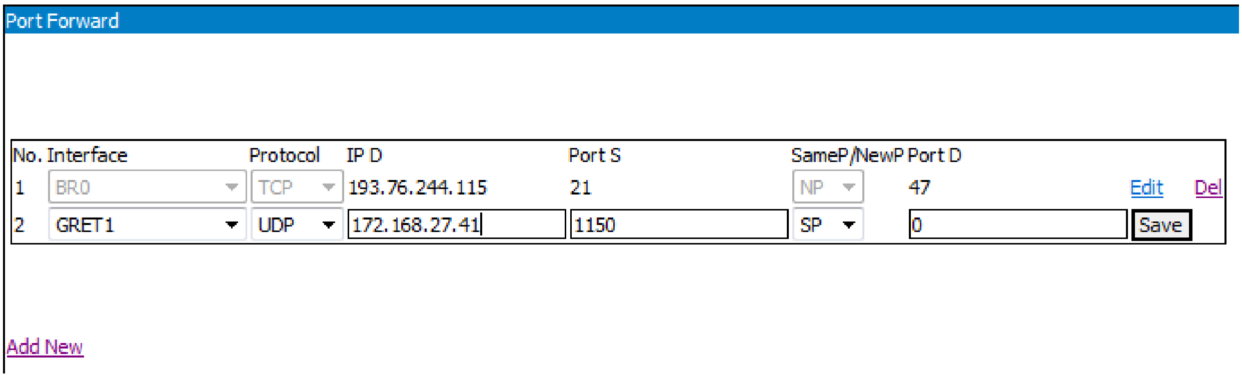
Figure 5-100: Additional links in the Firewall page.



At the bottom of the Firewall page there are another three clickable links, “Advanced Iptables” “View Active Rules” and respectively “MASQUERADE”, which will open additional sections.

Port forward

This section allows the forwarding of firewall ports from the Bytton LTE equipment to a local computer from the coverage area of the router. First use **Add New** to add a record (by default the table is empty), then Edit to change the parameters:



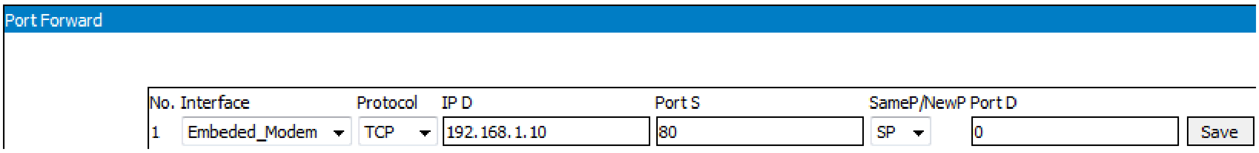
No.	Interface	Protocol	IP D	Port S	SameP/NewP	Port D		
1	BR0	TCP	193.76.244.115	21	NP	47	Edit	Del
2	GRET1	UDP	172.168.27.41	1150	SP	0	Save	

Figure 5-101: Topmost section of the Firewall web page, Port Forward

It forwards a port from a Interface with public IP (WAN) to a interface (LAN) with a private IP.

Example how to forward port 80 TCP from SIM data connection to LAN interface IP 192.168.1.10, over the same port.

No.	**Interface**	**Protocol**	**IP D**	**Port S**	**SameP/NewP**	**Port D**
1	**PPP Embeded**	**TCP**	**192.168.1.10**	**80**	**SP**	**0**



Port Forward

No.	Interface	Protocol	IP D	Port S	SameP/NewP	Port D	
1	Embeded_Modem	TCP	192.168.1.10	80	SP	0	Save

This will generate to firewall "View Active Rule"; after Save > Commit the next rules:

The following rules will be generated - in *nat section:
-A PREROUTING -i ppp1 -p tcp -m tcp --dport 80 -j DNAT --to-destination 192.168.1.10:80

and respectively in the * filter section:
-A FORWARD -d 192.168.1.10 -p tcp -m tcp --dport 80 -j ACCEPT

To forward port 8080 TCP from SIM data connection to LAN interface IP 192.168.1.11, over port 80.

No.	**Interface**	**Protocol**	**IP D**	**Port S**	**SameP/NewP**	**Port D**
1	**PPP Embedded**	**TCP**	**192.168.1.11**	**8080**	**NP**	**80**

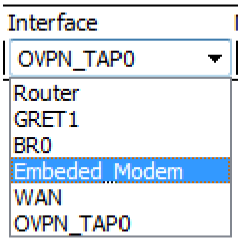
This will generate also to the firewall the next rules:

In *nat section:
-A PREROUTING -i ppp1 -p tcp -m tcp --dport 8080 -j DNAT --to-destination 192.168.1.11:80

and in the * filter section:

```
-A FORWARD -d 192.168.1.11 -p tcp -m tcp --dport 80 -j ACCEPT .
```

Interface – select the type of the used interface in order to communicate with the Bytton equipment.

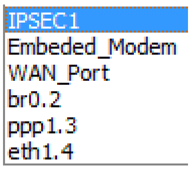


The available options are:

- BR0 – the default bridge that joins all local (wireless or wired) ports of Bytton;
- WAN Ethernet port – the WAN port;
- PPP interface – the Embeded_Modem for mobile (UMTS / HSPA) connection;

GRET1 – the first GRE IP tunnel.
OPVPN_TAP0 – the Open VPN tunnel, working in TAP mode

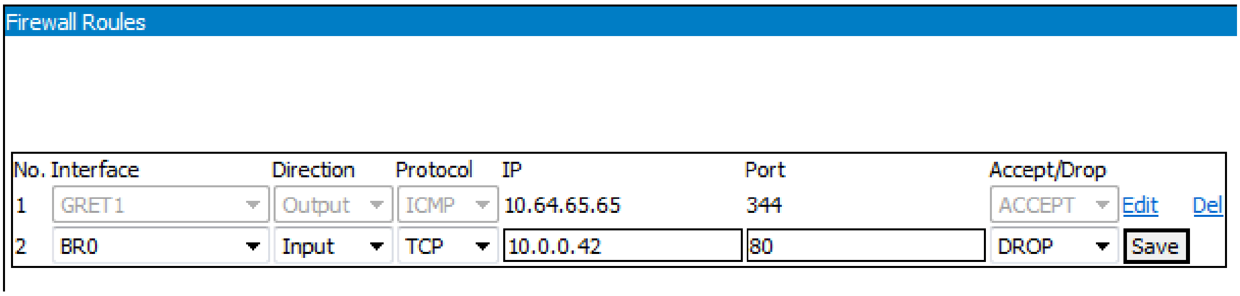
As you can see, in addition to the physical, “real” interfaces, drop list shows **all** logical interfaces that you have defined on the system: bridges, virtual LANs, GRE, IPSEC or Open VPN tunnels, and so on.



- **Protocol** – select the IP protocol. **TCP** and **UDP** protocols are used for communications, while the **ICMP** protocol is for the “ping” command;
- **IP D** – The IP Destination field. It contains the IP address of the computer where the firewall ports will be forwarded. If you enabled rule but leave the IP to the default "0.0.0.0", then no rule will be added to iptables.
- **Port S** – The source port – represents the number of the port that will be forwarded;
- **Same P / New P** – This section allows you to select two options:
  - **SP** – when this option is selected the source port typed in the Port S field will be forwarded on the **same port** to the computer with the IP address from the IP D field. If you select the “SP” option, the “Port D” field will be filled only with the 0 value;
  - **NP** – if you select this option, you will have to fill the “**Port D**” area with the number of the **new** port to which you want to forward the port from the “Port S” field.
- **Port D** – the destination port. This area is filled when the “NP” option is selected in the “Same P / New P” section. It represents the number of port where the source port is forwarded.

IP tables rules

For each interface, you can select, depending upon direction, protocol, IP address and port number, if the respective data packets will be accepted or deleted (DROP):

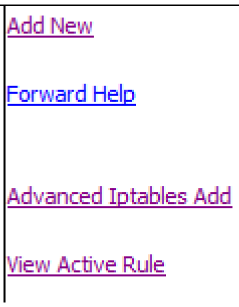


Firewall Roules

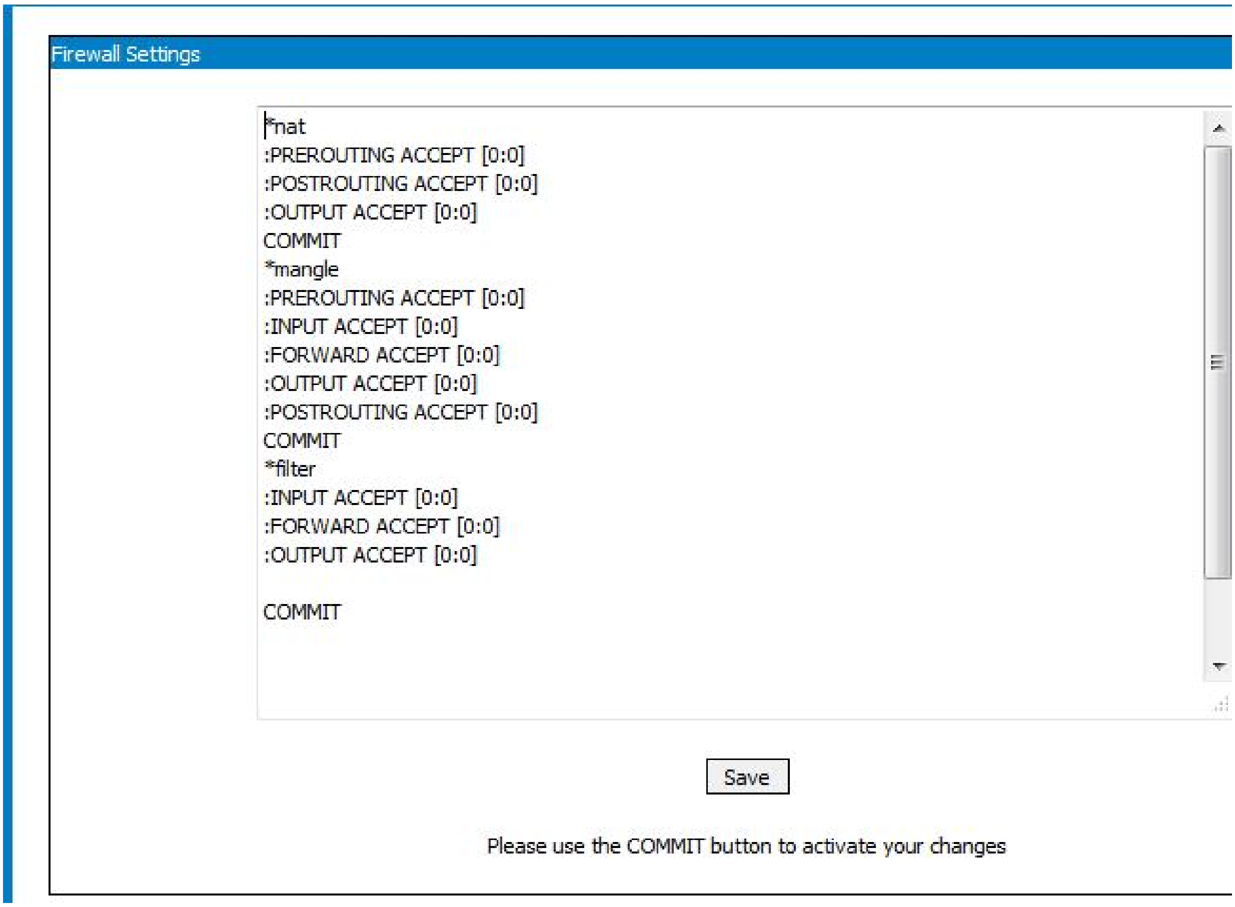
No.	Interface	Direction	Protocol	IP	Port	Accept/Drop		
1	GRET1	Output	ICMP	10.64.65.65	344	ACCEPT	Edit	Del
2	BR0	Input	TCP	10.0.0.42	80	DROP	Save	

Figure 5-102: IP tables (accept/reject rules) section of the Firewall web page

- **No** – the number of the rule for the iptables: 1, 2 and so on.
- **Interface** - select the type of the used interface in order to communicate with the Bytton equipment. The available options are the same as for the **Port forward** section;
- **Direction** – select “Input” to open a communication link or “Output” to get out from the Bytton equipment;
- **Protocol** – select the communication protocol used. The options are TCP, UDP or ICMP;
- **IP** – the IP address of the computer from the coverage area of the Bytton, in the case when in the “Direction” field is set “Forward”. When it is set the “Input” option the IP address will not be filled;
- **Port** – the number of source port which will be open;
- **D/A** – Accept or Drop the respective rule.

Use the link "Advanced Iptables Add" to go directly to the IP tables window and set up additional rules: Figure 5-103: The link "Advanced Iptables Add"	 Add New Forward Help Advanced Iptables Add View Active Rule

You can define firewall rules in this table (expert use only):



```
*nat
:PREROUTING ACCEPT [0:0]
:POSTROUTING ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
COMMIT
*mangle
:PREROUTING ACCEPT [0:0]
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
:POSTROUTING ACCEPT [0:0]
COMMIT
*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]

COMMIT
```

Please use the COMMIT button to activate your changes

Figure 5-104: Directly writing firewall rules (settings in iptables)

General info:

The firewall has several sections, for pre-routing, post-routing, input, output and forwarding of data packets. This refers to the moment of time for the data packets:

PREROUTING: before effective routing, as soon as the packets are received by an interface.

POSTROUTING: after the local routing is performed, but before *leaving* an interface

INPUT: Right before they are sent a local process, the rules apply to external packets that are sent to the equipment.

OUTPUT: Right after they are generated by a local process, rules apply to packets that et out of the BYTTON router.

FORWARD: transfer operations, the data packets are coming in through one interface and getting out via another interface.

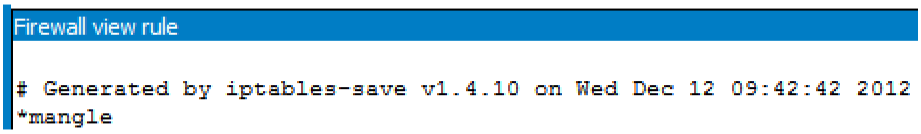
All these sections may be seen and changed or supplemented in the "Firewall Settings".

Don't forget to use the "Save" button at the bottom!

View Active Rules

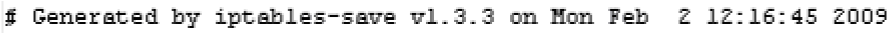
View Active Rule	When you click this link, a web page opens up allowing you to see the active rules for the firewall, rules that you have set in the previous section. Note that at the beginning (on top of the page you can see a line that says "**generated by iptables on Date / Time**", where the timestamp indicates the real moment when the new rules have been saved into the Bytton LTE equipment.

Examples of such timestamps:

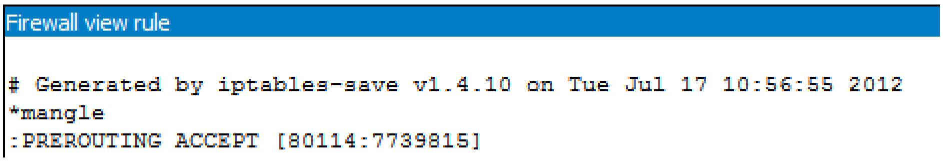


Firewall view rule

```
# Generated by iptables-save v1.4.10 on Wed Dec 12 09:42:42 2012
*mangle
```

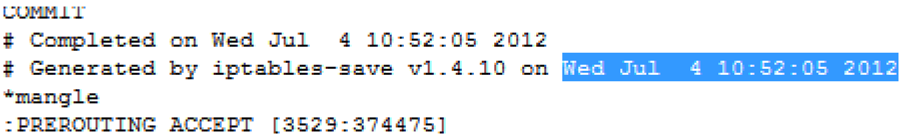


```
# Generated by iptables-save v1.3.3 on Mon Feb  2 12:16:45 2009
```



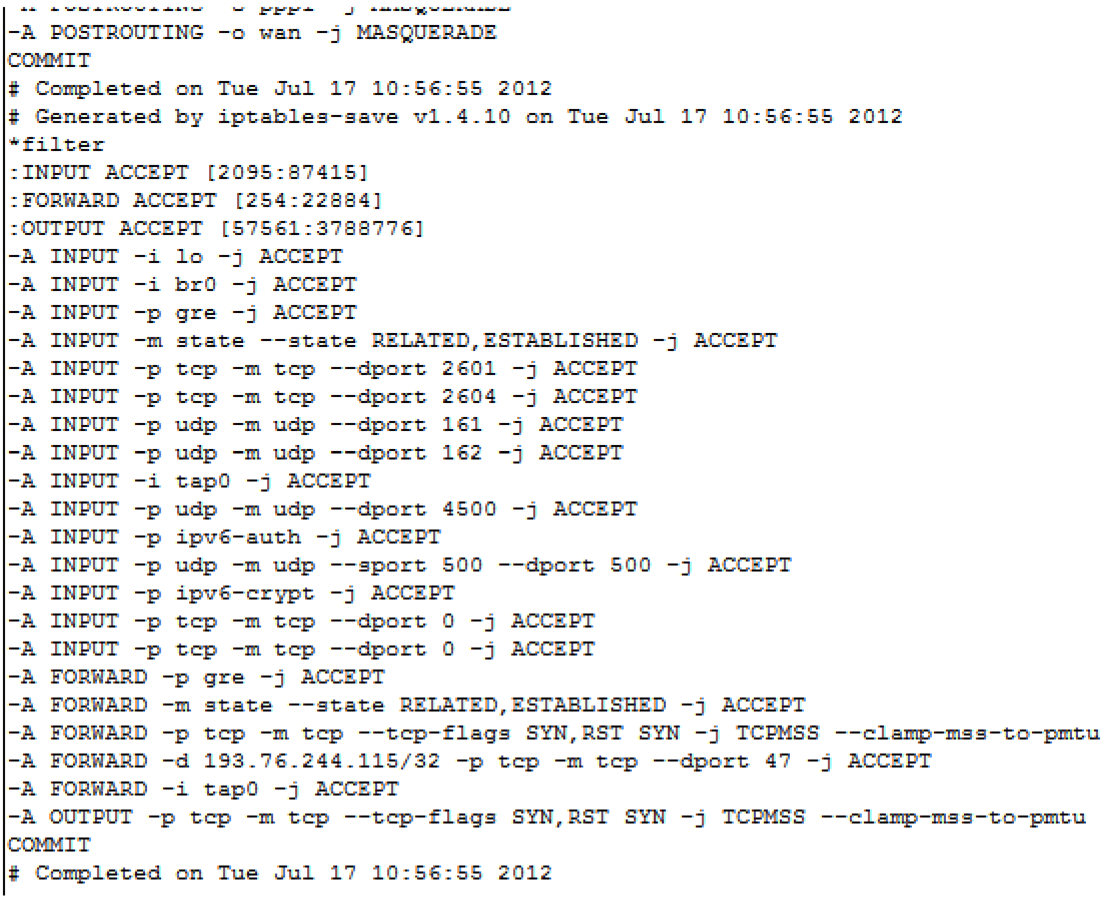
Firewall view rule

```
# Generated by iptables-save v1.4.10 on Tue Jul 17 10:56:55 2012
*mangle
:PREROUTING ACCEPT [80114:7739815]
```



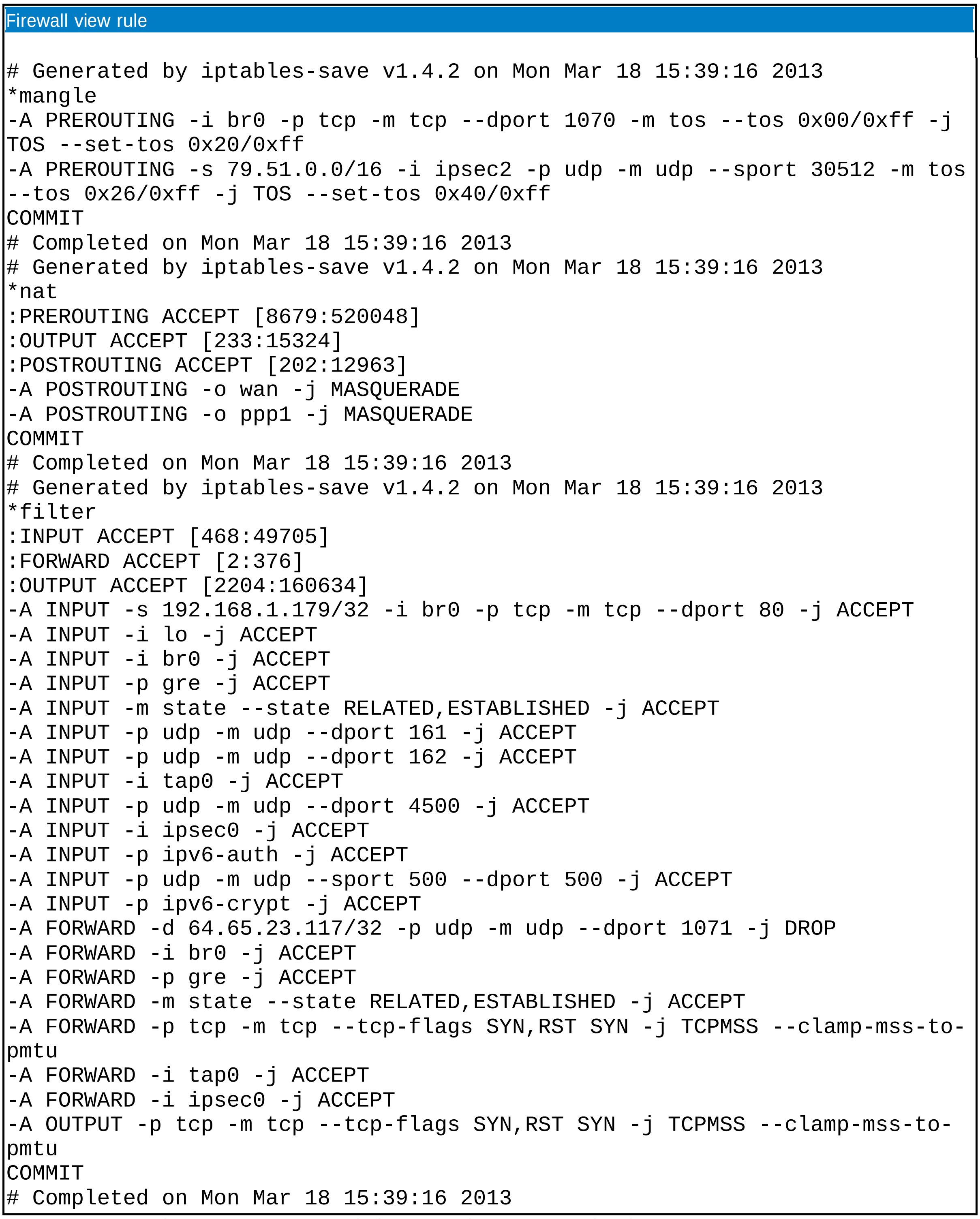
```
COMMIT
# Completed on Wed Jul  4 10:52:05 2012
# Generated by iptables-save v1.4.10 on Wed Jul  4 10:52:05 2012
*mangle
:PREROUTING ACCEPT [3529:374475]
```

View the active rules:



```
-A POSTROUTING -o ppp+ -j MASQUERADE
-A POSTROUTING -o wan -j MASQUERADE
COMMIT
# Completed on Tue Jul 17 10:56:55 2012
# Generated by iptables-save v1.4.10 on Tue Jul 17 10:56:55 2012
*filter
:INPUT ACCEPT [2095:87415]
:FORWARD ACCEPT [254:22884]
:OUTPUT ACCEPT [57561:3788776]
-A INPUT -i lo -j ACCEPT
-A INPUT -i br0 -j ACCEPT
-A INPUT -p gre -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -p tcp -m tcp --dport 2601 -j ACCEPT
-A INPUT -p tcp -m tcp --dport 2604 -j ACCEPT
-A INPUT -p udp -m udp --dport 161 -j ACCEPT
-A INPUT -p udp -m udp --dport 162 -j ACCEPT
-A INPUT -i tap0 -j ACCEPT
-A INPUT -p udp -m udp --dport 4500 -j ACCEPT
-A INPUT -p ipv6-auth -j ACCEPT
-A INPUT -p udp -m udp --sport 500 --dport 500 -j ACCEPT
-A INPUT -p ipv6-crypt -j ACCEPT
-A INPUT -p tcp -m tcp --dport 0 -j ACCEPT
-A INPUT -p tcp -m tcp --dport 0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
-A FORWARD -d 193.76.244.115/32 -p tcp -m tcp --dport 47 -j ACCEPT
-A FORWARD -i tap0 -j ACCEPT
-A OUTPUT -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
COMMIT
# Completed on Tue Jul 17 10:56:55 2012
```

Figure 5-105: Viewing the Active Rules of the firewall of Bytton ICR.



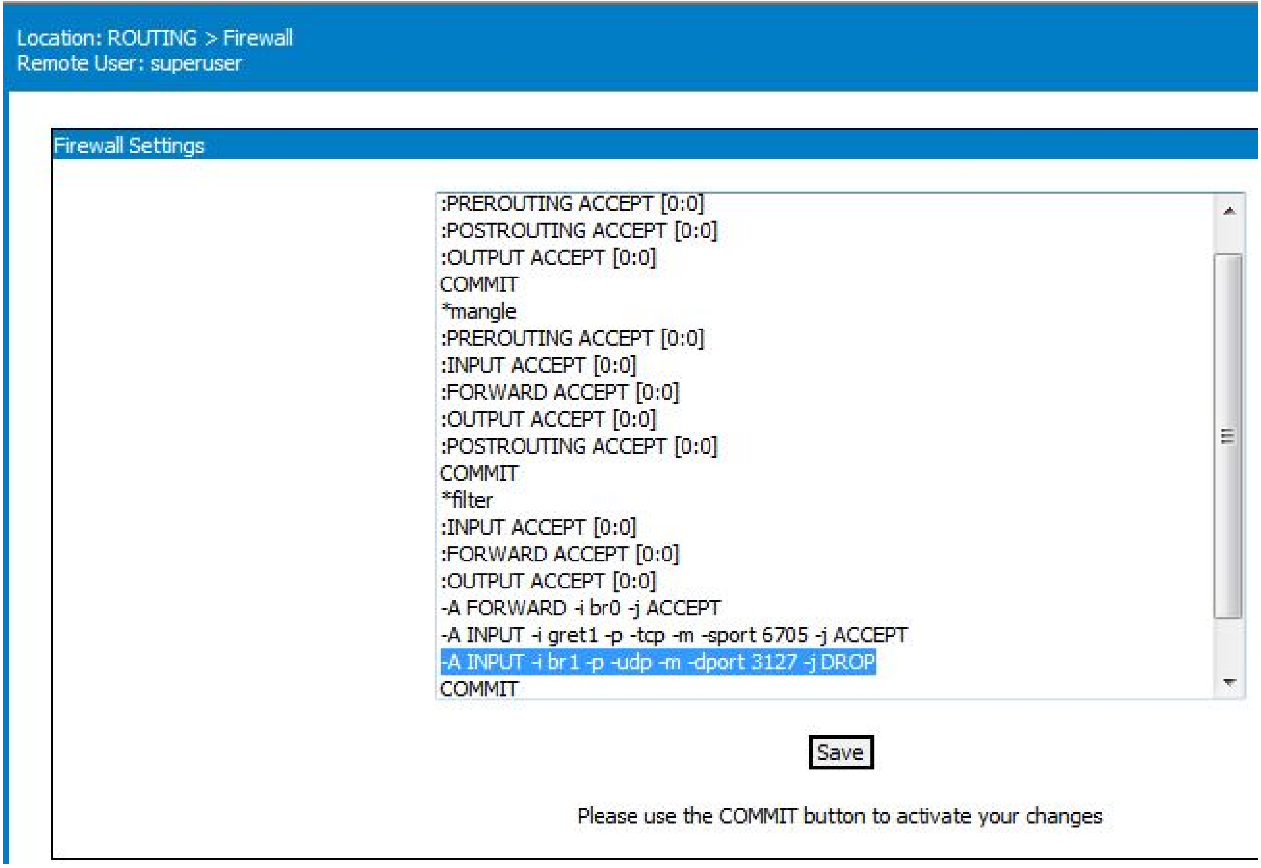
Firewall view rule

```
# Generated by iptables-save v1.4.2 on Mon Mar 18 15:39:16 2013
*mangle
-A PREROUTING -i br0 -p tcp -m tcp --dport 1070 -m tos --tos 0x00/0xff -j
TOS --set-tos 0x20/0xff
-A PREROUTING -s 79.51.0.0/16 -i ipsec2 -p udp -m udp --sport 30512 -m tos
--tos 0x26/0xff -j TOS --set-tos 0x40/0xff
COMMIT
# Completed on Mon Mar 18 15:39:16 2013
# Generated by iptables-save v1.4.2 on Mon Mar 18 15:39:16 2013
*nat
:PREROUTING ACCEPT [8679:520048]
:OUTPUT ACCEPT [233:15324]
:POSTROUTING ACCEPT [202:12963]
-A POSTROUTING -o wan -j MASQUERADE
-A POSTROUTING -o ppp1 -j MASQUERADE
COMMIT
# Completed on Mon Mar 18 15:39:16 2013
# Generated by iptables-save v1.4.2 on Mon Mar 18 15:39:16 2013
*filter
:INPUT ACCEPT [468:49705]
:FORWARD ACCEPT [2:376]
:OUTPUT ACCEPT [2204:160634]
-A INPUT -s 192.168.1.179/32 -i br0 -p tcp -m tcp --dport 80 -j ACCEPT
-A INPUT -i lo -j ACCEPT
-A INPUT -i br0 -j ACCEPT
-A INPUT -p gre -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -p udp -m udp --dport 161 -j ACCEPT
-A INPUT -p udp -m udp --dport 162 -j ACCEPT
-A INPUT -i tap0 -j ACCEPT
-A INPUT -p udp -m udp --dport 4500 -j ACCEPT
-A INPUT -i ipsec0 -j ACCEPT
-A INPUT -p ipv6-auth -j ACCEPT
-A INPUT -p udp -m udp --sport 500 --dport 500 -j ACCEPT
-A INPUT -p ipv6-crypt -j ACCEPT
-A FORWARD -d 64.65.23.117/32 -p udp -m udp --dport 1071 -j DROP
-A FORWARD -i br0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-
pmtu
-A FORWARD -i tap0 -j ACCEPT
-A FORWARD -i ipsec0 -j ACCEPT
-A OUTPUT -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-
pmtu
COMMIT
# Completed on Mon Mar 18 15:39:16 2013
```

Figure 5-107: Actual listing of Active Rules of the firewall of Bytton ICR.

Advanced Iptables Add

This link provides you access to a console where you can add and edit rules for routing:



Location: ROUTING > Firewall
Remote User: superuser

Firewall Settings

```
:PREROUTING ACCEPT [0:0]
:POSTROUTING ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
COMMIT
*mangle
:PREROUTING ACCEPT [0:0]
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
:POSTROUTING ACCEPT [0:0]
COMMIT
*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
-A FORWARD -i br0 -j ACCEPT
-A INPUT -i gret1 -p -tcp -m -sport 6705 -j ACCEPT
-A INPUT -i br1 -p -udp -m -dport 3127 -j DROP
COMMIT
```

Please use the COMMIT button to activate your changes

Figure 5-108: Example and explanations for Advanced Iptables Add firewall rules.

The firewall and advanced packet routing can be configured using the *iptables* commands. For more information, see http://www.netfilter.org.

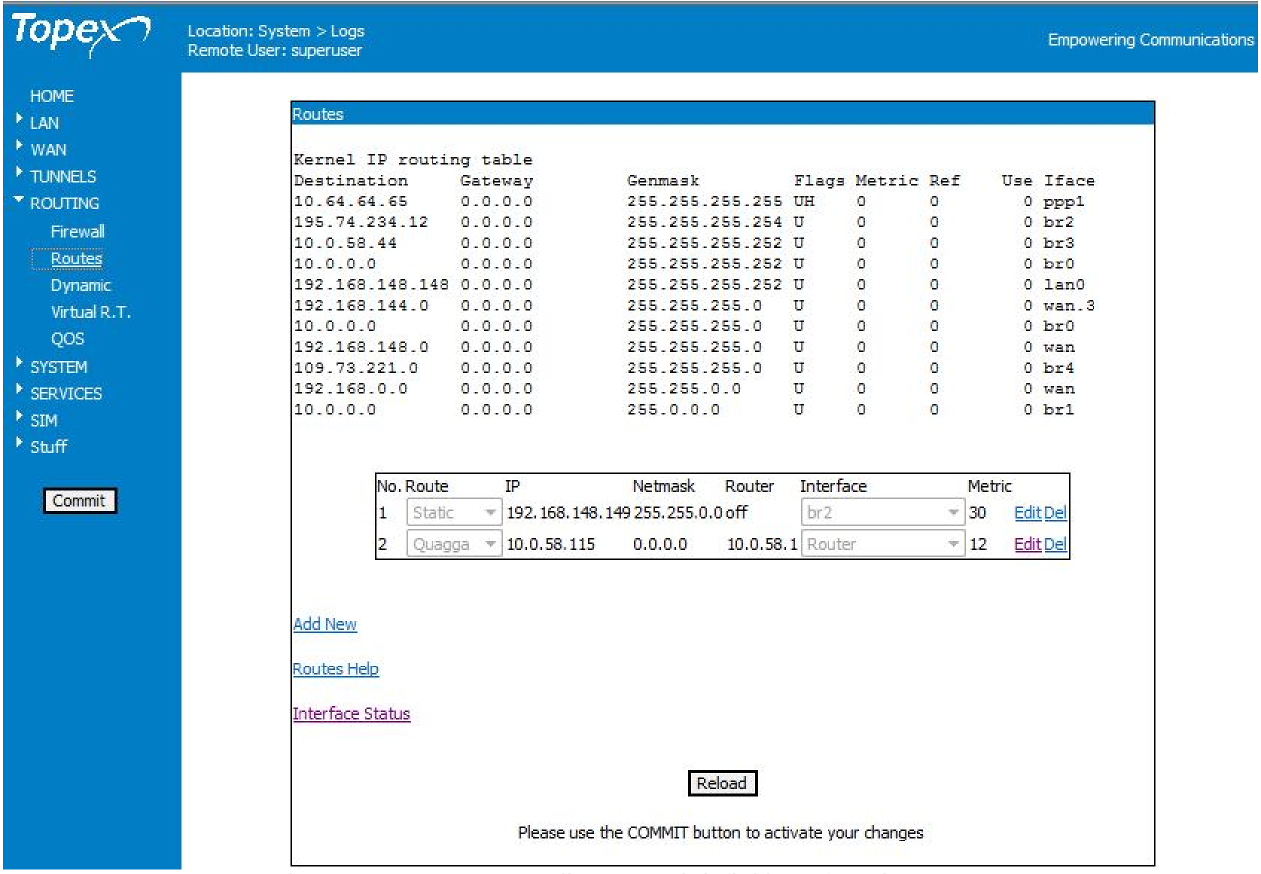
Warning! *Please remember that if you change the default values you may compromise your network security by allowing entrusted access. These configuration options need an advanced level of knowledge regarding network security and Linux kernel packet handling.*

Note: As you may see, the visible settings of the NAT/firewall configuration page are quite few. This happens because the basic rules for address translation and packet filtering **are already defined**, and they are not directly accessible to the user. Since they can't be changed, they are not visible!

What you see are the additional rules, the ones that you are allowed to modify, to supplement or delete.
The firmware of Bytton LTE automatically installs the basic rules that are required. For instance, if you enable the Webcam feature, the firmware opens the port 2000 for TCP traffic, if you enable the NTP service it opens port 123 for UDP traffic, and so on.

5.4.2 Static Routes

Routing means determining and prescribing the path or method used for forwarding data packets.
This option page is concerned with fixed (static) routes.
It shows the current routing table for Bytton LTE and allows you to define several static routes.



Location: System > Logs
Remote User: superuser

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
195.74.234.12   0.0.0.0         255.255.255.254 U     0      0        0 br2
10.0.58.44      0.0.0.0         255.255.255.252 U     0      0        0 br3
10.0.0.0        0.0.0.0         255.255.255.252 U     0      0        0 br0
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
192.168.144.0   0.0.0.0         255.255.255.0   U     0      0        0 wan.3
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
109.73.221.0    0.0.0.0         255.255.255.0   U     0      0        0 br4
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
10.0.0.0        0.0.0.0         255.0.0.0       U     0      0        0 br1
```

No.	Route	IP	Netmask	Router	Interface	Metric	
1	Static	192.168.148.149	255.255.0.0	off	br2	30	Edit Del
2	Quagga	10.0.58.115	0.0.0.0	10.0.58.1	Router	12	Edit Del

Add New

Routes Help

Interface Status

Reload

Please use the COMMIT button to activate your changes

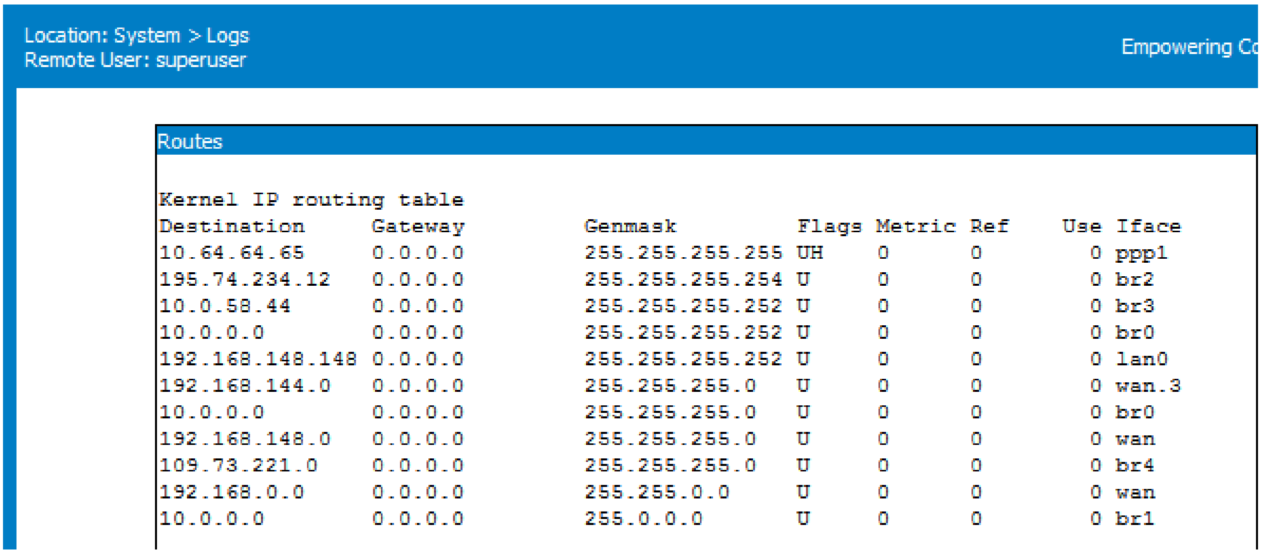
Figure 5-109: Routes – display and definition of static routes.

Note that the Static Routes configuration screen also has two distinct parts:

the **upper** pane **displays** the current routing table, such as:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
194.102.255.23  192.168.1.8     255.255.255.255 UGH   0      0        0 wan
195.74.234.12   0.0.0.0         255.255.255.254 U     0      0        0 br2
10.0.0.0        0.0.0.0         255.255.255.252 U     0      0        0 br0
192.168.144.0   0.0.0.0         255.255.255.0   U     0      0        0 wan.3
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
10.0.0.0        0.0.0.0         255.0.0.0       U     0      0        0 br1
```

Or:

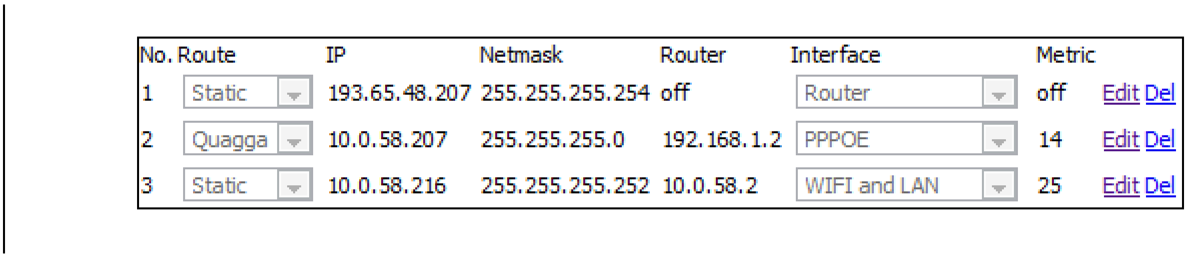


```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
195.74.234.12   0.0.0.0         255.255.255.254 U     0      0        0 br2
10.0.58.44      0.0.0.0         255.255.255.252 U     0      0        0 br3
10.0.0.0        0.0.0.0         255.255.255.252 U     0      0        0 br0
192.168.148.148 0.0.0.0         255.255.255.252 U     0      0        0 lan0
192.168.144.0   0.0.0.0         255.255.255.0   U     0      0        0 wan.3
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
109.73.221.0    0.0.0.0         255.255.255.0   U     0      0        0 br4
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
10.0.0.0        0.0.0.0         255.0.0.0       U     0      0        0 br1
```

Figure 5-110: Static Routes – upper panel, display of static routes.

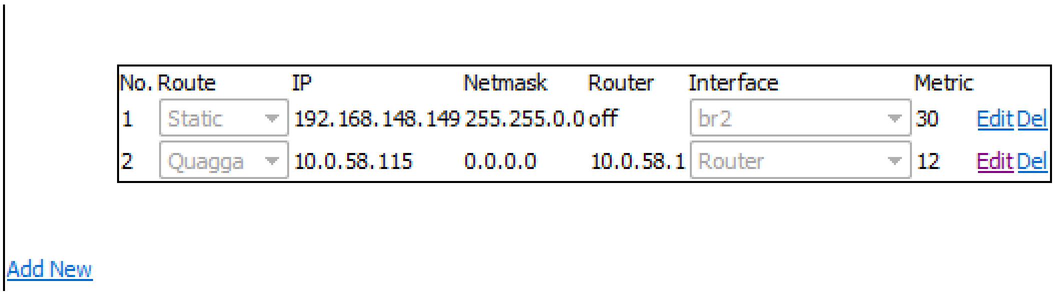
Here you can only see the existing static routes for Bytton LTE (default routes, gateway, masquerading if used, interface used, and so on), you cannot perform changes;

the **lower** pane allows you to **define** several static routes:



No.	Route	IP	Netmask	Router	Interface	Metric	
1	Static	193.65.48.207	255.255.255.254	off	Router	off	Edit Del
2	Quagga	10.0.58.207	255.255.255.0	192.168.1.2	PPPOE	14	Edit Del
3	Static	10.0.58.216	255.255.255.252	10.0.58.2	WIFI and LAN	25	Edit Del

Or:

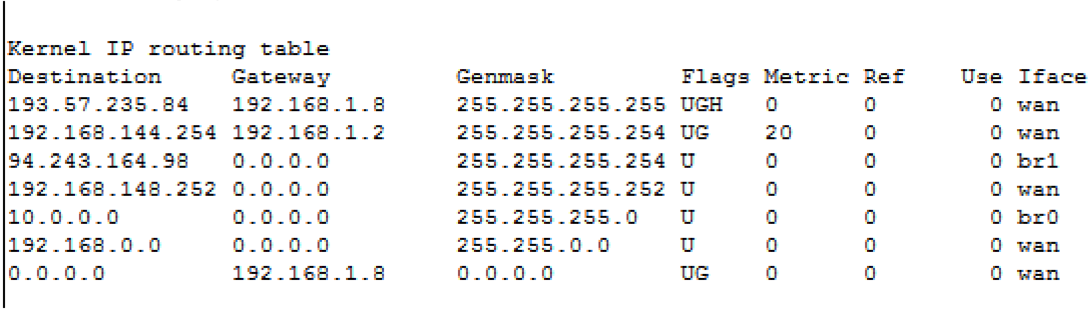


No.	Route	IP	Netmask	Router	Interface	Metric	
1	Static	192.168.148.149	255.255.0.0	off	br2	30	Edit Del
2	Quagga	10.0.58.115	0.0.0.0	10.0.58.1	Router	12	Edit Del

Add New

Figure 5-111: Static Routes – lower panel, table for defining display of routes.

Static Route Display



```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
193.57.235.84   192.168.1.8     255.255.255.255 UGH   0      0        0 wan
192.168.144.254 192.168.1.2     255.255.255.254 UG    20     0        0 wan
94.243.164.98   0.0.0.0         255.255.255.254 U     0      0        0 br1
192.168.148.252 0.0.0.0         255.255.255.252 U     0      0        0 wan
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         192.168.1.8     0.0.0.0         UG    0      0        0 wan
```

Figure 5-112: Routes – Static Routes Display.

The routes are shown top downwards from the most specific to the least specific.

Destination - the destination network or host system. Declaring a default route means adding a route with 0.0.0.0 as its destination.

Gateway - the access gateway the respective routing entry points to. If this field has only zeroes (0.0.0.0) or an asterisk (*), this means no gateway is used, the destination network is connected directly to the computer.

Genmask - the bit mask applied to the destination. It shows the “generality” of the route.

Flags - indicator flags that describe some characteristics of the route. Such flags are:

U - the route is active and operating, the interface to be used is up;

G - the route uses an external gateway (the network interfaces of the system supply routes to the networks which are directly connected, all other routes use external gateways. Thus, the networks which are directly connected don’t have the G flag, but it is activated for all other routes).

H – it is a route towards a single host instead of a network.

D - the table entry has been generated dynamically, either by a routing protocol or by a an ICMP redirect message (see section 3.5).

M – this route was modified by a dynamic routing protocol;

R - the route vas re-activated following update by dynamic routing protocol. Routes may be configured as passive or static even when a protocol for dynamic routing is used.

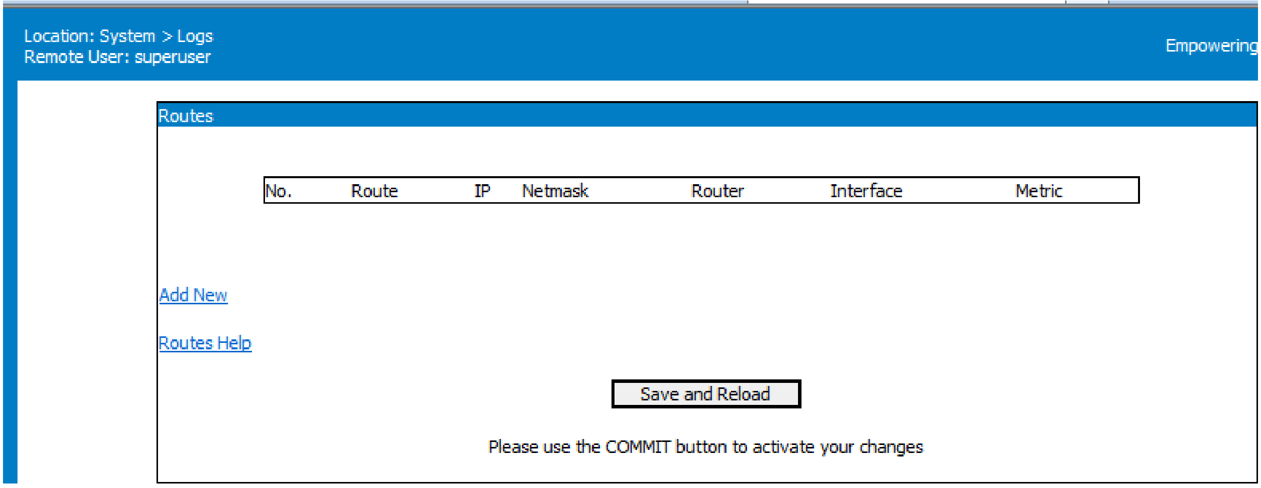
Other fields refer to the **Metric** (routing cost), the number of references to this route, etc,

Finally, **Iface** is the name of the network interface used for this route.
For Ethernet interfaces the names will be *lan0*, lan1, lan2 and so on, for the PPP interfaces the names will be **ppp1**, **ppp2**, for WAN you have **wan** and **wan0**, for the GRE tunnels, **gret1**, **gret2** and so on, while the default bridge is **br0** and the VLAN is **br0.2**.

Static Route Definition

Such a static route is a possible path from a device to its destination or to another host.
*You **must** insert predefined rules of routing for BYTTON in case you append one or several network equipments such as routers behind the Bytton LTE device, to share the same connection to the mobile Internet.*
This way the Bytton router will be able to know where it may deliver the data packets coming from the Internet with different destination IP addresses.

At first, the routing table is empty, so you must use Add New to create a new entry:



Location: System > Logs
Remote User: superuser

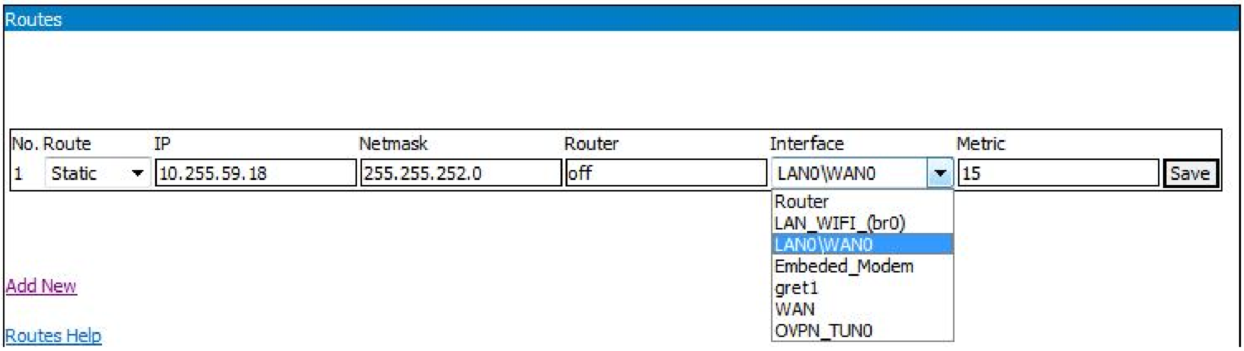
Empowering

Routes

No.	Route	IP	Netmask	Router	Interface	Metric

Please use the COMMIT button to activate your changes

then Edit to modify it and finally the **Save** button to individually save the respective rule.

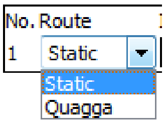


Routes

No.	Route	IP	Netmask	Router	Interface	Metric	
1	Static	10.255.59.18	255.255.252.0	off	LAN0\WAN0	15	Save

Figure 5-113: Routes – Definition of Static Routes.

For each route shown as above you may perform these settings:



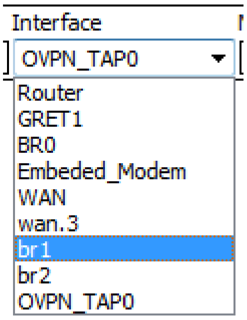
No. Route
1 Static

Route: How it will be defined – statically, by the kernel (operating system) or dynamically, by the Quagga routing program:

IP: Address of the remote network or host to which you want to assign a static route.
Netmask: the subnet mask determines which portion of the destination IP address is the network part and which is the host part.

Router: the gateway to be used, enter here the IP address of the router which allows for contact between Bytton and the remote host or network. If you specify a gateway here, it will send the route to the next router.
This specified Router must be reachable first!
If the Router is “off”, then you need to set up an interface.

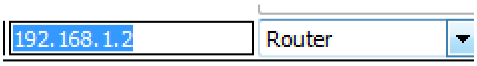
Interface: the interface to be used for the respective route.
This setting forces the route to be associated with the specified device.
You may select one of the following available options: BR0 for local network (WIFI and LAN Ethernet ports), WAN Ethernet port, PPP (embedded HSPA modem), PPPoE (PPP link over the Ethernet), or **Router**.



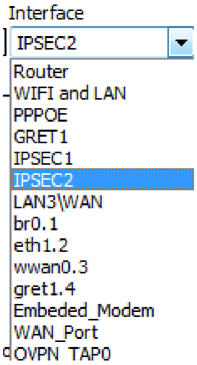
Interface
OVPN_TAP0

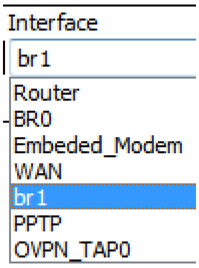
Figure 5-114: Routes – Selecting Interface for Static Routes.

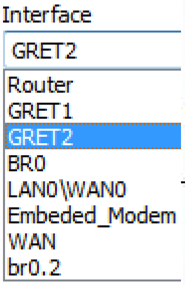
When you choose for interface “Router”, of course you will need to set a Router IP.

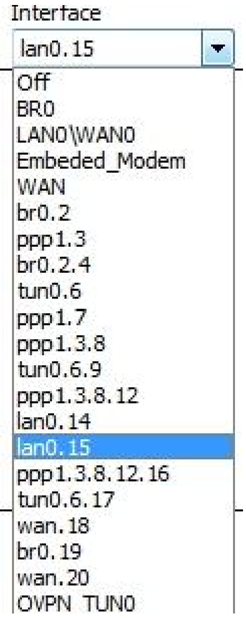


192.168.1.2 Router









Here also, besides the physical interfaces shown above, the Drop list for “Interface” includes all logical (virtual) interfaces: GRE tunnels, IPSEC tunnels, LAN0/Wan0 port, bridges defined, Virtual LANs, Open VPN or PPTP tunnels, and so on:

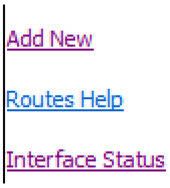
Metric:

Routing now features also the *metric* parameter: in case of multiple paths to the destination, you may specify the metric for each route (0, 1, and 2 etc).
The routing program will check the metric to select the shortest route for the data packets.

After performing changes over the firewall and routing settings, it is recommended that you click again the link “View Active Rules”, explained previously, to check that the rules generated by iptables are the ones you really want.

See below an example of such routes:

```
# Generated by iptables-save v1.4.10 on Fri Jun 22 07:49:03 2012
*filter
:INPUT ACCEPT [364:46765]
:FORWARD ACCEPT [50:4214]
:OUTPUT ACCEPT [2398:251024]
-A INPUT -i lo -j ACCEPT
-A INPUT -i br0 -j ACCEPT
-A INPUT -p gre -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -i ppp3 -j ACCEPT
-A INPUT -i tap0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
-A FORWARD -d 193.76.244.115/32 -p tcp -m tcp --dport 47 -j ACCEPT
-A OUTPUT -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-pmtu
COMMIT
# Completed on Fri Jun 22 07:49:03 2012
# Generated by iptables-save v1.4.10 on Fri Jun 22 07:49:03 2012
*nat
:PREROUTING ACCEPT [375:39168]
:OUTPUT ACCEPT [279:18046]
:POSTROUTING ACCEPT [186:11701]
-A PREROUTING -i br0 -p tcp -m tcp --dport 21 -j DNAT --to-destination
193.76.244.115:47
-A POSTROUTING -o ppp3 -j MASQUERADE
-A POSTROUTING -o tap0 -j MASQUERADE
-A POSTROUTING -o ppp1 -j MASQUERADE
-A POSTROUTING -o wan -j MASQUERADE
COMMIT
# Completed on Fri Jun 22 07:49:03 2012
```

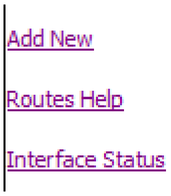


For further details, click the “**Routes help**” link to see the embedded help with examples:

```
In the Routes web page you have the following columns:

No.     Route   IP      Netmask Router  Interface       Metric

No - Number of the route.
Route - Type of the route:
        Static - will add a static route.
        Quagga - will send the route to Dynamic route Daemon.

IP - Ip that you like to add a route.
Netmask - Netmask for IP.

Ex:
route to IP: 10.10.10.1 netmask 255.255.255.255 will add a host route.
route to IP: 10.10.10.1 netmask 255.255.255.0 will fail to be add netmask / ip
conflict.

route to a network: 10.10.10.0 netmask 255.255.255.0

New EX:
Route add to host from 10.216.240.225 to 10.216.240.230

If a route to a network is needed you will set IP = Network IP not a Host IP.

For this example the corect connfig is:
IP=10.216.240.224
Netmask=255.255.255.248

Address:   10.216.240.225       00001010.11011000.11110000.11100 001
Netmask:   255.255.255.248 = 29 11111111.11111111.11111111.11111 000
Wildcard:  0.0.0.7              00000000.00000000.00000000.00000 111
=>
Network:   10.216.240.224/29    00001010.11011000.11110000.11100 000
HostMin:   10.216.240.225       00001010.11011000.11110000.11100 001
HostMax:   10.216.240.230       00001010.11011000.11110000.11100 110
Broadcast: 10.216.240.231       00001010.11011000.11110000.11100 111
Hosts/Net: 6                     Class A, Private Internet

Router (or gateway) - Will send the route to the next router.
The specified Router must be reachable first.
If Router is off you need to set a interface.

Interface - Will add the route to interface.
Force the route to be associated with the specified device.
If interface is Router you need to set a Router IP.

Metric - set the metric field in the routing table.
```

Figure 5-115: Routes – Embedded help for defining static routes

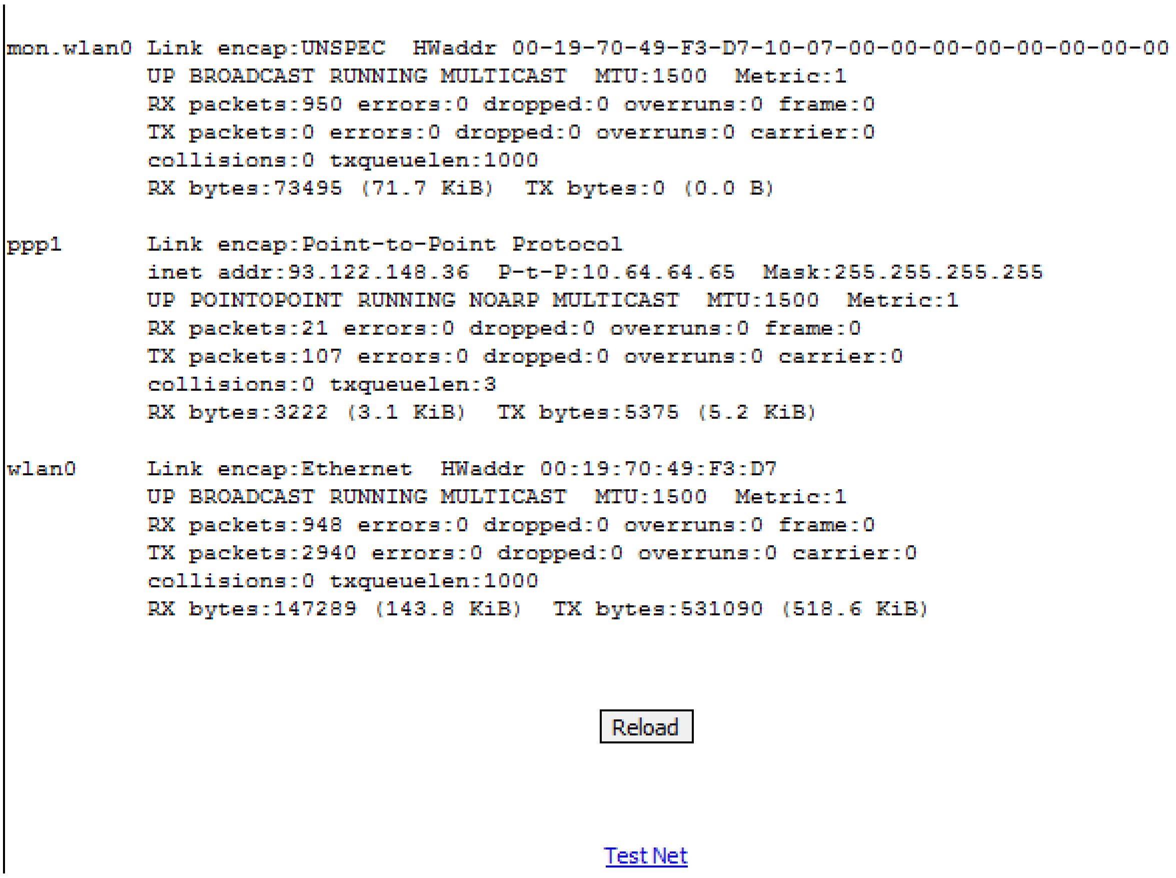
Interface Status:
When you click the link "Interface Status", it will show the state of *all network interfaces* of the Bytton LTE device, external or internal, physical or virtual. Interface Status has been explained in the chapter about LAN, but it is used also here, since it shows the logical interfaces created over the Bytton equipment:



```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:10.0.0.1  Bcast:10.0.0.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1488  Metric:1
          RX packets:455237 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1189164 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:30974697 (29.5 MiB)  TX bytes:1754139440 (1.6 GiB)

br1       Link encap:Ethernet  HWaddr 16:7A:CD:4F:F3:83
          inet addr:94.243.164.98  Bcast:94.255.255.255  Mask:255.255.255.254
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:454877 errors:174 dropped:0 overruns:0 frame:0
          TX packets:1189543 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:37377143 (35.6 MiB)  TX bytes:1754266004 (1.6 GiB)
          Base address:0x2200

lan0      Link encap:Ethernet  HWaddr 00:50:C2:F5:23:27
          UP BROADCAST RUNNING MULTICAST  MTU:1488  Metric:1
          RX packets:1179 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2224 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:260820 (254.7 KiB)  TX bytes:409600 (400.0 KiB)
          Base address:0x2000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:15664 errors:0 dropped:0 overruns:0 frame:0
          TX packets:15664 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:877964 (857.3 KiB)  TX bytes:877964 (857.3 KiB)

mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-10-07-00-00-00-00-00-00-
00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:7450 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:650277 (635.0 KiB)  TX bytes:0 (0.0 B)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1420977 errors:272 dropped:0 overruns:0 frame:0
          TX packets:451456 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1767668651 (1.6 GiB)  TX bytes:34203167 (32.6 MiB)
          Base address:0x3000

wan:0     Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.148.254  Bcast:192.168.148.255
Mask:255.255.255.252
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          Base address:0x3000

wlan0     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2124 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:339480 (331.5 KiB)
```

Figure 5-116: Interface Status – shows the current state of all network interfaces.

Use the button “Reload” located at the bottom to read the latest statistics about the network interfaces of Bytton LTE:

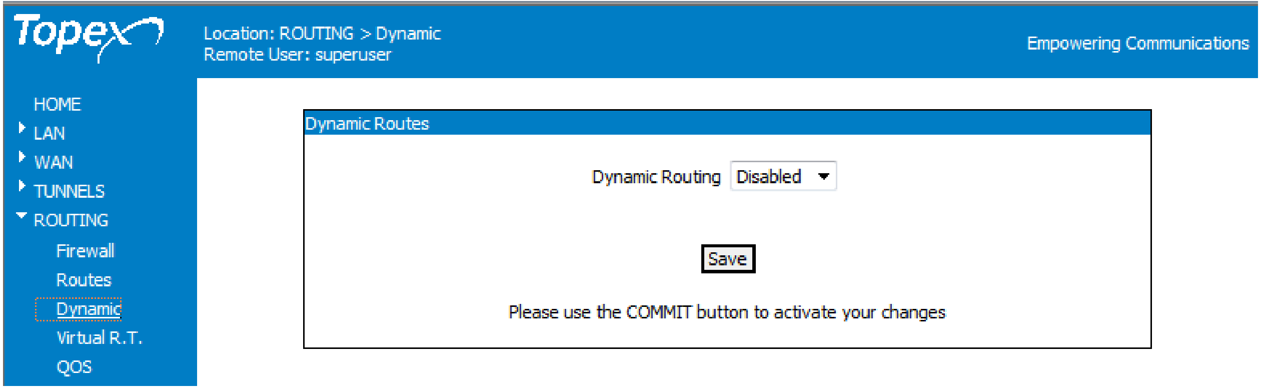


```
mon.wlan0 Link encap:UNSPEC  HWaddr 00-19-70-49-F3-D7-10-07-00-00-00-00-00-00-00-00
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:950 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:73495 (71.7 KiB)  TX bytes:0 (0.0 B)

ppp1      Link encap:Point-to-Point Protocol
          inet addr:93.122.148.36  P-t-P:10.64.64.65  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:21 errors:0 dropped:0 overruns:0 frame:0
          TX packets:107 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:3222 (3.1 KiB)  TX bytes:5375 (5.2 KiB)

wlan0     Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:948 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2940 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:147289 (143.8 KiB)  TX bytes:531090 (518.6 KiB)
```

Figure 5-117: Details of **Interface Status** window, including the “Reload” button.

5.4.3 Dynamic routes

The last configuration page in “Routing” is for dynamic routing. As an alternative to defining static routes for the connection of your network to the Internet using Bytton, you may choose Dynamic Routing.

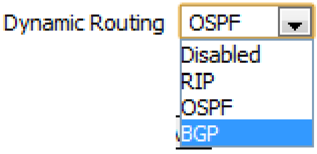


Dynamic Routing: Disabled

Please use the COMMIT button to activate your changes

Figure 5-118: ROUTING page – section Dynamic Routes.

You may select to leave the Dynamic Routing Disabled (the default setting) or to use either RIP, OSPF or BGP algorithm for dynamic routing.



In the Dynamic mode of routing, you need not specify fixed routes. Instead, the router adjusts automatically to physical changes in the layout of the network and it exchanges routing tables with other routers.

The available options for dynamic routes are:

RIP - Routing Information Protocol.

It was the first routing protocol implemented for dynamic routing and hence it is widely used. RIP is a distance-vector routing protocol.

The route of the data packets is determined in such way as to have the fewest possible number of hops between the source and the destination.

OSPF - Open Shortest Path First.

This is a link state routing protocol, as opposed to distance vector protocol (RIP). It is an Internet standard IGP defined in RFCs 1583 1793 and RFC 2328.

OSPF Runs directly over IP and interfaces with SNMP for configuration and control purposes.

As a link-state routing protocol, OSPF contrasts with RIP and IGRP, which are distance -vector routing protocols

The SPF (shortest path first) algorithm used by OSPF has the advantage is that it results in smaller more frequent updates everywhere, thus it makes for a stable network.

Its disadvantage is that it is intensive, it requires for processing more CPU power and memory.

BGP - Border Gateway Protocol).

It is a protocol for exchanging routing information between gateway hosts (each has its own router) in a network of “autonomous systems” (AS). For this, it maintains a table of IP networks or 'prefixes' which designate network reach-ability among autonomous systems.

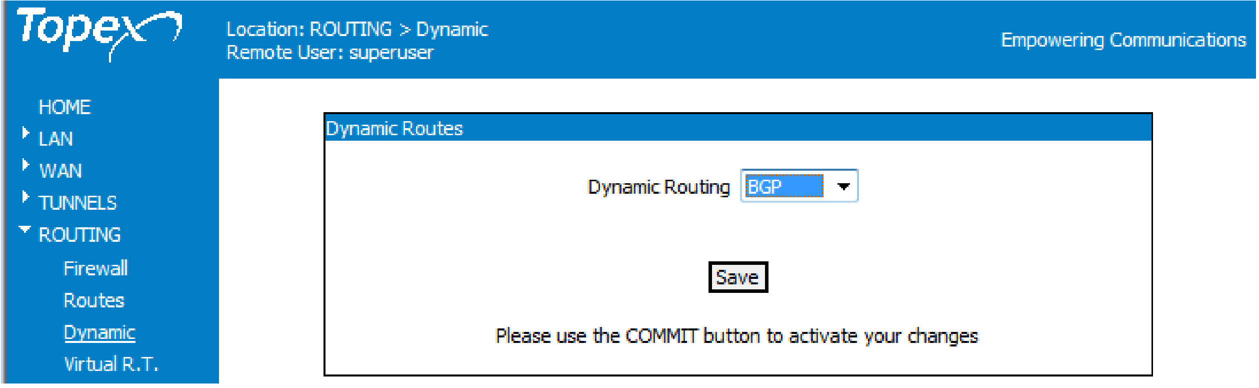
BGP does not use traditional Interior Gateway Protocol (IGP) metrics like RIP or OSPF, but instead makes routing decisions based on path, network policies and/or rule-sets.

BGP has been created to replace the Exterior Gateway Protocol (EGP) protocol to allow fully decentralized routing in order to transition from the core network model to a decentralized system that is more like the present day Internet.

Since 1994, version four of the BGP has been in use on the Internet. All previous versions are now obsolete. And since January 2006, version 4 is codified in RFC 4271, which went through more than 20 drafts based on the earlier RFC 1771 version 4.

Why BGP?

Obviously, most Internet users do not employ BGP directly. But almost every Internet service providers have to use BGP in order to establish routing between one another (especially if they are multihomed). Thus, even if less well-known, BGP is one of the most important protocols of the Internet!
And very large private IP networks use BGP internally, allowing the joining of a number of large OSPF networks where the OSPF protocol itself would become inoperative.
Also, the usage of BGP allows for increased redundancy. This is why the Dynamic routing feature of Bytton LTE does include the BGP protocol too, besides RIP and OSPF.



Dynamic Routing BGP

Please use the COMMIT button to activate your changes

Quagga routing

Quagga is a routing software suite for Unix platforms such as Linux, and it has been embedded into the Bytton LTE firmware. It provides implementations of OSPF, RIP and BGP-4. The architecture of Quagga consists of a core daemon and several clients which typically implement a routing protocol and communicate routing updates to the daemon. Currently there are clients for various dynamic routing protocols: OSPF, RIP and BGPv4+.

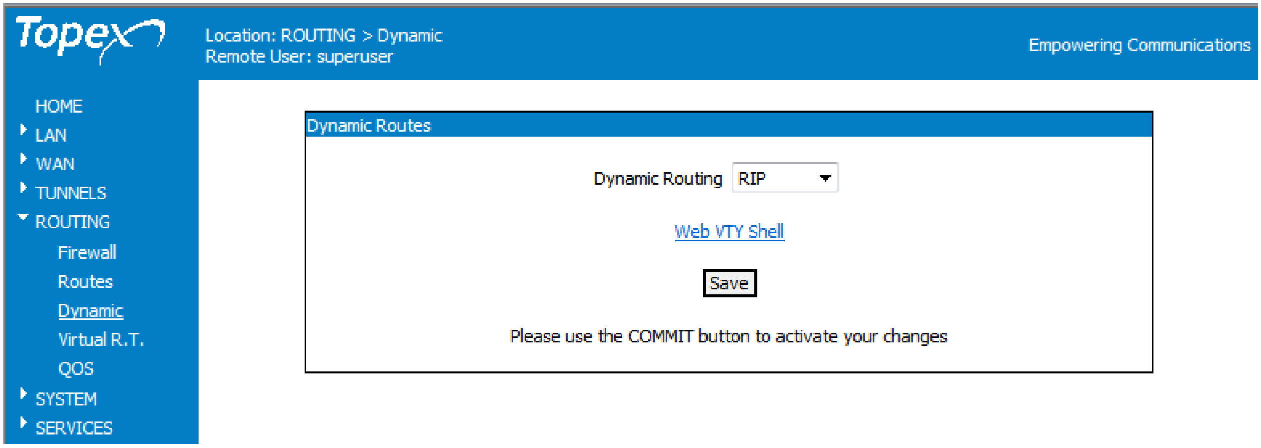
In order to configure the static or dynamic routes with Quagga, the system administrator must connect to the programming console of BYTTON via SSH.

Topex Bytton LTE lets you choose for dynamic routing the protocol that you think is the best for the actual condition of your applications.

Don’t forget to click the Save button and then “Commit” to make permanent the change you performed!

VTY console

When you enable Dynamic routing (select RIP, OSPF or BGP), a new link appears in the configuration window, “Web VTY Shell”:



Dynamic Routing RIP

Please use the COMMIT button to activate your changes

Figure 5-119: Dynamic ROUTING page –“VTY Shell” shows up when Dynamic Routing is enabled.

When you click on the link Web VTY Shell, the web shell for the Quagga program show up, allowing you to enter advanced commands for Quagga routing:

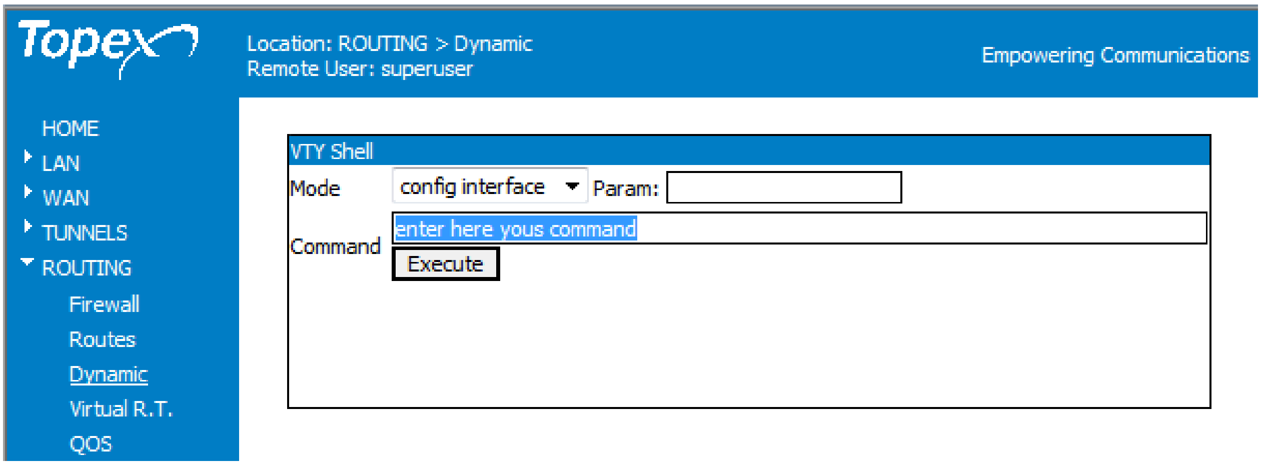
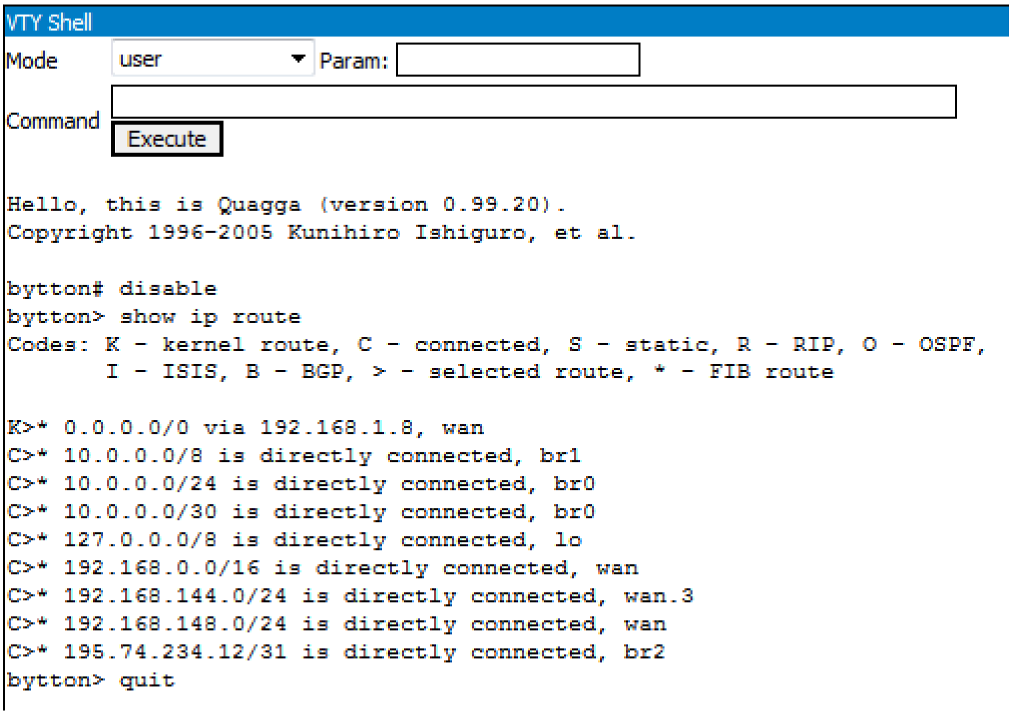


Figure 5-120: Entering commands and parameters in “VTY Shell”.

See below some results of using the Web console for Quagga:

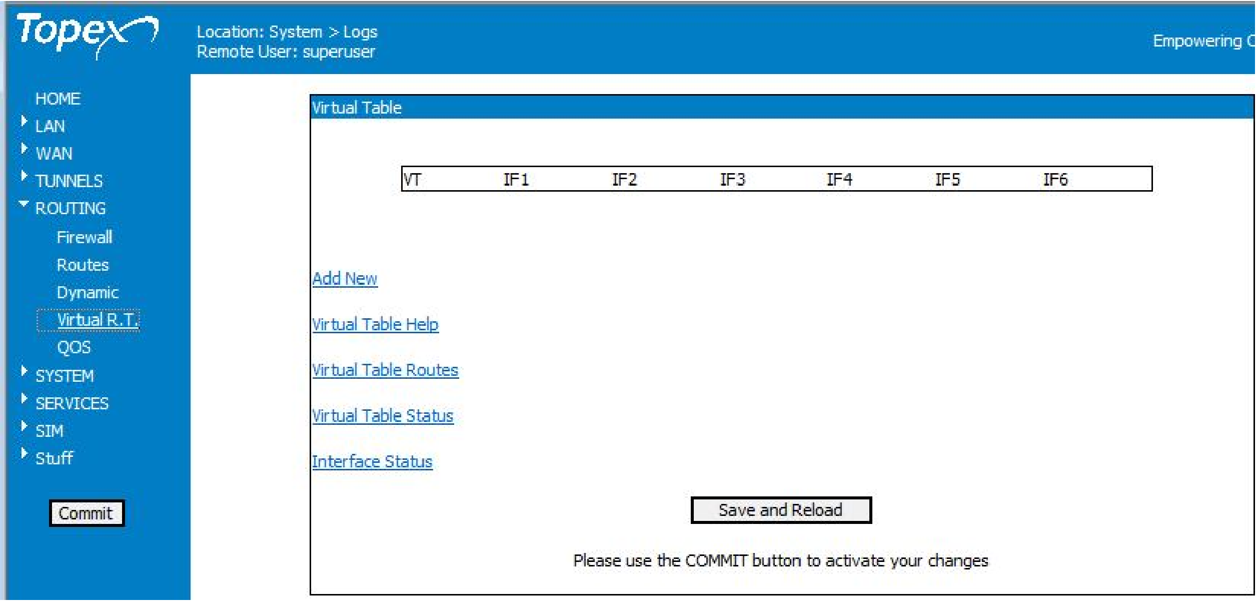


```
Hello, this is Quagga (version 0.99.20).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

bytton# disable
bytton> show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

K>* 0.0.0.0/0 via 192.168.1.8, wan
C>* 10.0.0.0/8 is directly connected, br1
C>* 10.0.0.0/24 is directly connected, br0
C>* 10.0.0.0/30 is directly connected, br0
C>* 127.0.0.0/8 is directly connected, lo
C>* 192.168.0.0/16 is directly connected, wan
C>* 192.168.144.0/24 is directly connected, wan.3
C>* 192.168.148.0/24 is directly connected, wan
C>* 195.74.234.12/31 is directly connected, br2
bytton> quit
```

Figure 5-121: Actual results of the commands entered in “VTY Shell” console.

5.4.4 Virtual Routing Table

This page lets you define, configure and analyze the Virtual routing tables on Bytton:



Virtual Table

VT	IF1	IF2	IF3	IF4	IF5	IF6

Add New

Virtual Table Help

Virtual Table Routes

Virtual Table Status

Interface Status

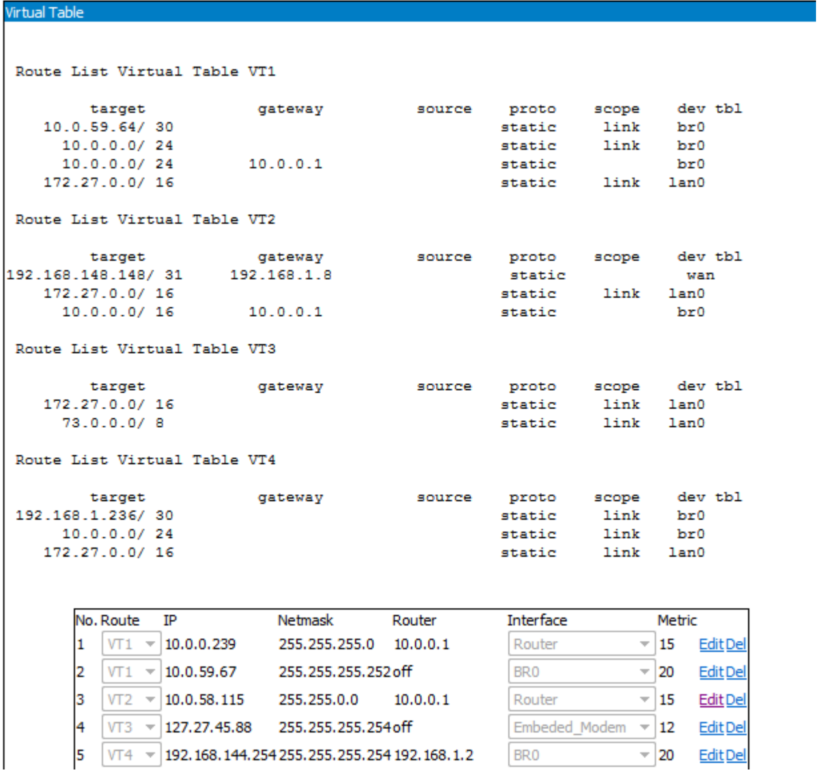
Please use the COMMIT button to activate your changes

Figure 5-122: Aspect of Virtual Routing Table window in the Routing section.

What is VR?

Virtual routing and forwarding is a technology included in IP network routers that allows multiple instances of a routing table to exist in a single router, and work simultaneously.
This way network paths can be segmented without using multiple devices.
Since traffic is now automatically segregated, VR increases not only functionality but also increases network security and can eliminate the need for encryption and authentication.
not only individual users, but also several big Internet service providers take advantage of VR to create separate virtual private networks for customers, this is why the Virtual routing and forwarding method is also referred to as VPN routing and forwarding.

Virtual Routing acts like a logical router, as shown below it displays the routes in each of the up to four Virtual Tables that you have defined over Bytton LTE:

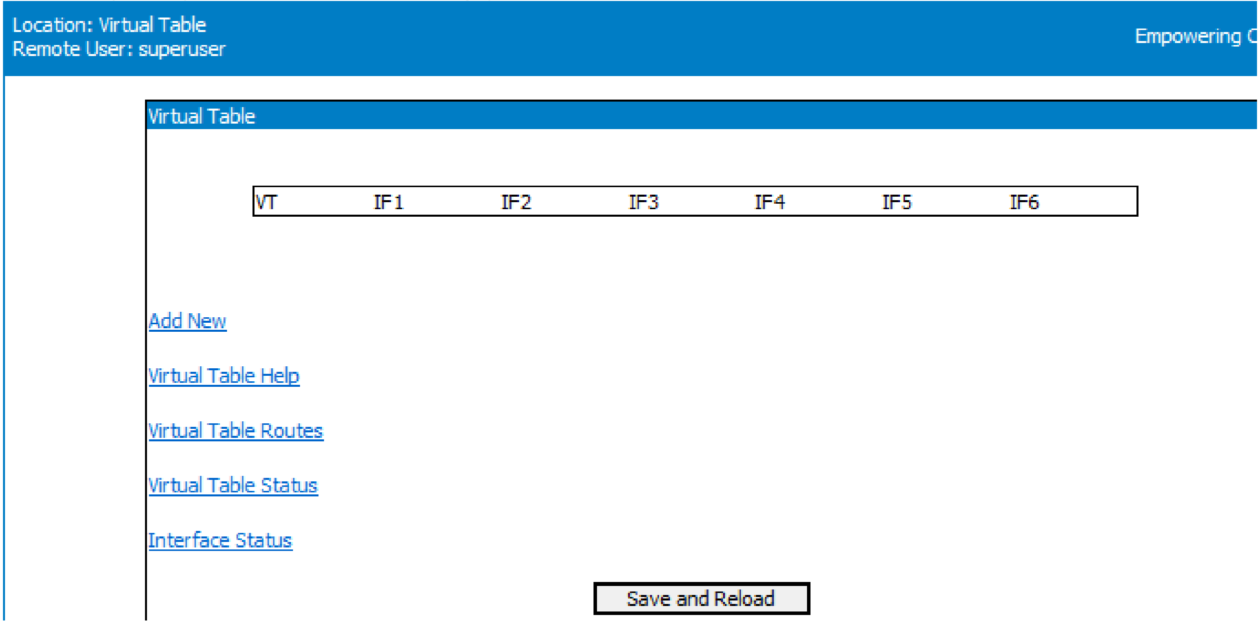


```
 Route List Virtual Table VT1

        target              gateway           source     proto     scope     dev tbl
    10.0.59.64/ 30                                       static     link     br0
      10.0.0.0/ 24                                       static     link     br0
      10.0.0.0/ 24         10.0.0.1                      static              br0
    172.27.0.0/ 16                                       static     link    lan0

 Route List Virtual Table VT2

        target              gateway           source     proto     scope     dev tbl
192.168.148.148/ 31     192.168.1.8                       static              wan
    172.27.0.0/ 16                                       static     link    lan0
      10.0.0.0/ 16         10.0.0.1                      static              br0

 Route List Virtual Table VT3

        target              gateway           source     proto     scope     dev tbl
    172.27.0.0/ 16                                       static     link    lan0
      73.0.0.0/ 8                                        static     link    lan0

 Route List Virtual Table VT4

        target              gateway           source     proto     scope     dev tbl
 192.168.1.236/ 30                                       static     link     br0
      10.0.0.0/ 24                                       static     link     br0
    172.27.0.0/ 16                                       static     link    lan0
```

No.	Route	IP	Netmask	Router	Interface	Metric	
1	VT1	10.0.0.239	255.255.255.0	10.0.0.1	Router	15	Edit Del
2	VT1	10.0.59.67	255.255.255.252	off	BR0	20	Edit Del
3	VT2	10.0.58.115	255.255.0.0	10.0.0.1	Router	15	Edit Del
4	VT3	127.27.45.88	255.255.255.254	off	Embeded_Modem	12	Edit Del
5	VT4	192.168.144.254	255.255.255.254	192.168.1.2	BR0	20	Edit Del

Figure 5-123: Virtual Table with status, route list and table of definitions.

In the beginning, the Virtual table is empty:

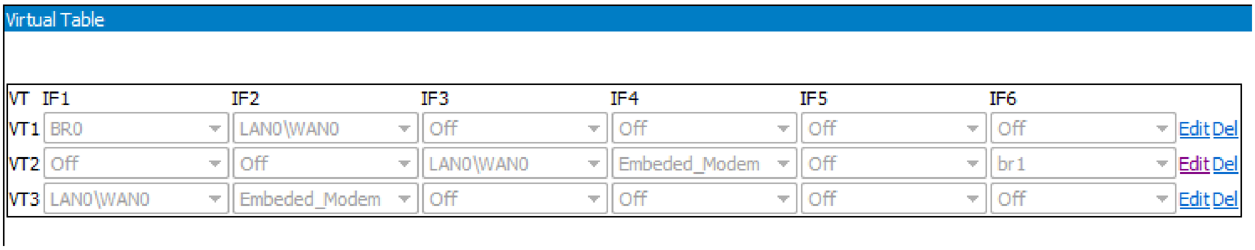


Location: Virtual Table
Remote User: superuser

Virtual Table

VT	IF1	IF2	IF3	IF4	IF5	IF6

So you must first define, using the link Add New, up to four Virtual Table entries (VT1 to VT4):



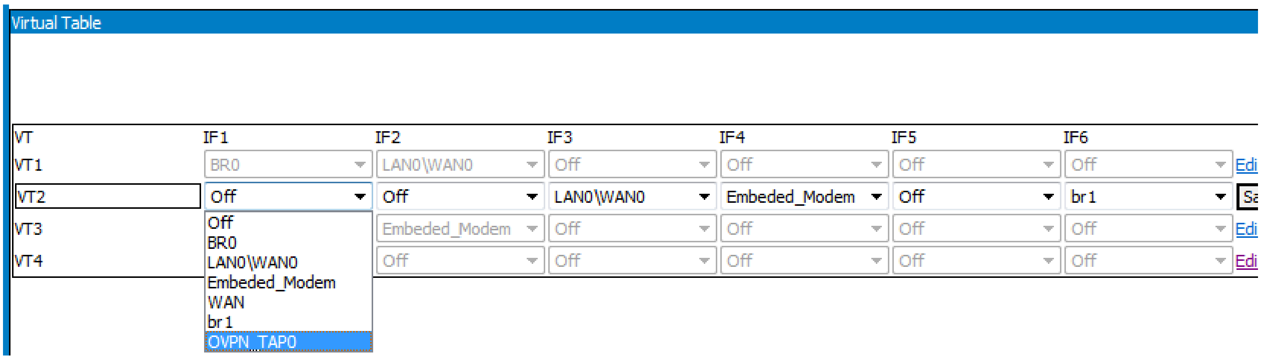
Virtual Table

VT	IF1	IF2	IF3	IF4	IF5	IF6	
VT1	BR0	LAN0\WAN0	Off	Off	Off	Off	Edit Del
VT2	Off	Off	LAN0\WAN0	Embeded_Modem	Off	br1	Edit Del
VT3	LAN0\WAN0	Embeded_Modem	Off	Off	Off	Off	Edit Del

Figure 5-124: Ading new entries into the Virtual Routing Table.

Each of the four VT entries may join up to six interfaces of the Bytton equipment.

Choose for every VT entry the corresponding interfaces (IF1 to IF6) from the drop list:

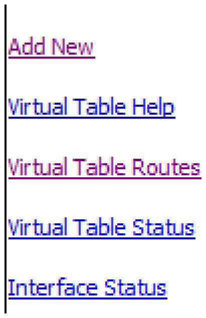


Virtual Table

VT	IF1	IF2	IF3	IF4	IF5	IF6	
VT1	BR0	LAN0\WAN0	Off	Off	Off	Off	Edi
VT2	Off	Off	LAN0\WAN0	Embeded_Modem	Off	br1	Sa
VT3		Embeded_Modem	Off	Off	Off	Off	Edi
VT4		Off	Off	Off	Off	Off	Edi

Next, you will define the routes for each of these Virtual Routing entries.
For this, use the links located at the bottom of the page:

VT Links



Add New

Virtual Table Help

Virtual Table Routes

Virtual Table Status

Interface Status

To the left, under the table with the four VT entries, there are several links to additional pages, as shown:

- Add New, to add a new entry (maximum four)
- VT Help, help that explains about Virtual Routing
- VT Routes, where you define the routes for each VT entry
- VT Status, shows the current state of the Virtual Routing on Bytton
- Interface Status, the current state of all the physical and logical interfaces of the Bytton equipment.

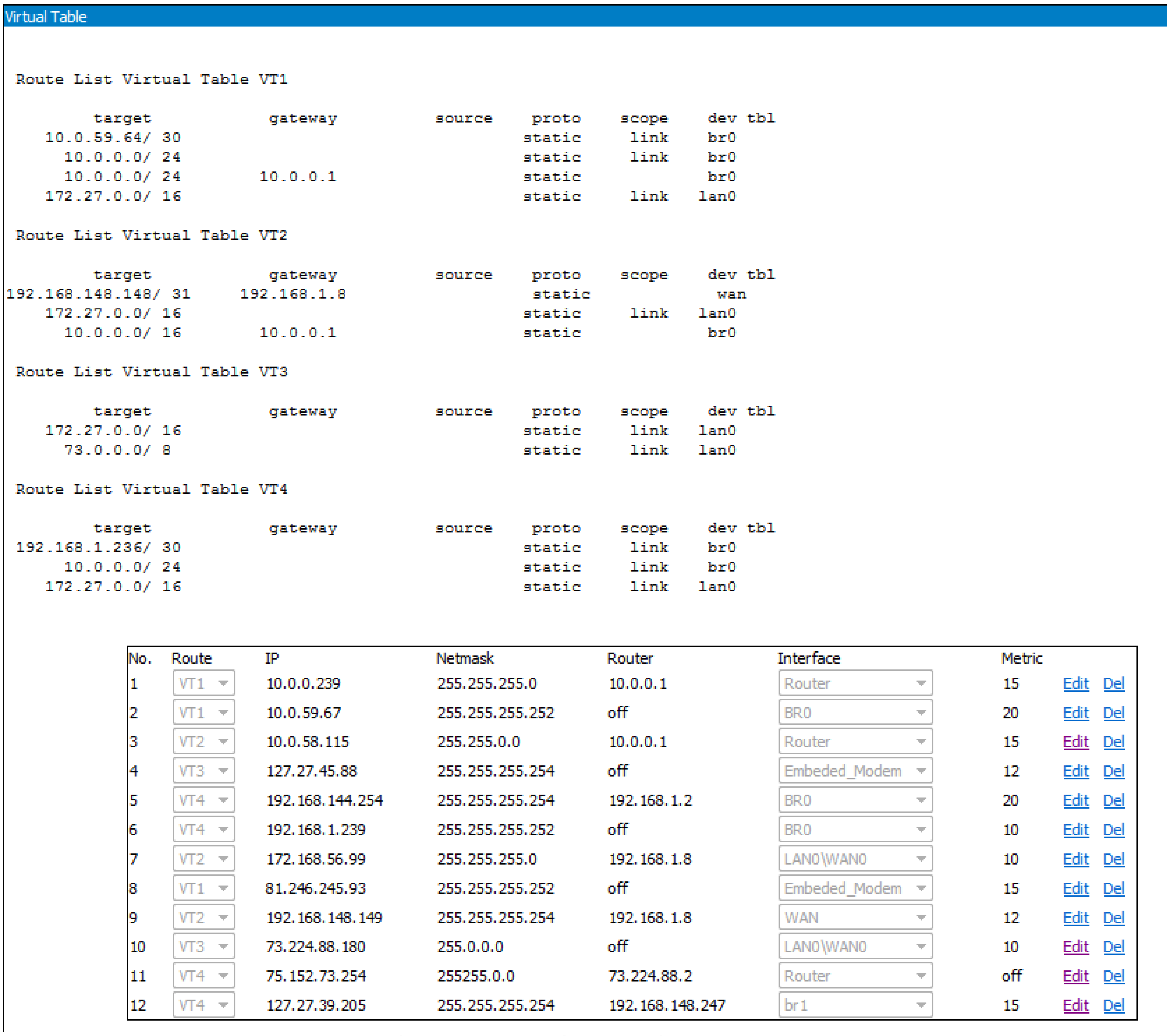
Figure 5-125: Additional links to the left of the Virtual Routing Table.

VT Help

Displays a Help page for the Virtual Routing tables.

VT Routes:

On top of the Virtual table page are displayed the established routes for each of the four VR tables, while at the bottom is the table where you define the routes:



Virtual Table

```
 Route List Virtual Table VT1

        target            gateway          source     proto     scope     dev tbl
   10.0.59.64/ 30                                     static     link     br0
     10.0.0.0/ 24                                     static     link     br0
     10.0.0.0/ 24        10.0.0.1                     static              br0
   172.27.0.0/ 16                                     static     link    lan0

 Route List Virtual Table VT2

        target            gateway          source     proto     scope     dev tbl
192.168.148.148/ 31     192.168.1.8                    static               wan
   172.27.0.0/ 16                                     static     link    lan0
     10.0.0.0/ 16        10.0.0.1                     static              br0

 Route List Virtual Table VT3

        target            gateway          source     proto     scope     dev tbl
   172.27.0.0/ 16                                     static     link    lan0
      73.0.0.0/ 8                                     static     link    lan0

 Route List Virtual Table VT4

        target            gateway          source     proto     scope     dev tbl
 192.168.1.236/ 30                                    static     link     br0
     10.0.0.0/ 24                                     static     link     br0
   172.27.0.0/ 16                                     static     link    lan0
```

No.	Route	IP	Netmask	Router	Interface	Metric		
1	VT1	10.0.0.239	255.255.255.0	10.0.0.1	Router	15	Edit	Del
2	VT1	10.0.59.67	255.255.255.252	off	BR0	20	Edit	Del
3	VT2	10.0.58.115	255.255.0.0	10.0.0.1	Router	15	Edit	Del
4	VT3	127.27.45.88	255.255.255.254	off	Embeded_Modem	12	Edit	Del
5	VT4	192.168.144.254	255.255.255.254	192.168.1.2	BR0	20	Edit	Del
6	VT4	192.168.1.239	255.255.255.252	off	BR0	10	Edit	Del
7	VT2	172.168.56.99	255.255.255.0	192.168.1.8	LAN0\WAN0	10	Edit	Del
8	VT1	81.246.245.93	255.255.255.252	off	Embeded_Modem	15	Edit	Del
9	VT2	192.168.148.149	255.255.255.254	192.168.1.8	WAN	12	Edit	Del
10	VT3	73.224.88.180	255.0.0.0	off	LAN0\WAN0	10	Edit	Del
11	VT4	75.152.73.254	255255.0.0	73.224.88.2	Router	off	Edit	Del
12	VT4	127.27.39.205	255.255.255.254	192.168.148.247	br1	15	Edit	Del

Figure 5-126: Virtual Table Routes.

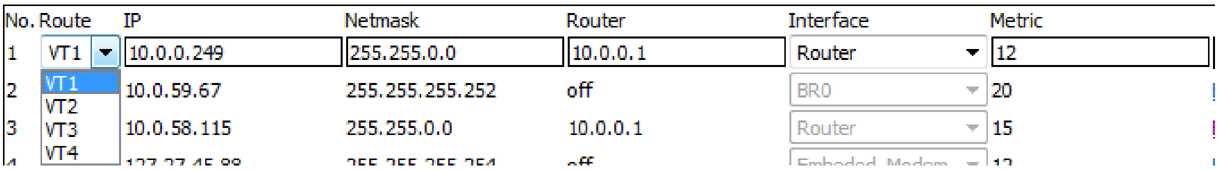
List of current routes for each VT:

```
Route List Virtual Table VT1

          target             gateway          source    proto    scope    dev tbl
    10.0.59.64/ 30                                      static    link    br0
      10.0.0.0/ 24                                      static    link    br0
      10.0.0.0/ 24          10.0.0.1                    static            br0
    172.27.0.0/ 16                                      static    link   lan0

 Route List Virtual Table VT2

          target             gateway          source    proto    scope    dev tbl
192.168.148.148/ 31      192.168.1.8                     static            wan
    172.27.0.0/ 16                                      static    link   lan0
      10.0.0.0/ 16          10.0.0.1                    static            br0

 Route List Virtual Table VT3

          target             gateway          source    proto    scope    dev tbl
    172.27.0.0/ 16                                      static    link   lan0
      73.0.0.0/ 8                                       static    link   lan0

 Route List Virtual Table VT4

          target             gateway          source    proto    scope    dev tbl
 192.168.1.236/ 30                                      static    link    br0
      10.0.0.0/ 24                                      static    link    br0
    172.27.0.0/ 16                                      static    link   lan0
```

Figure 5-127: Examples of VT Routes listing.

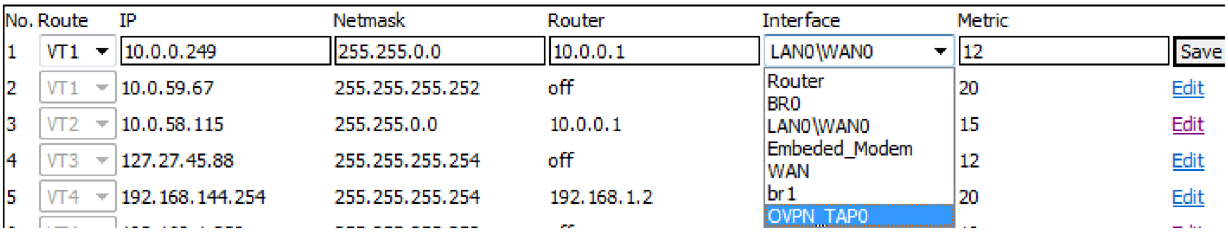
Defining routes:

At first, this table is empy, so you must use Add New to create a new rule,



No.	Route	IP	Netmask	Router	Interface	Metric
1	VT1	10.0.0.249	255.255.0.0	10.0.0.1	Router	12
2	VT1	10.0.59.67	255.255.255.252	off	BR0	20
3	VT3	10.0.58.115	255.255.0.0	10.0.0.1	Router	15

then choose for this route the IP and net mask, the router and / or the interface to be used, and the metric:



No.	Route	IP	Netmask	Router	Interface	Metric	
1	VT1	10.0.0.249	255.255.0.0	10.0.0.1	LAN0\WAN0	12	Save
2	VT1	10.0.59.67	255.255.255.252	off		20	Edit
3	VT2	10.0.58.115	255.255.0.0	10.0.0.1		15	Edit
4	VT3	127.27.45.88	255.255.255.254	off		12	Edit
5	VT4	192.168.144.254	255.255.255.254	192.168.1.2		20	Edit

Figure 5-128: Define new Virtual Table entries.

These routes, being virtual, will not show up in the ROUTING>Routes page:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
10.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.148.0   0.0.0.0         255.255.255.0   U     0      0        0 wan
172.27.0.0      0.0.0.0         255.255.0.0     U     0      0        0 lan0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

VT Status

Shows the detailed state of the Virtual Routing Tables. A few examples are shown below:

When no virtual Routes have been yet defined on Bytton:

```
Virtual RT status

Show Rule

0:       from all lookup local
32766:   from all lookup main
32767:   from all lookup default


 Show Route

         target            gateway           source    proto    scope    dev tbl
    10.64.64.65                       10.81.121.148   kernel     link   ppp1
   172.168.1.0/ 24                      172.168.1.1   kernel     link    br0
        default        10.64.64.65                                      ppp1
127.255.255.255          broadcast        127.0.0.1   kernel     link     lo local
  10.81.121.148              local    10.81.121.148   kernel     host   ppp1 local
    172.168.1.0          broadcast      172.168.1.1   kernel     link    br0 local
    172.168.1.1              local      172.168.1.1   kernel     host    br0 local
  172.168.1.255          broadcast      172.168.1.1   kernel     link    br0 local
      127.0.0.0          broadcast        127.0.0.1   kernel     link     lo local
      127.0.0.1              local        127.0.0.1   kernel     host     lo local
     127.0.0.0/ 8            local        127.0.0.1   kernel     host     lo local
```

Figure 5-129: Show Route in VT Status.

As you can see, there is no “Virtual Table x” sections, just the general rules and respectively routes active on the equipment are shown!

After you have defined Virtual routing tables 1 and 2:

```
Virtual Table VT1

10.0.59.64/30 dev br0  proto static  scope link  metric 20
10.0.0.0/24 dev br0  proto static  scope link
10.0.0.0/24 via 10.0.0.1 dev br0  proto static  metric 15
172.27.0.0/16 dev lan0  proto static  scope link

 Route List Virtual Table VT1

        target          gateway         source   proto   scope   dev tbl
   10.0.59.64/ 30                               static    link   br0
     10.0.0.0/ 24                               static    link   br0
     10.0.0.0/ 24      10.0.0.1                 static           br0
   172.27.0.0/ 16                               static    link  lan0

 Virtual Table VT2
172.27.0.0/16 dev lan0  proto static  scope link
10.0.0.0/16 via 10.0.0.1 dev br0  proto static  metric 15


Show Rule

0:       from all lookup local
1011:    from all iif br0 lookup VT1
1012:    from all iif lan0 lookup VT1
1023:    from all iif lan0 lookup VT2
1024:    from all iif ppp1 lookup VT2
1031:    from all iif lan0 lookup VT3
1032:    from all iif ppp1 lookup VT3
1041:    from all iif br0 lookup VT4
1042:    from all iif lan0 lookup VT4
1043:    from all iif tap0 lookup VT4
32766:   from all lookup main
32767:   from all lookup default
```

```
 Show Route
         target            gateway          source    proto    scope    dev tbl
 192.168.1.236/ 30                                   static     link    br0 VT4
      10.0.0.0/ 24                                   static     link    br0 VT4
    172.27.0.0/ 16                                   static     link   lan0 VT4
    172.27.0.0/ 16                                   static     link   lan0 VT2
      10.0.0.0/ 16        10.0.0.1                   static             br0 VT2
      10.0.0.0/ 24                        10.0.0.1   kernel     link    br0
 192.168.148.0/ 24                   192.168.148.4   kernel     link    wan
    172.27.0.0/ 16                   172.27.168.71   kernel     link   lan0
   192.168.0.0/ 16                   192.168.1.148   kernel     link    wan
        default        192.168.1.8                                      wan
    172.27.0.0/ 16                                   static     link   lan0 VT3
    10.0.59.64/ 30                                   static     link    br0 VT1
      10.0.0.0/ 24                                   static     link    br0 VT1
      10.0.0.0/ 24        10.0.0.1                   static             br0 VT1
    172.27.0.0/ 16                                   static     link   lan0 VT1
  192.168.1.148              local   192.168.1.148   kernel     host    wan local
127.255.255.255          broadcast       127.0.0.1   kernel     link     lo local
     172.27.0.0          broadcast   172.27.168.71   kernel     link   lan0 local
       10.0.0.1              local        10.0.0.1   kernel     host    br0 local
192.168.148.255          broadcast   192.168.148.4   kernel     link    wan local
       10.0.0.0          broadcast        10.0.0.1   kernel     link    br0 local
192.168.255.255          broadcast   192.168.1.148   kernel     link    wan local
  192.168.148.4              local   192.168.148.4   kernel     host    wan local
    192.168.0.0          broadcast   192.168.1.148   kernel     link    wan local
  192.168.148.0          broadcast   192.168.148.4   kernel     link    wan local
 172.27.255.255          broadcast   172.27.168.71   kernel     link   lan0 local
  172.27.168.71              local   172.27.168.71   kernel     host   lan0 local
     10.0.0.255          broadcast        10.0.0.1   kernel     link    br0 local
      127.0.0.0          broadcast       127.0.0.1   kernel     link     lo local
      127.0.0.1              local       127.0.0.1   kernel     host     lo local
     127.0.0.0/ 8            local       127.0.0.1   kernel     host     lo local
```

For VT4 also:

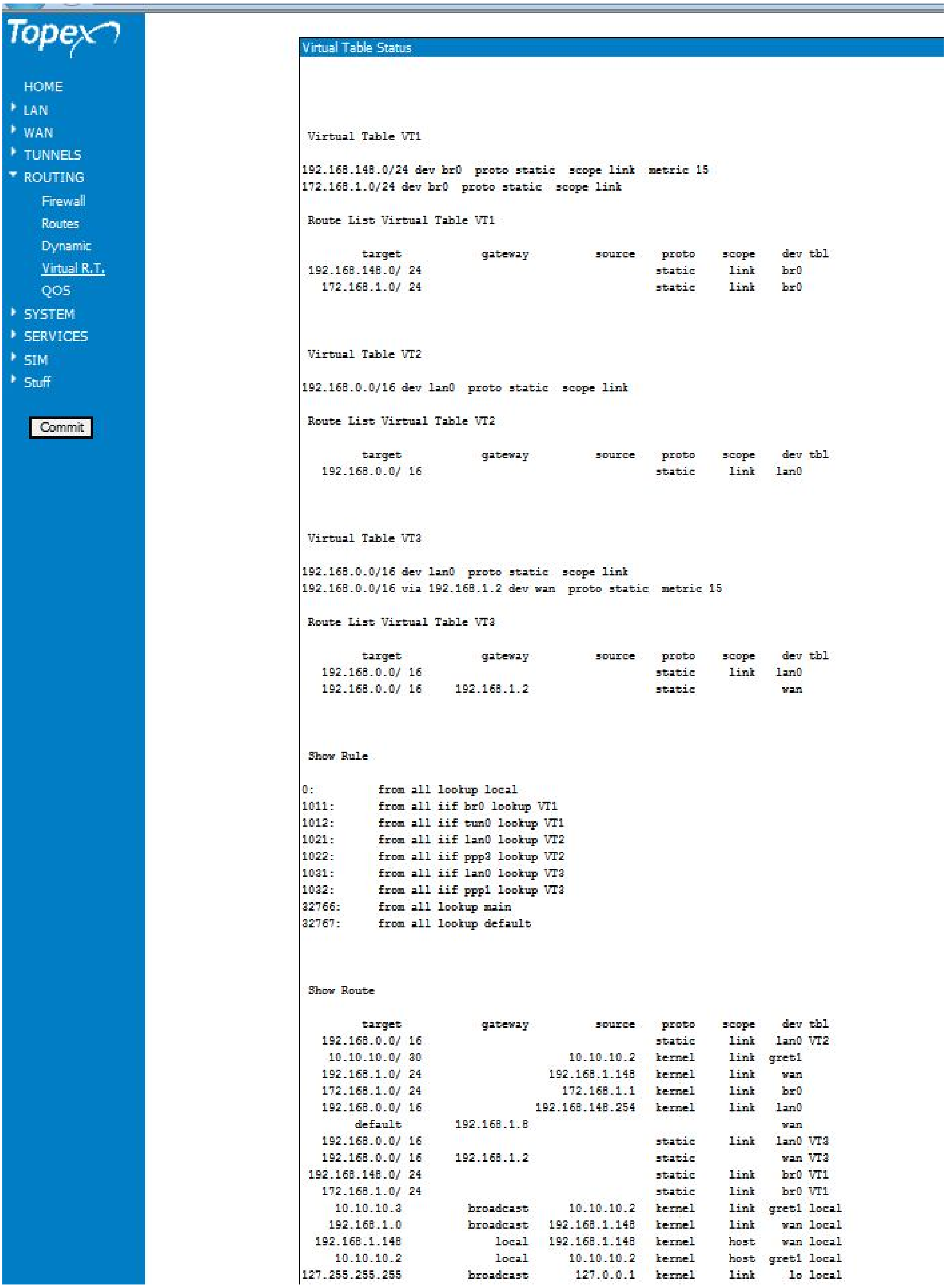
```
Virtual Table VT4

192.168.1.236/30 dev br0  proto static  scope link  metric 10
10.0.0.0/24 dev br0  proto static  scope link
172.27.0.0/16 dev lan0  proto static  scope link

 Route List Virtual Table VT4

         target            gateway          source    proto    scope    dev tbl
 192.168.1.236/ 30                                   static     link    br0
      10.0.0.0/ 24                                   static     link    br0
    172.27.0.0/ 16                                   static     link   lan0
```

Figure 5-130: Show Rule and Show Route sections in VT Status.

```
 Show Rule
0:       from all lookup local
1011:    from all iif br0 lookup VT1
1012:    from all iif lan0 lookup VT1
1041:    from all iif br0 lookup VT4
1042:    from all iif lan0 lookup VT4
1043:    from all iif tap0 lookup VT4
32766:   from all lookup main
32767:   from all lookup default
```

```
 Show Route
         target            gateway          source    proto    scope    dev tbl
 192.168.1.236/ 30                                   static     link    br0 VT4
      10.0.0.0/ 24                                   static     link    br0 VT4
    172.27.0.0/ 16                                   static     link   lan0 VT4
192.168.148.148/ 31     192.168.1.8                   static             wan VT2
    172.27.0.0/ 16                                   static     link   lan0 VT2
      10.0.0.0/ 16        10.0.0.1                   static             br0 VT2
    10.64.64.65                      93.122.250.36   kernel     link   ppp1
      10.0.0.0/ 24                        10.0.0.1   kernel     link    br0
 192.168.148.0/ 24                   192.168.148.4   kernel     link    wan
    172.27.0.0/ 16                   172.27.168.71   kernel     link   lan0
   192.168.0.0/ 16                   192.168.1.148   kernel     link    wan
        default        10.64.64.65                                     ppp1
```

As you can see, **Virtual Table Status** has three distinct panes:



Virtual Table Status

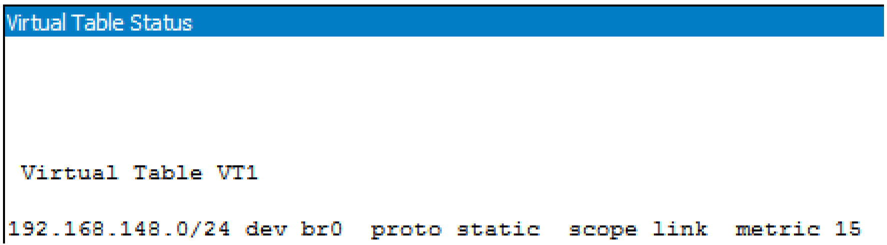
```
 Virtual Table VT1

192.168.148.0/24 dev br0  proto static  scope link  metric 15
172.168.1.0/24 dev br0  proto static  scope link

 Route List Virtual Table VT1

        target            gateway          source   proto    scope    dev tbl
 192.168.148.0/ 24                                  static    link    br0
   172.168.1.0/ 24                                  static    link    br0



 Virtual Table VT2

192.168.0.0/16 dev lan0  proto static  scope link

 Route List Virtual Table VT2

        target            gateway          source   proto    scope    dev tbl
   192.168.0.0/ 16                                  static    link   lan0



 Virtual Table VT3

192.168.0.0/16 dev lan0  proto static  scope link
192.168.0.0/16 via 192.168.1.2 dev wan  proto static  metric 15

 Route List Virtual Table VT3

        target            gateway          source   proto    scope    dev tbl
   192.168.0.0/ 16                                  static    link   lan0
   192.168.0.0/ 16    192.168.1.2                   static            wan



 Show Rule

0:          from all lookup local
1011:       from all iif br0 lookup VT1
1012:       from all iif tun0 lookup VT1
1021:       from all iif lan0 lookup VT2
1022:       from all iif ppp3 lookup VT2
1031:       from all iif lan0 lookup VT3
1032:       from all iif ppp1 lookup VT3
32766:      from all lookup main
32767:      from all lookup default



 Show Route

        target            gateway          source   proto    scope    dev tbl
   192.168.0.0/ 16                                  static    link   lan0 VT2
    10.10.10.0/ 30                     10.10.10.2   kernel    link  gret1
   192.168.1.0/ 24                  192.168.1.148   kernel    link    wan
   172.168.1.0/ 24                    172.168.1.1   kernel    link    br0
   192.168.0.0/ 16                192.168.148.254   kernel    link   lan0
       default        192.168.1.8                                     wan
   192.168.0.0/ 16                                  static    link   lan0 VT3
   192.168.0.0/ 16    192.168.1.2                   static            wan VT3
 192.168.148.0/ 24                                  static    link    br0 VT1
   172.168.1.0/ 24                                  static    link    br0 VT1
     10.10.10.3         broadcast      10.10.10.2   kernel    link  gret1 local
    192.168.1.0         broadcast   192.168.1.148   kernel    link    wan local
  192.168.1.148             local   192.168.1.148   kernel    host    wan local
     10.10.10.2             local      10.10.10.2   kernel    host  gret1 local
127.255.255.255         broadcast       127.0.0.1   kernel    link     lo local
```

Figure 5-131: Full VT Status page, with VT list, Show Rule and Show Route sections.

As can bee seen, this table is much too large to properly fit in a single screen page!

This is why it will be explained section by section. The VT Status table has:

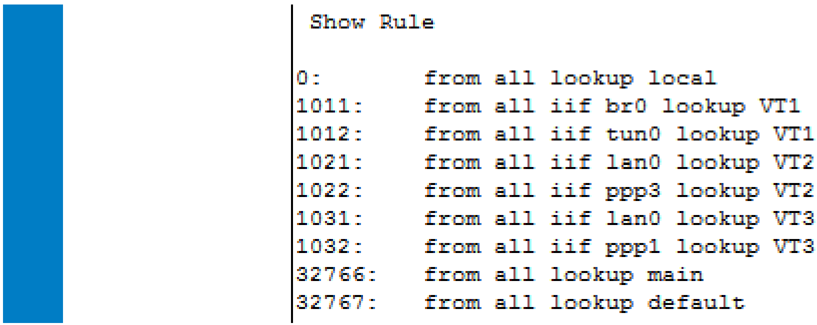
- an upper part, showing each of the four VT tables and rules lists:



```
 Virtual Table VT1

192.168.148.0/24 dev br0  proto static  scope link  metric 15
```

```
Virtual Table VT1

10.0.59.64/30 dev br0  proto static  scope link  metric 20
10.0.0.220/30 dev br0  proto static  scope link  metric 12
10.0.0.0/24 dev br0  proto static  scope link
10.0.0.0/24 via 10.0.0.1 dev br0  proto static  metric 15
172.27.0.0/16 dev lan0  proto static  scope link

 Route List Virtual Table VT1
         target            gateway          source    proto    scope    dev tbl
    10.0.59.64/ 30                                   static     link    br0
    10.0.0.220/ 30                                   static     link    br0
      10.0.0.0/ 24                                   static     link    br0
      10.0.0.0/ 24        10.0.0.1                   static             br0
    172.27.0.0/ 16                                   static     link   lan0


 Virtual Table VT2
39.41.125.78/31 dev lan0  proto static  scope link  metric 15
172.27.0.0/16 dev lan0  proto static  scope link
10.0.0.0/16 via 10.0.0.1 dev br0  proto static  metric 15

 Route List Virtual Table VT2
         target            gateway          source    proto    scope    dev tbl
  39.41.125.78/ 31                                   static     link   lan0
    172.27.0.0/ 16                                   static     link   lan0
      10.0.0.0/ 16        10.0.0.1                   static             br0


 Virtual Table VT3
192.168.148.208/30 dev wan  proto static  scope link  metric 20
192.168.0.0/16 dev wan  proto static  scope link

 Route List Virtual Table VT3
         target            gateway          source    proto    scope    dev tbl
192.168.148.208/ 30                                   static     link    wan
   192.168.0.0/ 16                                   static     link    wan


 Virtual Table VT4
192.168.1.236/30 dev br0  proto static  scope link  metric 10
10.0.0.0/24 dev br0  proto static  scope link
172.27.0.0/16 dev lan0  proto static  scope link

 Route List Virtual Table VT4
         target            gateway          source    proto    scope    dev tbl
 192.168.1.236/ 30                                   static     link    br0
      10.0.0.0/ 24                                   static     link    br0
    172.27.0.0/ 16                                   static     link   lan0
```

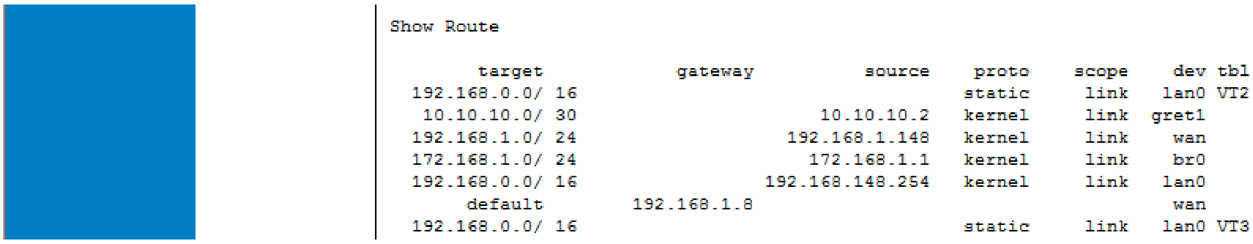
- a middle pane “Show Rule”,



```
Show Rule

0:       from all lookup local
1011:    from all iif br0 lookup VT1
1012:    from all iif tun0 lookup VT1
1021:    from all iif lan0 lookup VT2
1022:    from all iif ppp3 lookup VT2
1031:    from all iif lan0 lookup VT3
1032:    from all iif ppp1 lookup VT3
32766:   from all lookup main
32767:   from all lookup default
```

```
Show Rule

0:      from all lookup local
1011:   from all iif br0 lookup VT1
1012:   from all iif lan0 lookup VT1
1023:   from all iif lan0 lookup VT2
1024:   from all iif ppp1 lookup VT2
1031:   from all iif wan lookup VT3
1032:   from all iif ppp1 lookup VT3
1041:   from all iif br0 lookup VT4
1042:   from all iif lan0 lookup VT4
1043:   from all iif tap0 lookup VT4
32766:  from all lookup main
32767:  from all lookup default
```

- and a main part, “Show Route”, located at the bottom, where each route is shown:



```
Show Route

        target          gateway           source    proto    scope    dev tbl
  192.168.0.0/ 16                                   static    link   lan0 VT2
   10.10.10.0/ 30                       10.10.10.2  kernel    link  gret1
  192.168.1.0/ 24                    192.168.1.148  kernel    link    wan
  172.168.1.0/ 24                      172.168.1.1  kernel    link    br0
  192.168.0.0/ 16                  192.168.148.254  kernel    link   lan0
       default      192.168.1.8                                       wan
  192.168.0.0/ 16                                   static    link   lan0 VT3
```

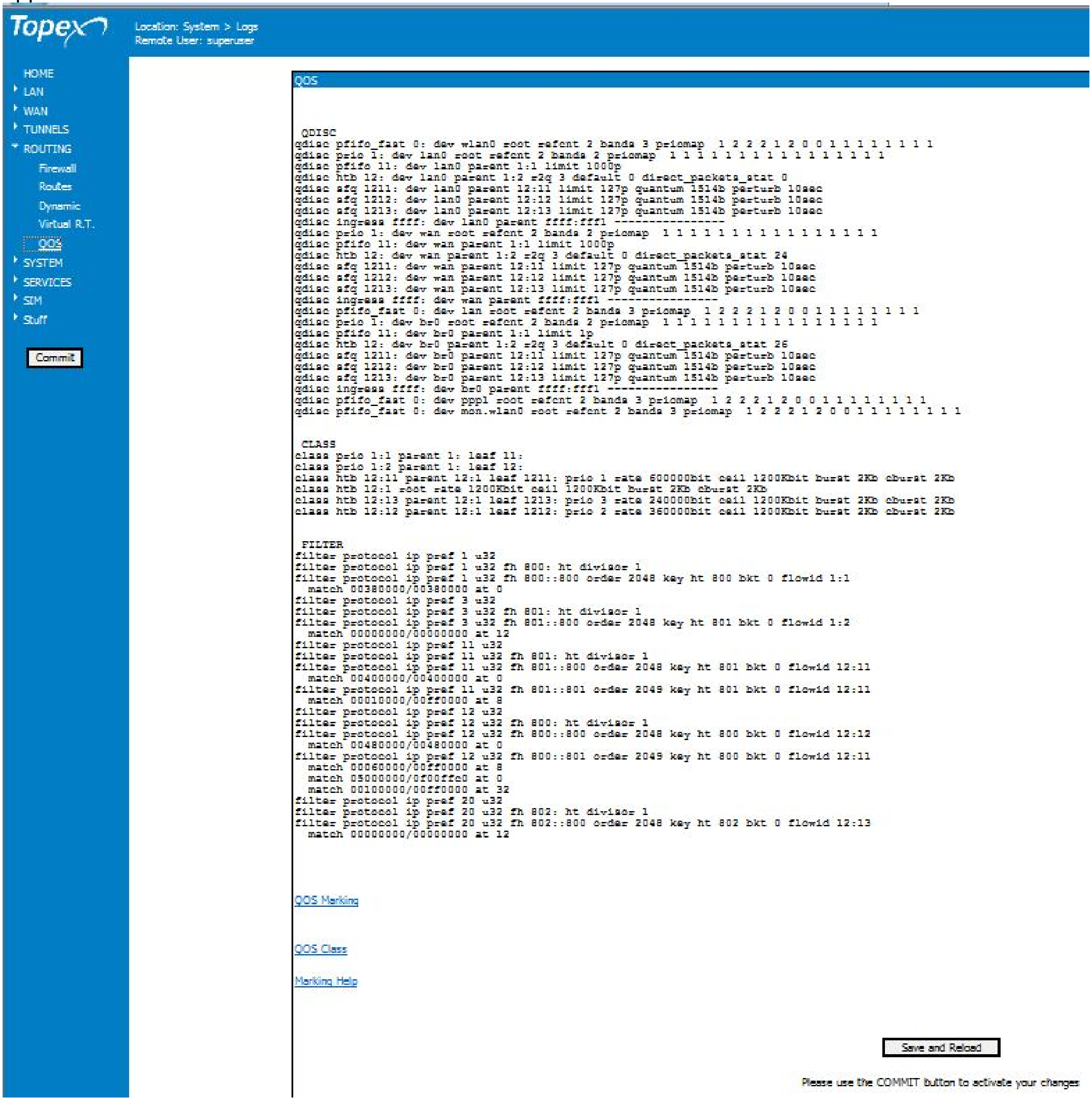
```
Show Route

        target            gateway          source    proto    scope    dev tbl
 192.168.1.236/ 30                                   static     link    br0 VT4
      10.0.0.0/ 24                                   static     link    br0 VT4
    172.27.0.0/ 16                                   static     link   lan0 VT4
192.168.148.148/ 31     192.168.1.8                   static              wan VT2
    172.27.0.0/ 16                                   static     link   lan0 VT2
      10.0.0.0/ 16        10.0.0.1                   static             br0 VT2
    10.64.64.65                      93.122.250.36   kernel     link   ppp1
      10.0.0.0/ 24                        10.0.0.1   kernel     link    br0
 192.168.148.0/ 24                   192.168.148.4   kernel     link    wan
    172.27.0.0/ 16                   172.27.168.71   kernel     link   lan0
   192.168.0.0/ 16                   192.168.1.148   kernel     link    wan
        default        10.64.64.65                                     ppp1
    172.27.0.0/ 16                                   static     link   lan0 VT3
      73.0.0.0/ 8                                    static     link   lan0 VT3
    10.0.59.64/ 30                                   static     link    br0 VT1
      10.0.0.0/ 24                                   static     link    br0 VT1
      10.0.0.0/ 24        10.0.0.1                   static             br0 VT1
    172.27.0.0/ 16                                   static     link   lan0 VT1
  192.168.1.148              local   192.168.1.148   kernel     host    wan local
127.255.255.255          broadcast       127.0.0.1   kernel     link     lo local
     172.27.0.0          broadcast   172.27.168.71   kernel     link   lan0 local
       10.0.0.1              local        10.0.0.1   kernel     host    br0 local
192.168.148.255          broadcast   192.168.148.4   kernel     link    wan local
       10.0.0.0          broadcast        10.0.0.1   kernel     link    br0 local
  93.122.250.36              local   93.122.250.36   kernel     host   ppp1 local
192.168.255.255          broadcast   192.168.1.148   kernel     link    wan local
  192.168.148.4              local   192.168.148.4   kernel     host    wan local
    192.168.0.0          broadcast   192.168.1.148   kernel     link    wan local
  192.168.148.0          broadcast   192.168.148.4   kernel     link    wan local
 172.27.255.255          broadcast   172.27.168.71   kernel     link   lan0 local
  172.27.168.71              local   172.27.168.71   kernel     host   lan0 local
     10.0.0.255          broadcast        10.0.0.1   kernel     link    br0 local
      127.0.0.0          broadcast       127.0.0.1   kernel     link     lo local
      127.0.0.1              local       127.0.0.1   kernel     host     lo local
     127.0.0.0/ 8            local       127.0.0.1   kernel     host     lo local
```

The fields (columns) of this “Show Route” section are:

- target, the destination IP together with its netmask, such as 192.168.1.236/ 20 or 94.243.164.98/ 31;
- gateway, which may be an actual gateway such as 192.168.1.2 or “broadcast” or “local”
- source, the source IP address, such as 10.81.86.155 or 172.2.168.71;
- proto, the routing protocol, which may be static or kernel
- scope, which may be link or host
- device, which may be wan, lan, br0, br1, ppp1 or lo
- routing table, one of the virtual tables VT1 … VT4, or local.

5.4.5 Quality of Services

The “Quality of Service” (QoS) section involves prioritization of network traffic by marking and prioritizing the data packets.
First you mark the packets, then you divide them into classes, to ensure adequate performance for critical applications.



```
 QDISC
qdisc pfifo_fast 0: dev wlan0 root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
qdisc prio 1: dev lan0 root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev lan0 parent 1:1 limit 1000p
qdisc htb 12: dev lan0 parent 1:2 r2q 3 default 0 direct_packets_stat 0
qdisc sfq 1211: dev lan0 parent 12:11 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1212: dev lan0 parent 12:12 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1213: dev lan0 parent 12:13 limit 127p quantum 1514b perturb 10sec
qdisc ingress ffff: dev lan0 parent ffff:fff1 ----------------
qdisc prio 1: dev wan root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev wan parent 1:1 limit 1000p
qdisc htb 12: dev wan parent 1:2 r2q 3 default 0 direct_packets_stat 24
qdisc sfq 1211: dev wan parent 12:11 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1212: dev wan parent 12:12 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1213: dev wan parent 12:13 limit 127p quantum 1514b perturb 10sec
qdisc ingress ffff: dev wan parent ffff:fff1 ----------------
qdisc pfifo_fast 0: dev lan root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
qdisc prio 1: dev br0 root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev br0 parent 1:1 limit 1p
qdisc htb 12: dev br0 parent 1:2 r2q 3 default 0 direct_packets_stat 26
qdisc sfq 1211: dev br0 parent 12:11 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1212: dev br0 parent 12:12 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1213: dev br0 parent 12:13 limit 127p quantum 1514b perturb 10sec
qdisc ingress ffff: dev br0 parent ffff:fff1 ----------------
qdisc pfifo_fast 0: dev ppp1 root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
qdisc pfifo_fast 0: dev mon.wlan0 root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1


 CLASS
class prio 1:1 parent 1: leaf 11:
class prio 1:2 parent 1: leaf 12:
class htb 12:11 parent 12:1 leaf 1211: prio 1 rate 600000bit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:1 root rate 1200Kbit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:13 parent 12:1 leaf 1213: prio 3 rate 240000bit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:12 parent 12:1 leaf 1212: prio 2 rate 360000bit ceil 1200Kbit burst 2Kb cburst 2Kb


 FILTER
filter protocol ip pref 1 u32
filter protocol ip pref 1 u32 fh 800: ht divisor 1
filter protocol ip pref 1 u32 fh 800::800 order 2048 key ht 800 bkt 0 flowid 1:1
  match 00380000/00380000 at 0
filter protocol ip pref 3 u32
filter protocol ip pref 3 u32 fh 801: ht divisor 1
filter protocol ip pref 3 u32 fh 801::800 order 2048 key ht 801 bkt 0 flowid 1:2
  match 00000000/00000000 at 12
filter protocol ip pref 11 u32
filter protocol ip pref 11 u32 fh 801: ht divisor 1
filter protocol ip pref 11 u32 fh 801::800 order 2048 key ht 801 bkt 0 flowid 12:11
  match 00400000/00400000 at 0
filter protocol ip pref 11 u32 fh 801::801 order 2049 key ht 801 bkt 0 flowid 12:11
  match 00010000/00ff0000 at 8
filter protocol ip pref 12 u32
filter protocol ip pref 12 u32 fh 800: ht divisor 1
filter protocol ip pref 12 u32 fh 800::800 order 2048 key ht 800 bkt 0 flowid 12:12
  match 00480000/00480000 at 0
filter protocol ip pref 12 u32 fh 800::801 order 2049 key ht 800 bkt 0 flowid 12:11
  match 00060000/00ff0000 at 8
  match 05000000/0f00ffc0 at 0
  match 00100000/00ff0000 at 32
filter protocol ip pref 20 u32
filter protocol ip pref 20 u32 fh 802: ht divisor 1
filter protocol ip pref 20 u32 fh 802::800 order 2048 key ht 802 bkt 0 flowid 12:13
  match 00000000/00000000 at 12
```

Please use the COMMIT button to activate your changes

Figure 5-132: Quality of Service configuration page.

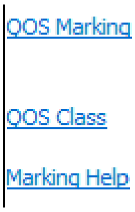
Why QoS?

Generally, “QoS” refers to several networking technologies and techniques that are used with the goal of providing provide guarantees on the ability of the equipment network to deliver predictable results. In our case, QoS is targeted at assuring the performance of the Bytton router.
QoS is especially important for the multimedia of Internet applications such as VoIP, video streaming and other consumer services. Since some core networking technologies such as Ethernet were not designed to support prioritized traffic or guaranteed performance levels, the equipment must have the means of implementing QoS solutions across the Internet!

In order to partition network traffic into multiple priority levels or classes of service, Packet Marking and Classification features are used. For example, by using the three precedence bits in the Type of service (ToS) field of the IP packet header, the data packets can be categorized into a limited set of up to six traffic classes. In Bytton's QOS, this is done by "QOS Marking" and respectively "QOS Class". Following classification of the packets, other QoS features may be utilized to assign the appropriate traffic handling policies including allocation of bandwidth, congestion management, etc for each of the classes of traffic that were defined.

At the bottom left of the QOS Web page there are three links to corresponding sub-pages:

- QOS Marking
- QOS Class
- Marking Help



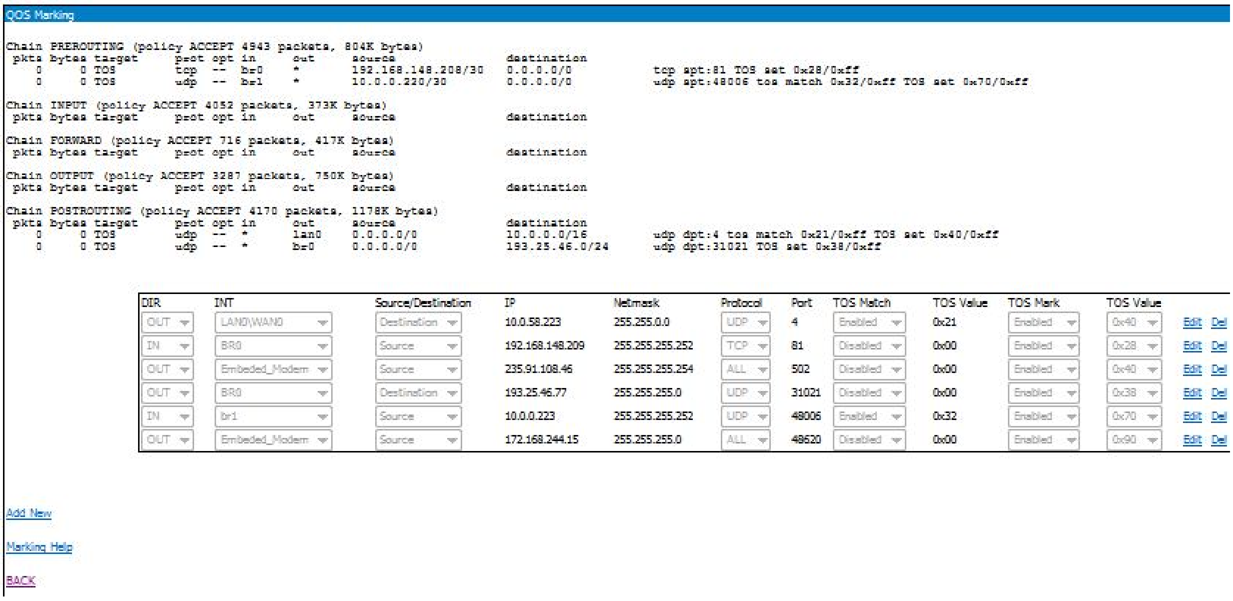
QOS Marking

QOS Class

Marking Help

QoS marking

At first, this table is empty, use Add New to add a new entry:



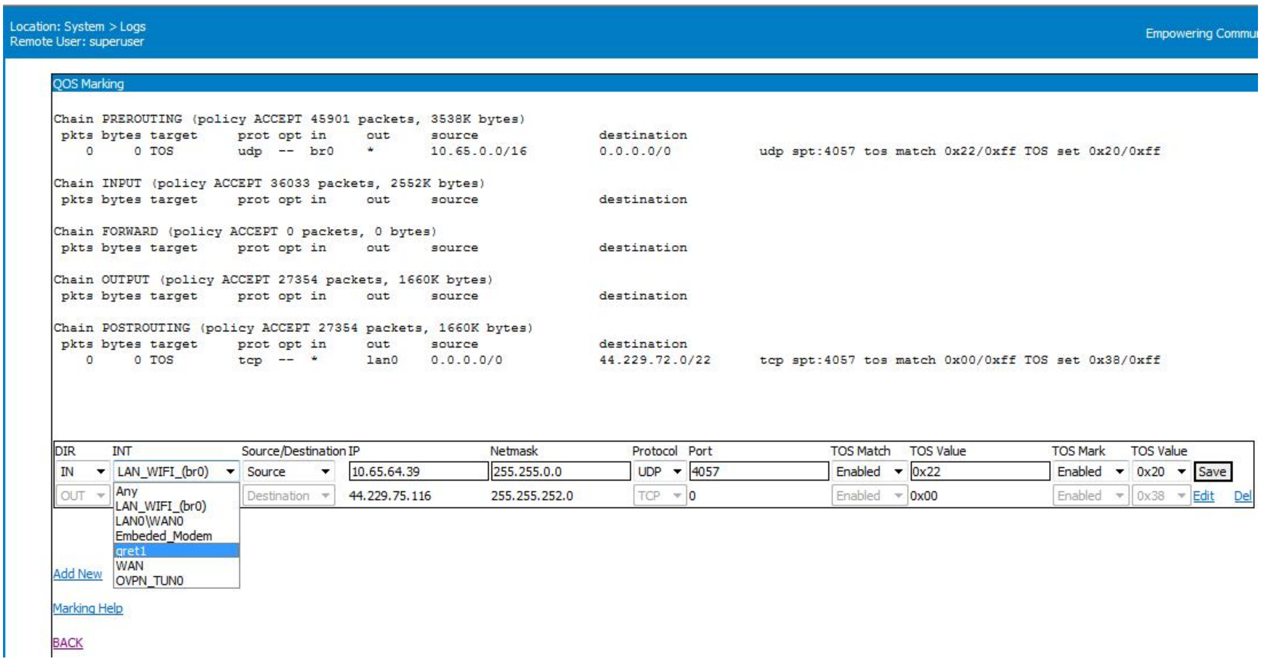
QOS Marking

```
Chain PREROUTING (policy ACCEPT 4943 packets, 804K bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 TOS        tcp  --  br0    *       192.168.148.208/30   0.0.0.0/0           tcp spt:81 TOS set 0x28/0xff
    0     0 TOS        udp  --  br1    *       10.0.0.220/30        0.0.0.0/0           udp spt:48006 tos match 0x32/0xff TOS set 0x70/0xff

Chain INPUT (policy ACCEPT 4052 packets, 373K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain FORWARD (policy ACCEPT 716 packets, 417K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain OUTPUT (policy ACCEPT 3287 packets, 750K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain POSTROUTING (policy ACCEPT 4170 packets, 1178K bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 TOS        udp  --  *      lan0    0.0.0.0/0            10.0.0.0/16         udp dpt:4 tos match 0x21/0xff TOS set 0x40/0xff
    0     0 TOS        udp  --  *      br0     0.0.0.0/0            193.25.46.0/24      udp dpt:31021 TOS set 0x38/0xff
```

DIR	INT	Source/Destination	IP	Netmask	Protocol	Port	TOS Match	TOS Value	TOS Mark	TOS Value	
OUT	LAN0\WAN0	Destination	10.0.58.223	255.255.0.0	UDP	4	Enabled	0x21	Enabled	0x40	Edit Del
IN	BR0	Source	192.168.148.209	255.255.255.252	TCP	81	Disabled	0x00	Enabled	0x28	Edit Del
OUT	Embeded_Modem	Source	235.91.108.46	255.255.255.254	ALL	502	Disabled	0x00	Enabled	0x40	Edit Del
OUT	BR0	Destination	193.25.46.77	255.255.255.0	UDP	31021	Disabled	0x00	Enabled	0x38	Edit Del
IN	br1	Source	10.0.0.223	255.255.255.252	UDP	48006	Enabled	0x32	Enabled	0x70	Edit Del
OUT	Embeded_Modem	Source	172.168.244.15	255.255.255.0	ALL	48620	Disabled	0x00	Enabled	0x90	Edit Del

Figure 5-133: Table for Quality of Service Marking

Then you can Edit and Save the respective entry, as shown:

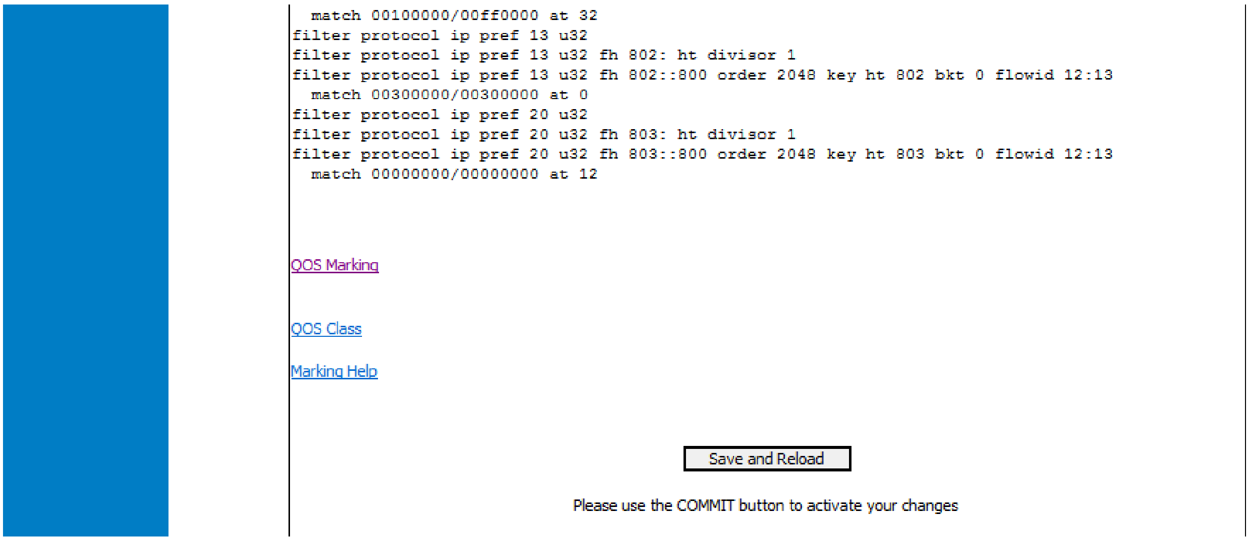


```
Chain PREROUTING (policy ACCEPT 45901 packets, 3538K bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 TOS        udp  --  br0    *       10.65.0.0/16         0.0.0.0/0           udp spt:4057 tos match 0x22/0xff TOS set 0x20/0xff

Chain INPUT (policy ACCEPT 36033 packets, 2552K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain FORWARD (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain OUTPUT (policy ACCEPT 27354 packets, 1660K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain POSTROUTING (policy ACCEPT 27354 packets, 1660K bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 TOS        tcp  --  *      lan0    0.0.0.0/0            44.229.72.0/22      tcp spt:4057 tos match 0x00/0xff TOS set 0x38/0xff
```

DIR	INT	Source/Destination	IP	Netmask	Protocol	Port	TOS Match	TOS Value	TOS Mark	TOS Value		
IN	LAN_WIFI_(br0)	Source	10.65.64.39	255.255.0.0	UDP	4057	Enabled	0x22	Enabled	0x20	Save	
OUT		Destination	44.229.75.116	255.255.252.0	TCP	0	Enabled	0x00	Enabled	0x38	Edit	Del

Figure 5-134: Editing the QoS MarkingTable

```
QDISC
qdisc pfifo_fast 0: dev wlan0 root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
qdisc prio 1: dev lan0 root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev lan0 parent 1:1 limit 1000p
qdisc htb 12: dev lan0 parent 1:2 r2q 3 default 0 direct_packets_stat 0
qdisc sfq 1211: dev lan0 parent 12:11 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1212: dev lan0 parent 12:12 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1213: dev lan0 parent 12:13 limit 127p quantum 1514b perturb 10sec
qdisc ingress ffff: dev lan0 parent ffff:fff1 ----------------
qdisc prio 1: dev wan root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev wan parent 1:1 limit 1000p
qdisc htb 12: dev wan parent 1:2 r2q 3 default 0 direct_packets_stat 27
qdisc sfq 1211: dev wan parent 12:11 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1212: dev wan parent 12:12 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1213: dev wan parent 12:13 limit 127p quantum 1514b perturb 10sec
qdisc ingress ffff: dev wan parent ffff:fff1 ----------------
qdisc pfifo_fast 0: dev lan root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
qdisc prio 1: dev br0 root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev br0 parent 1:1 limit 1p
qdisc htb 12: dev br0 parent 1:2 r2q 3 default 0 direct_packets_stat 31
qdisc sfq 1211: dev br0 parent 12:11 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1212: dev br0 parent 12:12 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1213: dev br0 parent 12:13 limit 127p quantum 1514b perturb 10sec
qdisc ingress ffff: dev br0 parent ffff:fff1 ----------------
qdisc pfifo_fast 0: dev ppp1 root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
qdisc pfifo_fast 0: dev mon.wlan0 root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1



 CLASS
class prio 1:1 parent 1: leaf 11:
class prio 1:2 parent 1: leaf 12:
class htb 12:11 parent 12:1 leaf 1211: prio 1 rate 600000bit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:1 root rate 1200Kbit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:13 parent 12:1 leaf 1213: prio 3 rate 240000bit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:12 parent 12:1 leaf 1212: prio 2 rate 360000bit ceil 1200Kbit burst 2Kb cburst 2Kb


 FILTER
filter protocol ip pref 1 u32
filter protocol ip pref 1 u32 fh 800: ht divisor 1
filter protocol ip pref 1 u32 fh 800::800 order 2048 key ht 800 bkt 0 flowid 1:1
  match 00380000/00380000 at 0
filter protocol ip pref 3 u32
filter protocol ip pref 3 u32 fh 801: ht divisor 1
filter protocol ip pref 3 u32 fh 801::800 order 2048 key ht 801 bkt 0 flowid 1:2
  match 00000000/00000000 at 12
filter protocol ip pref 11 u32
filter protocol ip pref 11 u32 fh 801: ht divisor 1
filter protocol ip pref 11 u32 fh 801::800 order 2048 key ht 801 bkt 0 flowid 12:11
  match 00400000/00400000 at 0
filter protocol ip pref 11 u32 fh 801::801 order 2049 key ht 801 bkt 0 flowid 12:11
  match 00010000/00ff0000 at 8
filter protocol ip pref 12 u32
filter protocol ip pref 12 u32 fh 800: ht divisor 1
filter protocol ip pref 12 u32 fh 800::800 order 2048 key ht 800 bkt 0 flowid 12:12
  match 00480000/00480000 at 0
filter protocol ip pref 12 u32 fh 800::801 order 2049 key ht 800 bkt 0 flowid 12:11
  match 00060000/00ff0000 at 8
  match 05000000/0f00ffc0 at 0
  match 00100000/00ff0000 at 32
filter protocol ip pref 20 u32
filter protocol ip pref 20 u32 fh 802: ht divisor 1
filter protocol ip pref 20 u32 fh 802::800 order 2048 key ht 802 bkt 0 flowid 12:13
  match 00000000/00000000 at 12
```



```
  match 00100000/00ff0000 at 32
filter protocol ip pref 13 u32
filter protocol ip pref 13 u32 fh 802: ht divisor 1
filter protocol ip pref 13 u32 fh 802::800 order 2048 key ht 802 bkt 0 flowid 12:13
  match 00300000/00300000 at 0
filter protocol ip pref 20 u32
filter protocol ip pref 20 u32 fh 803: ht divisor 1
filter protocol ip pref 20 u32 fh 803::800 order 2048 key ht 803 bkt 0 flowid 12:13
  match 00000000/00000000 at 12
```

Please use the COMMIT button to activate your changes

Figure 5-135: Detailed examples of QoS page

QoS Details:

On top of the QOS page you can see the “QDISC” listing.

```
qdisc pfifo_fast 0: dev wlan0 root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
qdisc prio 1: dev lan0 root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev lan0 parent 1:1 limit 1000p
qdisc htb 12: dev lan0 parent 1:2 r2q 3 default 0 direct_packets_stat 0
qdisc sfq 1211: dev lan0 parent 12:11 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1212: dev lan0 parent 12:12 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1213: dev lan0 parent 12:13 limit 127p quantum 1514b perturb 10sec
qdisc ingress ffff: dev lan0 parent ffff:fff1 ----------------
qdisc prio 1: dev wan root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev wan parent 1:1 limit 1000p
qdisc htb 12: dev wan parent 1:2 r2q 3 default 0 direct_packets_stat 272
qdisc sfq 1211: dev wan parent 12:11 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1212: dev wan parent 12:12 limit 127p quantum 1514b perturb 10sec
qdisc sfq 1213: dev wan parent 12:13 limit 127p quantum 1514b perturb 10sec
qdisc ingress ffff: dev wan parent ffff:fff1 ----------------
qdisc pfifo_fast 0: dev lan root refcnt 2 bands 3 priomap  1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
qdisc prio 1: dev br0 root refcnt 2 bands 2 priomap  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
qdisc pfifo 11: dev br0 parent 1:1 limit 1p
--------------------------------------------------------------------------------
```

Qdisc means “queue discipline” , it is an algorithm that manages the queue of an interface, either incoming (ingress) or outgoing (egress). Qdisc’s function is of a scheduler. In each case when the packets are in a queue, for instance over the output interface and input interfaces of the equipment, some type of scheduler is required. The default scheduler, invisible to the end user, is simply a FIFO (First-In, First-Out) but qdisc can assign priorities, it will rearrange the packets entering the scheduler's queue in accordance with the rules you have defined. “Scheduling” is the mechanism by which packets are (re)-arranged between input and output of a certain interface queue. In general, any set of traffic control mechanisms on an output queue can be regarded as a scheduler, because packets are arranged for output.

The queuing discipline algorithm used in for implementing QOS in Bytton LTE is *classful*, meaning that it includes several different classes of traffic, and can apply filters, in order to shape the traffic for each class. The terminal classes in a particular queuing discipline are known as a leaf class by analogy to the tree structure of the classes.

You can see below “leaf11”, “leaf12” and so on:

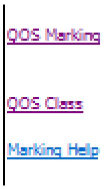
```
 CLASS
class prio 1:1 parent 1: leaf 11:
class prio 1:2 parent 1: leaf 12:
class htb 12:11 parent 12:1 leaf 1211: prio 1 rate 600000bit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:1 root rate 1200Kbit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:13 parent 12:1 leaf 1213: prio 3 rate 240000bit ceil 1200Kbit burst 2Kb cburst 2Kb
class htb 12:12 parent 12:1 leaf 1212: prio 2 rate 360000bit ceil 1200Kbit burst 2Kb cburst 2Kb
```

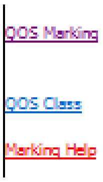
Next, the filters associated to each class are shown:

```
 FILTER
filter protocol ip pref 1 u32
filter protocol ip pref 1 u32 fh 800: ht divisor 1
filter protocol ip pref 1 u32 fh 800::800 order 2048 key ht 800 bkt 0 flowid 1:1
  match 00380000/00380000 at 0
filter protocol ip pref 3 u32
filter protocol ip pref 3 u32 fh 801: ht divisor 1
filter protocol ip pref 3 u32 fh 801::800 order 2048 key ht 801 bkt 0 flowid 1:2
  match 00000000/00000000 at 12
filter protocol ip pref 11 u32
filter protocol ip pref 11 u32 fh 801: ht divisor 1
filter protocol ip pref 11 u32 fh 801::800 order 2048 key ht 801 bkt 0 flowid 12:11
  match 00400000/00400000 at 0
filter protocol ip pref 11 u32 fh 801::801 order 2049 key ht 801 bkt 0 flowid 12:11
  match 00010000/00ff0000 at 8
filter protocol ip pref 12 u32
filter protocol ip pref 12 u32 fh 800: ht divisor 1
filter protocol ip pref 12 u32 fh 800::800 order 2048 key ht 800 bkt 0 flowid 12:12
  match 00480000/00480000 at 0
filter protocol ip pref 12 u32 fh 800::801 order 2049 key ht 800 bkt 0 flowid 12:11
  match 00060000/00ff0000 at 8
  match 05000000/0f00ffc0 at 0
  match 00100000/00ff0000 at 32
filter protocol ip pref 20 u32
filter protocol ip pref 20 u32 fh 802: ht divisor 1
filter protocol ip pref 20 u32 fh 802::800 order 2048 key ht 802 bkt 0 flowid 12:13
  match 00000000/00000000 at 12
```

Links

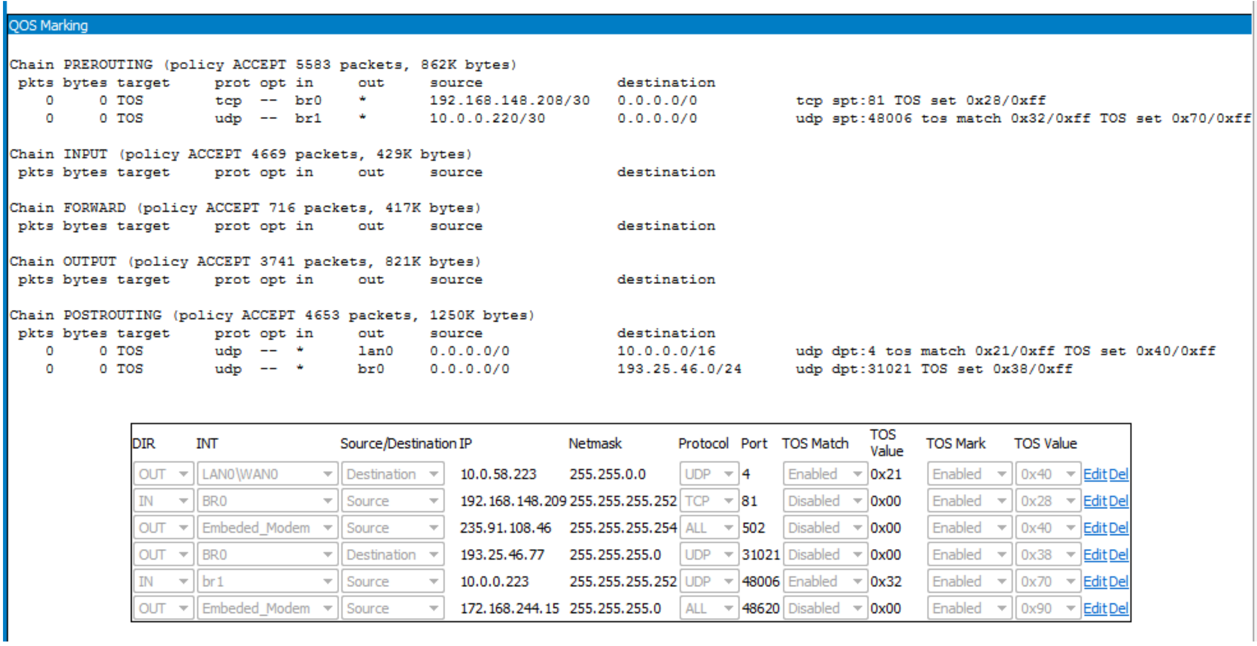
At the bottom of the screen, under the last listing (FILTER) there are three clickable links: QOS Marking, QOS Class and respectively the Help for QOS packet marking and sorting into classes.





QOS Marking

This page marks the data packets according to type (input or output), source/destination IP, port number and protocol used:



QOS Marking

```
Chain PREROUTING (policy ACCEPT 5583 packets, 862K bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 TOS        tcp  --  br0    *       192.168.148.208/30   0.0.0.0/0           tcp spt:81 TOS set 0x28/0xff
    0     0 TOS        udp  --  br1    *       10.0.0.220/30        0.0.0.0/0           udp spt:48006 tos match 0x32/0xff TOS set 0x70/0xff

Chain INPUT (policy ACCEPT 4669 packets, 429K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain FORWARD (policy ACCEPT 716 packets, 417K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain OUTPUT (policy ACCEPT 3741 packets, 821K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain POSTROUTING (policy ACCEPT 4653 packets, 1250K bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 TOS        udp  --  *      lan0    0.0.0.0/0            10.0.0.0/16         udp dpt:4 tos match 0x21/0xff TOS set 0x40/0xff
    0     0 TOS        udp  --  *      br0     0.0.0.0/0            193.25.46.0/24      udp dpt:31021 TOS set 0x38/0xff
```

DIR	INT	Source/Destination IP		Netmask	Protocol	Port	TOS Match	TOS Value	TOS Mark	TOS Value	
OUT	LAN0\WAN0	Destination	10.0.58.223	255.255.0.0	UDP	4	Enabled	0x21	Enabled	0x40	Edit Del
IN	BR0	Source	192.168.148.209	255.255.255.252	TCP	81	Disabled	0x00	Enabled	0x28	Edit Del
OUT	Embeded_Modem	Source	235.91.108.46	255.255.255.254	ALL	502	Disabled	0x00	Enabled	0x40	Edit Del
OUT	BR0	Destination	193.25.46.77	255.255.255.0	UDP	31021	Disabled	0x00	Enabled	0x38	Edit Del
IN	br1	Source	10.0.0.223	255.255.255.252	UDP	48006	Enabled	0x32	Enabled	0x70	Edit Del
OUT	Embeded_Modem	Source	172.168.244.15	255.255.255.0	ALL	48620	Disabled	0x00	Enabled	0x90	Edit Del

Figure 5-136: Active QoS Marking page

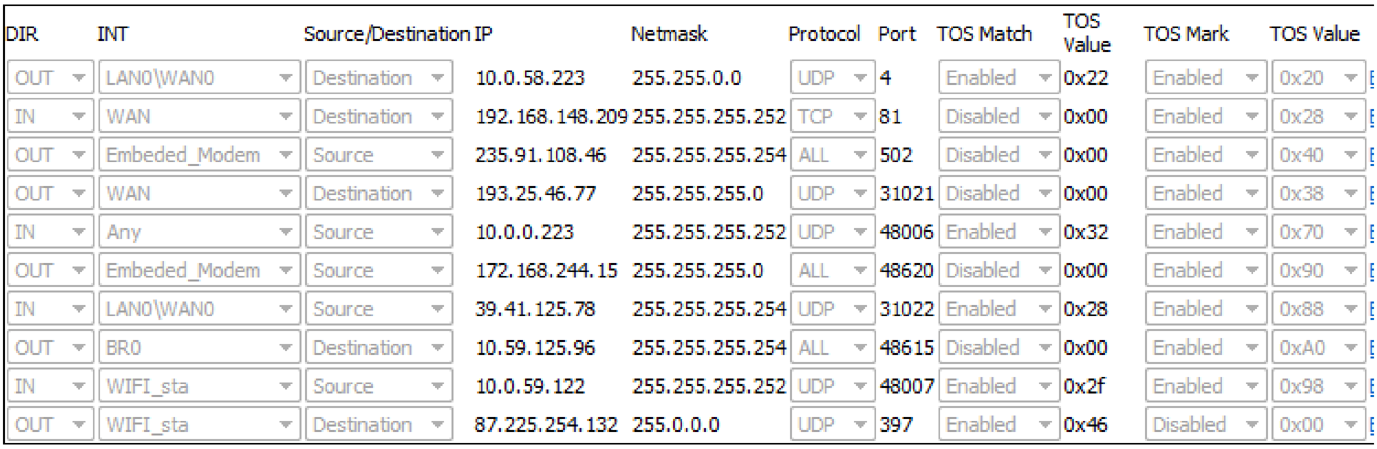
It also has two parts, the upper area displays the current marking rules, while the table for packet marking per direction and IP is located at the bottom.

Marking List

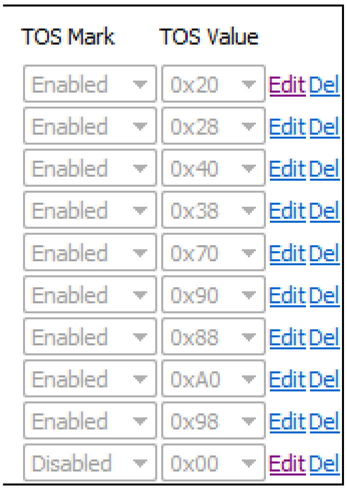
```
Chain PREROUTING (policy ACCEPT 2918 packets, 218K bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 TOS        tcp  --  wan    *       0.0.0.0/0            192.168.148.208/30  tcp dpt:81
TOS set 0x28/0xff
    0     0 TOS        udp  --  br1    *       10.0.0.220/30        0.0.0.0/0           udp
spt:48006 tos match 0x32/0xff TOS set 0x70/0xff
    0     0 TOS        udp  --  lan0   *       39.41.125.78/31      0.0.0.0/0           udp
spt:31022 tos match 0x28/0xff TOS set 0x88/0xff
    0     0 TOS        udp  --  wlan0  *       10.0.59.120/30       0.0.0.0/0           udp
spt:48007 tos match 0x2f/0xff TOS set 0x98/0xff

Chain INPUT (policy ACCEPT 2793 packets, 207K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain FORWARD (policy ACCEPT 13 packets, 1894 bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain OUTPUT (policy ACCEPT 2199 packets, 158K bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain POSTROUTING (policy ACCEPT 2214 packets, 161K bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 TOS        udp  --  *      lan0    0.0.0.0/0            10.0.0.0/16         udp dpt:4
tos match 0x22/0xff TOS set 0x20/0xff
    0     0 TOS        udp  --  *      wan     0.0.0.0/0            193.25.46.0/24      udp
dpt:31021 TOS set 0x38/0xff
    0     0            udp  --  *      wlan0   0.0.0.0/0            87.0.0.0/8          udp
dpt:397 tos match 0x46/0xff
```

Marking Table

In this table, which is empty at first, each entry must specify the direction (IN or OUT), the source or destination IP and corresponding Net mask, the protocol (either TCP, UDP or all), Type of Service (TOS) enabling or not and corresponding TOS match, TOS marking (enable or disable) and corresponding TOS value:



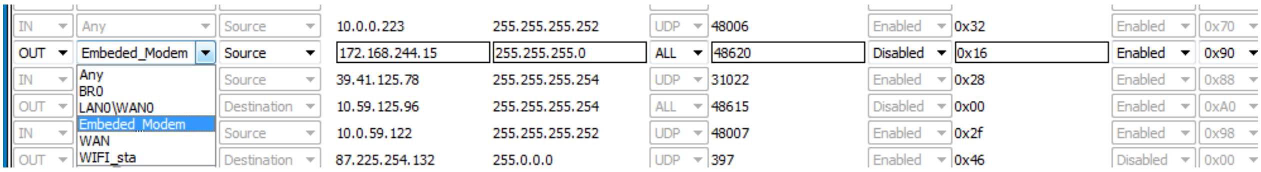
DIR	INT	Source/Destination	IP	Netmask	Protocol	Port	TOS Match	TOS Value	TOS Mark	TOS Value
OUT	LAN0\WAN0	Destination	10.0.58.223	255.255.0.0	UDP	4	Enabled	0x22	Enabled	0x20
IN	WAN	Destination	192.168.148.209	255.255.255.252	TCP	81	Disabled	0x00	Enabled	0x28
OUT	Embeded_Modem	Source	235.91.108.46	255.255.255.254	ALL	502	Disabled	0x00	Enabled	0x40
OUT	WAN	Destination	193.25.46.77	255.255.255.0	UDP	31021	Disabled	0x00	Enabled	0x38
IN	Any	Source	10.0.0.223	255.255.255.252	UDP	48006	Enabled	0x32	Enabled	0x70
OUT	Embeded_Modem	Source	172.168.244.15	255.255.255.0	ALL	48620	Disabled	0x00	Enabled	0x90
IN	LAN0\WAN0	Source	39.41.125.78	255.255.255.254	UDP	31022	Enabled	0x28	Enabled	0x88
OUT	BR0	Destination	10.59.125.96	255.255.255.254	ALL	48615	Disabled	0x00	Enabled	0xA0
IN	WIFI_sta	Source	10.0.59.122	255.255.255.252	UDP	48007	Enabled	0x2f	Enabled	0x98
OUT	WIFI_sta	Destination	87.225.254.132	255.0.0.0	UDP	397	Enabled	0x46	Disabled	0x00



TOS Mark	TOS Value	
Enabled	0x20	Edit Del
Enabled	0x28	Edit Del
Enabled	0x40	Edit Del
Enabled	0x38	Edit Del
Enabled	0x70	Edit Del
Enabled	0x90	Edit Del
Enabled	0x88	Edit Del
Enabled	0xA0	Edit Del
Enabled	0x98	Edit Del
Disabled	0x00	Edit Del

Each record in the marking table may be individually deleted or edited

Figure 5-137: Editing the QoS Marking table

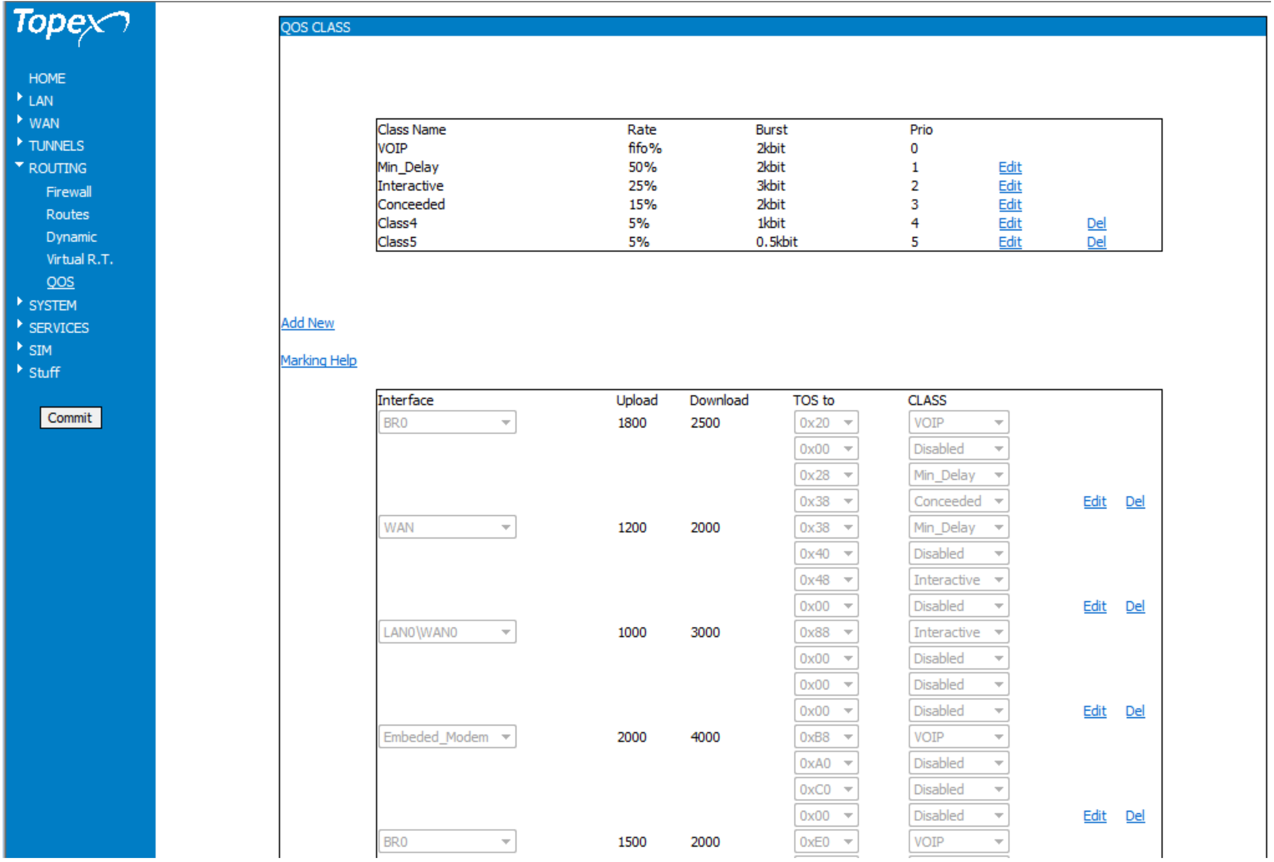


IN	Any	Source	10.0.0.223	255.255.255.252	UDP	48006	Enabled	0x32	Enabled	0x70
OUT	Embeded_Modem	Source	172.168.244.15	255.255.255.0	ALL	48620	Disabled	0x16	Enabled	0x90
IN		Source	39.41.125.78	255.255.255.254	UDP	31022	Enabled	0x28	Enabled	0x88
OUT		Destination	10.59.125.96	255.255.255.254	ALL	48615	Disabled	0x00	Enabled	0xA0
IN		Source	10.0.59.122	255.255.255.252	UDP	48007	Enabled	0x2f	Enabled	0x98
OUT		Destination	87.225.254.132	255.0.0.0	UDP	397	Enabled	0x46	Disabled	0x00

When you finished entering TOS marking and matching values, use the general Save, the long button called “Save and Reload” located at the bottom of the page:

QOS Class

After marking the packets, you must separate them into classes of traffic. The “QOS Class” page does this, sorts the data packets into several pre-defined classes.

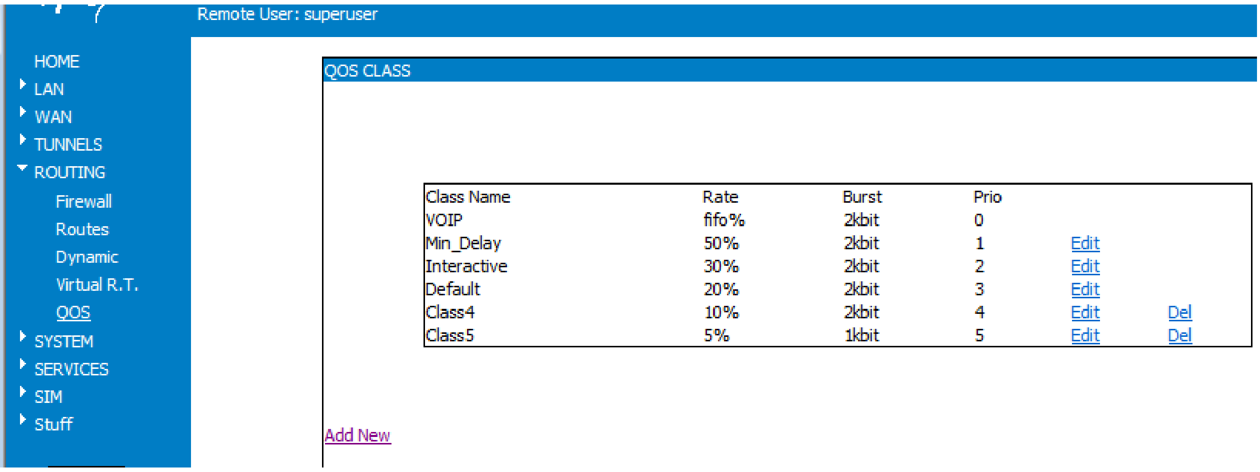


Class Name	Rate	Burst	Prio		
VOIP	fifo%	2kbit	0		
Min_Delay	50%	2kbit	1	Edit	
Interactive	25%	3kbit	2	Edit	
Conceeded	15%	2kbit	3	Edit	
Class4	5%	1kbit	4	Edit	Del
Class5	5%	0.5kbit	5	Edit	Del

Interface	Upload	Download	TOS to	CLASS		
BR0	1800	2500	0x20	VOIP		
			0x00	Disabled		
			0x28	Min_Delay		
			0x38	Conceeded	Edit	Del
WAN	1200	2000	0x38	Min_Delay		
			0x40	Disabled		
			0x48	Interactive		
			0x00	Disabled	Edit	Del
LAN0\WAN0	1000	3000	0x88	Interactive		
			0x00	Disabled		
			0x00	Disabled		
			0x00	Disabled	Edit	Del
Embeded_Modem	2000	4000	0xB8	VOIP		
			0xA0	Disabled		
			0xC0	Disabled		
			0x00	Disabled	Edit	Del
BR0	1500	2000	0xE0	VOIP		

Figure 5-138: Aspect of the QoS Class page

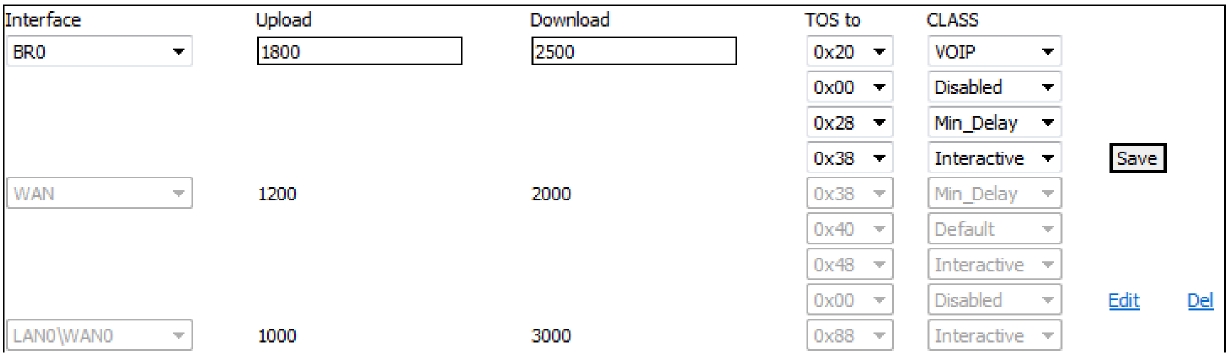
The “QOS Class” page also has two distinct panes, the upper table, predefined but which may be extended or modified (except for the topmost class, which is reserved for VoIP):



Class Name	Rate	Burst	Prio		
VOIP	fifo%	2kbit	0		
Min_Delay	50%	2kbit	1	Edit	
Interactive	30%	2kbit	2	Edit	
Default	20%	2kbit	3	Edit	
Class4	10%	2kbit	4	Edit	Del
Class5	5%	1kbit	5	Edit	Del

Figure 5-139: QoS Class topmost pane, listing of classes

And respectively the bottom part, where you assign for each Interface the upload and download figures, and Class distribution according to TOS value:



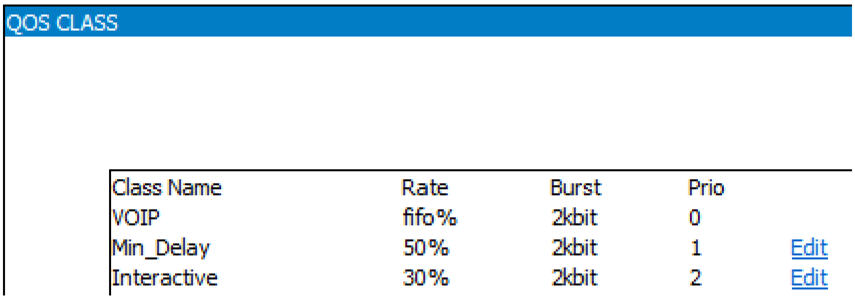
Interface	Upload	Download	TOS to	CLASS		
BR0	1800	2500	0x20	VOIP		
			0x00	Disabled		
			0x28	Min_Delay		
			0x38	Interactive	Save	
WAN	1200	2000	0x38	Min_Delay		
			0x40	Default		
			0x48	Interactive		
			0x00	Disabled	Edit	Del
LAN0\WAN0	1000	3000	0x88	Interactive		

Figure 5-140: QoS Class bottom pane, definition of classes

“QoS Class” upper table has 3+1 pre-defined classes, named respectively VOIP, Min Delay, Interactive and Default, with corresponding decreasing priorities 0,1, 2, 3, 4 and rates out of the 100% total.

You can see that VoIP traffic is placed above the other classes:

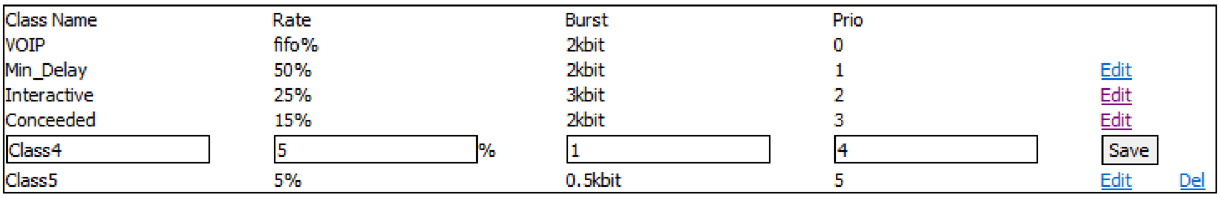
- it does not have a rate specified, but instead “fifo” – first-in, first-out scheduling;
- it cannot be edited, it has no Edit link to the right, like the other classes!



QOS CLASS

Class Name	Rate	Burst	Prio	
VOIP	fifo%	2kbit	0	
Min_Delay	50%	2kbit	1	Edit
Interactive	30%	2kbit	2	Edit

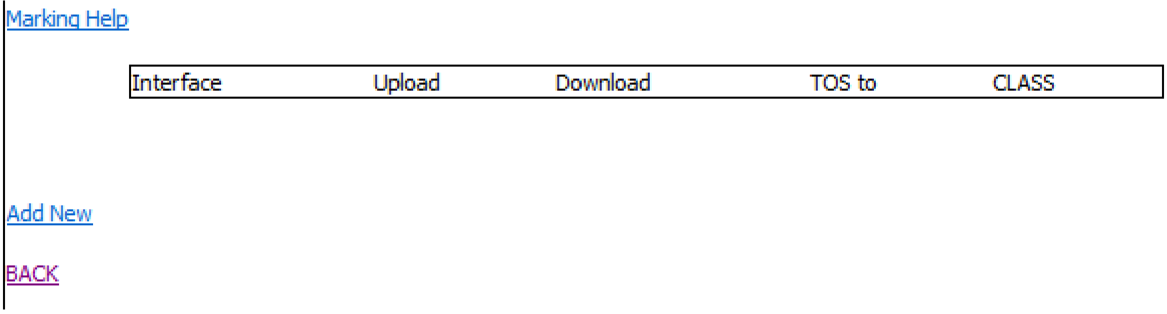
You may edit each of the other classes, changing the priorities, rates and burst assignment (in addition to the respective percent assigned), or add up additional classes:



Class Name	Rate	Burst	Prio		
VOIP	fifo%	2kbit	0		
Min_Delay	50%	2kbit	1	Edit	
Interactive	25%	3kbit	2	Edit	
Conceeded	15%	2kbit	3	Edit	
Class4	5 %	1	4	Save	
Class5	5%	0.5kbit	5	Edit	Del

QOS Class Entries

In the beginning, the bottom QOS Class table is empty:



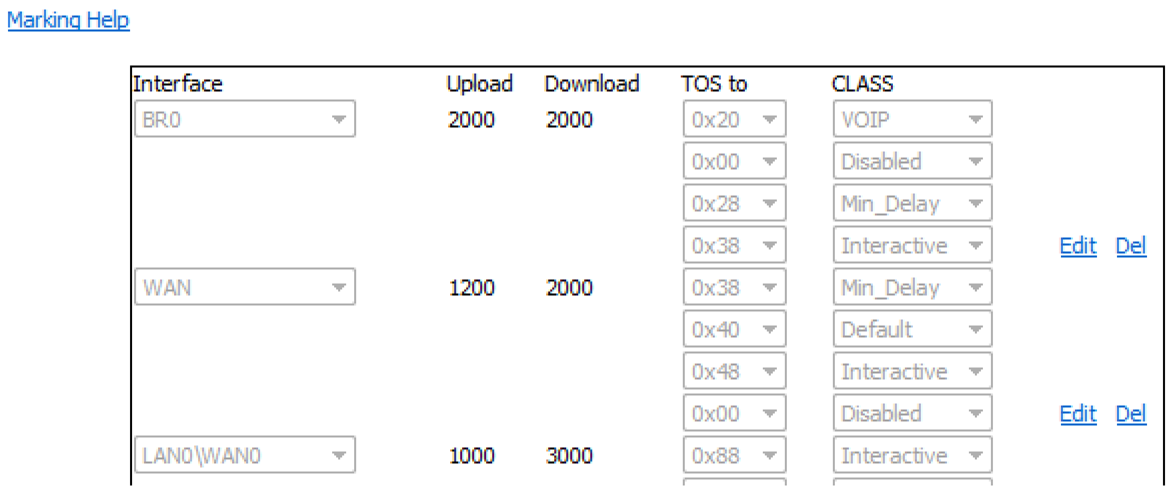
Marking Help

Interface	Upload	Download	TOS to	CLASS

Add New

BACK

so you must use Add New to create new entries in the table,



Marking Help

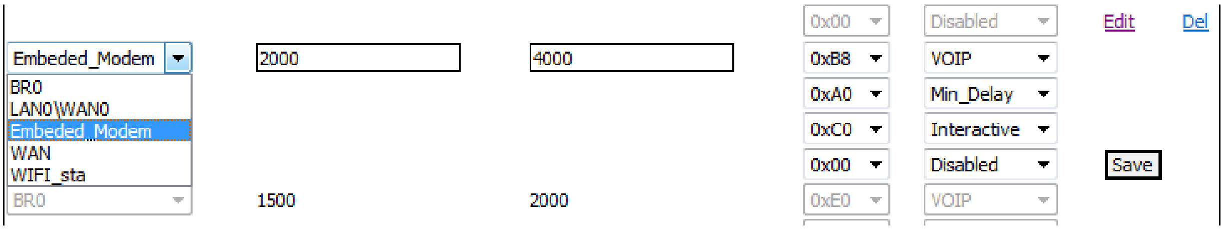
Interface	Upload	Download	TOS to	CLASS	
BR0	2000	2000	0x20	VOIP	
			0x00	Disabled	
			0x28	Min_Delay	
			0x38	Interactive	Edit Del
WAN	1200	2000	0x38	Min_Delay	
			0x40	Default	
			0x48	Interactive	
			0x00	Disabled	Edit Del
LAN0\WAN0	1000	3000	0x88	Interactive	

Figure 5-141: QoS Class specifying TOS and classes for each interface

And then edit the respective entries you have added !

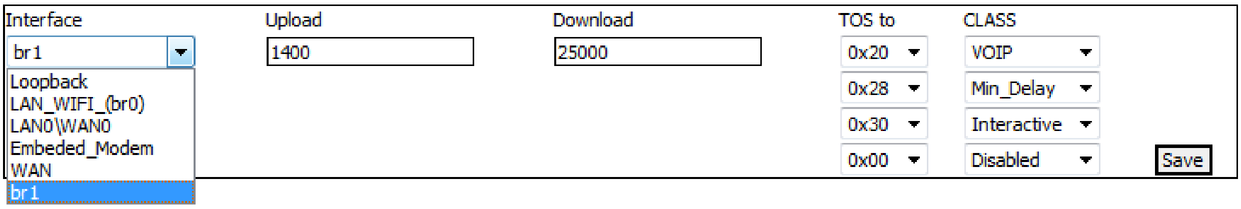
Define QoS classes by setting limits and value marking for each interface:

For each entry, you select an Interface from the drop list, then assign to it Upload and Download limits (in K bps), then define for each TOS value into which of the above-defined Classes it will be sorted (VOIP, Min Delay, Interactive, etc) or leave it to the default Disabled:



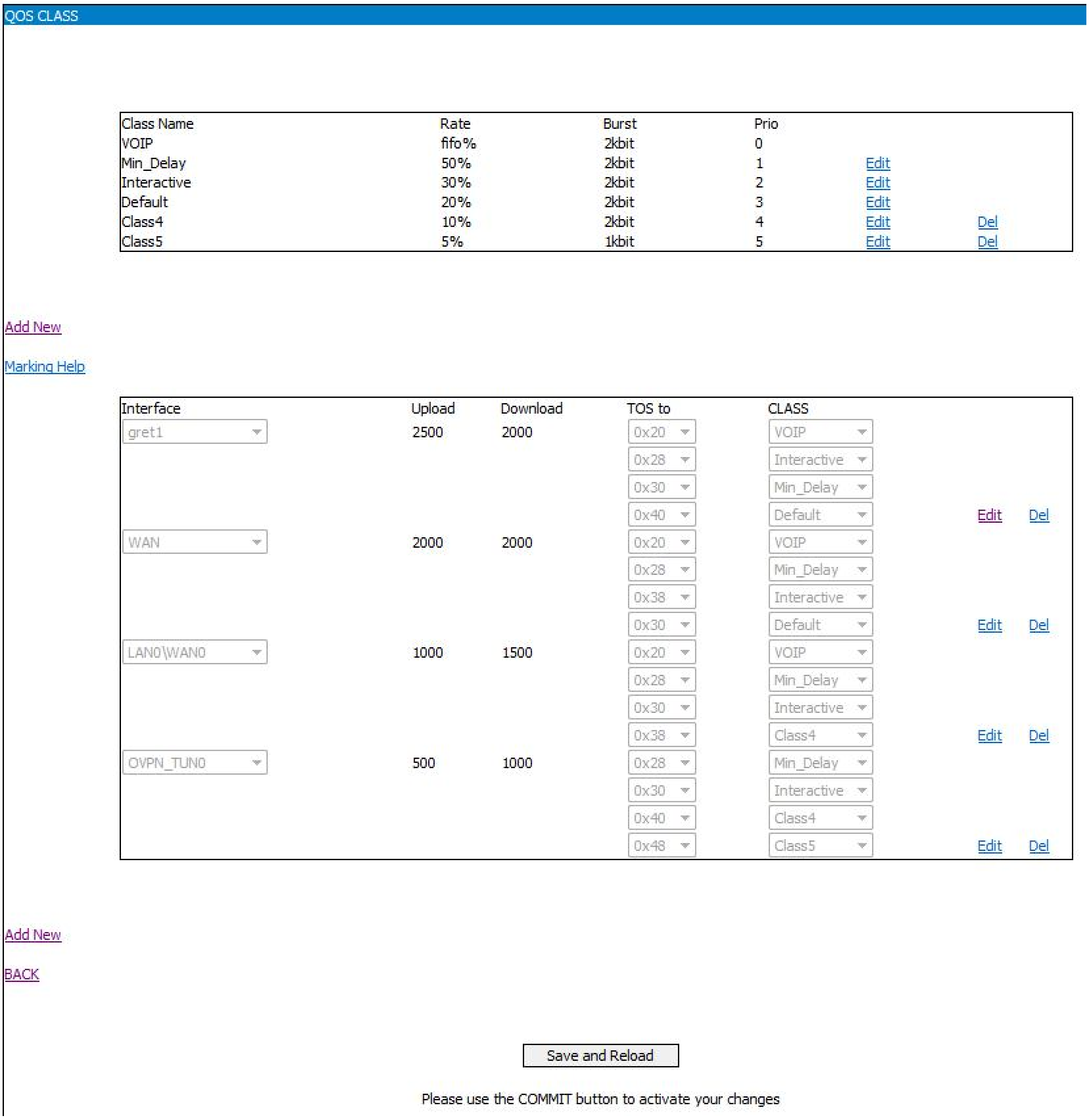
			0x00	Disabled	Edit Del
Embeded_Modem	2000	4000	0xB8	VOIP	
BR0 LAN0\WAN0 Embeded_Modem WAN WIFI_sta			0xA0	Min_Delay	
			0xC0	Interactive	
			0x00	Disabled	Save
BR0	1500	2000	0xE0	VOIP	

Or :



Interface	Upload	Download	TOS to	CLASS	
br1	1400	25000	0x20	VOIP	
Loopback LAN_WIFI_(br0) LAN0\WAN0 Embeded_Modem WAN br1			0x28	Min_Delay	
			0x30	Interactive	
			0x00	Disabled	Save

Do this for each of the interfaces where you need to shape the traffic:



QOS CLASS

Class Name	Rate	Burst	Prio		
VOIP	fifo%	2kbit	0		
Min_Delay	50%	2kbit	1	Edit	
Interactive	30%	2kbit	2	Edit	
Default	20%	2kbit	3	Edit	
Class4	10%	2kbit	4	Edit	Del
Class5	5%	1kbit	5	Edit	Del

Add New

Marking Help

Interface	Upload	Download	TOS to	CLASS		
gret1	2500	2000	0x20	VOIP		
			0x28	Interactive		
			0x30	Min_Delay		
			0x40	Default	Edit	Del
WAN	2000	2000	0x20	VOIP		
			0x28	Min_Delay		
			0x38	Interactive		
			0x30	Default	Edit	Del
LAN0\WAN0	1000	1500	0x20	VOIP		
			0x28	Min_Delay		
			0x30	Interactive		
			0x38	Class4	Edit	Del
OVPN_TUN0	500	1000	0x28	Min_Delay		
			0x30	Interactive		
			0x40	Class4		
			0x48	Class5	Edit	Del

Add New

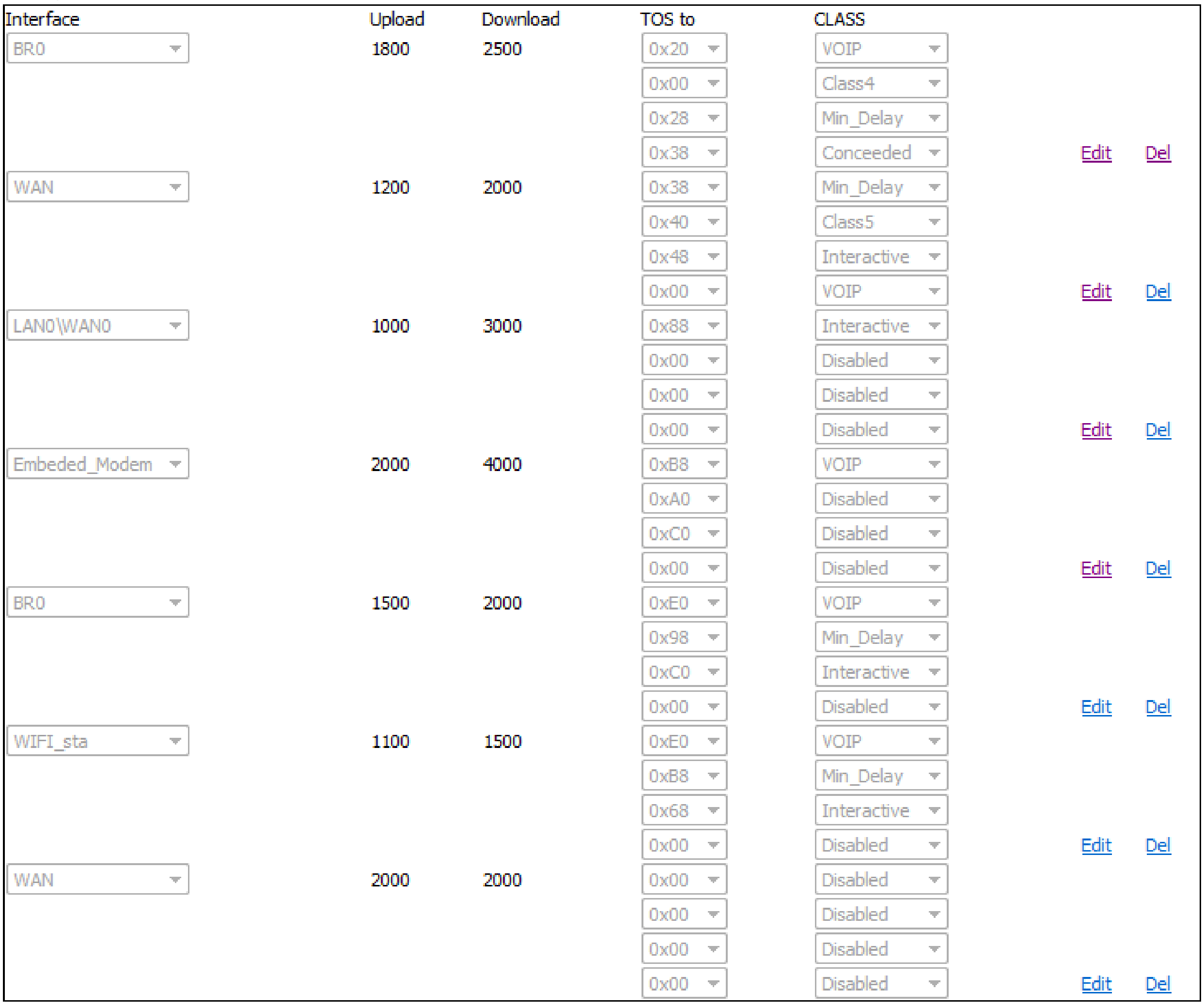
BACK

Save and Reload

Please use the COMMIT button to activate your changes

Figure 5-141: QoS Class – adding and edition the entries for each interface

Finally, the QOS Class table shall look somehow like this:

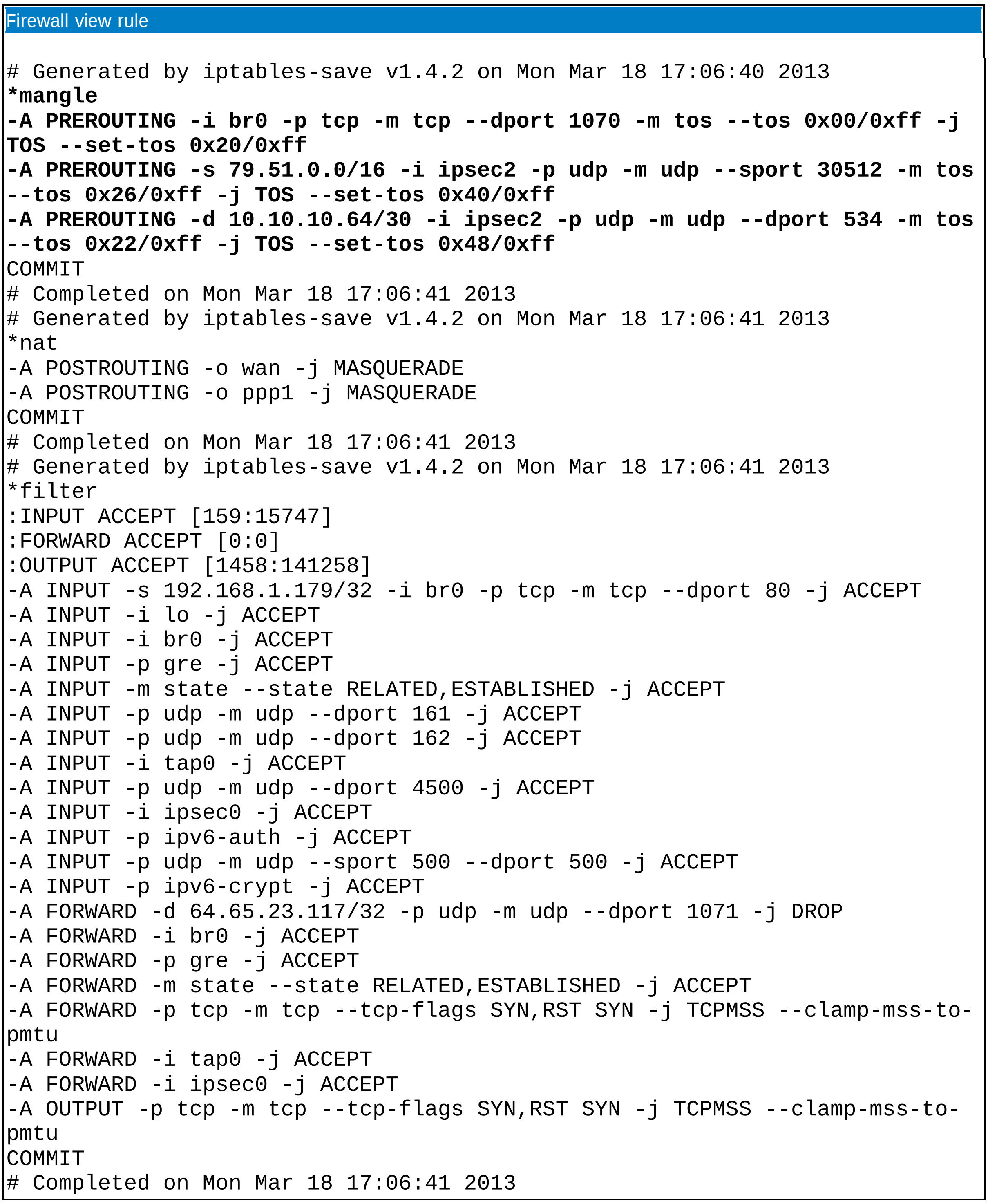


Interface	Upload	Download	TOS to	CLASS		
BR0	1800	2500	0x20	VOIP		
			0x00	Class4		
			0x28	Min_Delay		
			0x38	Conceeded	Edit	Del
WAN	1200	2000	0x38	Min_Delay		
			0x40	Class5		
			0x48	Interactive		
			0x00	VOIP	Edit	Del
LAN0\WAN0	1000	3000	0x88	Interactive		
			0x00	Disabled		
			0x00	Disabled		
			0x00	Disabled	Edit	Del
Embeded_Modem	2000	4000	0xB8	VOIP		
			0xA0	Disabled		
			0xC0	Disabled		
			0x00	Disabled	Edit	Del
BR0	1500	2000	0xE0	VOIP		
			0x98	Min_Delay		
			0xC0	Interactive		
			0x00	Disabled	Edit	Del
WIFI_sta	1100	1500	0xE0	VOIP		
			0xB8	Min_Delay		
			0x68	Interactive		
			0x00	Disabled	Edit	Del
WAN	2000	2000	0x00	Disabled		
			0x00	Disabled		
			0x00	Disabled		
			0x00	Disabled	Edit	Del

Figure 5-141: Completed QoS table

The Bytton firmware automatically generates the corresponding firewall rules (labeled TOS), as can be seen in the next examples:

```
*mangle
-A PREROUTING -d 192.168.148.208/30 -i wan -p tcp -m tcp --dport 81 -j TOS --
set-tos 0x28/0xff
-A PREROUTING -s 10.0.0.220/30 -i br1 -p udp -m udp --sport 48006 -m tos --tos
0x32/0xff -j TOS --set-tos 0x70/0xff
-A PREROUTING -s 39.41.125.78/31 -i lan0 -p udp -m udp --sport 31022 -m tos --
tos 0x28/0xff -j TOS --set-tos 0x88/0xff
-A PREROUTING -s 10.0.59.120/30 -i wlan0 -p udp -m udp --sport 48007 -m tos --
tos 0x2f/0xff -j TOS --set-tos 0x98/0xff
-A POSTROUTING -d 10.0.0.0/16 -o lan0 -p udp -m udp --dport 4 -m tos --tos
0x22/0xff -j TOS --set-tos 0x20/0xff
-A POSTROUTING -d 193.25.46.0/24 -o wan -p udp -m udp --dport 31021 -j TOS --
set-tos 0x38/0xff
-A POSTROUTING -d 87.0.0.0/8 -o wlan0 -p udp -m udp --dport 397 -m tos --tos
0x46/0xff
COMMIT
```



Firewall view rule

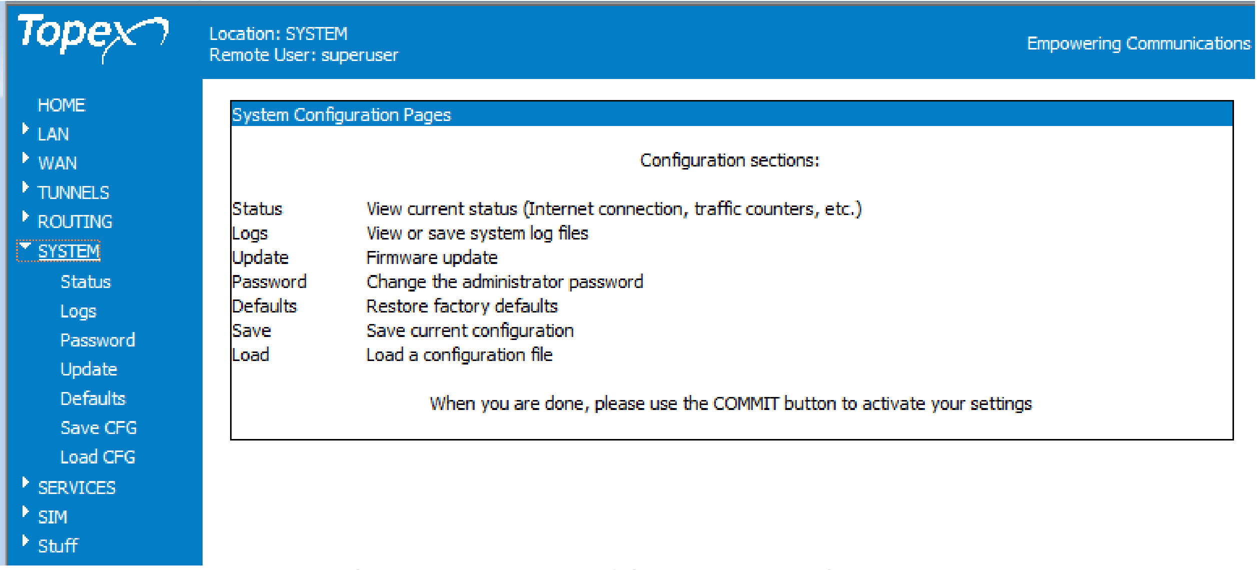
```
# Generated by iptables-save v1.4.2 on Mon Mar 18 17:06:40 2013
*mangle
-A PREROUTING -i br0 -p tcp -m tcp --dport 1070 -m tos --tos 0x00/0xff -j
TOS --set-tos 0x20/0xff
-A PREROUTING -s 79.51.0.0/16 -i ipsec2 -p udp -m udp --sport 30512 -m tos
--tos 0x26/0xff -j TOS --set-tos 0x40/0xff
-A PREROUTING -d 10.10.10.64/30 -i ipsec2 -p udp -m udp --dport 534 -m tos
--tos 0x22/0xff -j TOS --set-tos 0x48/0xff
COMMIT
# Completed on Mon Mar 18 17:06:41 2013
# Generated by iptables-save v1.4.2 on Mon Mar 18 17:06:41 2013
*nat
-A POSTROUTING -o wan -j MASQUERADE
-A POSTROUTING -o ppp1 -j MASQUERADE
COMMIT
# Completed on Mon Mar 18 17:06:41 2013
# Generated by iptables-save v1.4.2 on Mon Mar 18 17:06:41 2013
*filter
:INPUT ACCEPT [159:15747]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [1458:141258]
-A INPUT -s 192.168.1.179/32 -i br0 -p tcp -m tcp --dport 80 -j ACCEPT
-A INPUT -i lo -j ACCEPT
-A INPUT -i br0 -j ACCEPT
-A INPUT -p gre -j ACCEPT
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -p udp -m udp --dport 161 -j ACCEPT
-A INPUT -p udp -m udp --dport 162 -j ACCEPT
-A INPUT -i tap0 -j ACCEPT
-A INPUT -p udp -m udp --dport 4500 -j ACCEPT
-A INPUT -i ipsec0 -j ACCEPT
-A INPUT -p ipv6-auth -j ACCEPT
-A INPUT -p udp -m udp --sport 500 --dport 500 -j ACCEPT
-A INPUT -p ipv6-crypt -j ACCEPT
-A FORWARD -d 64.65.23.117/32 -p udp -m udp --dport 1071 -j DROP
-A FORWARD -i br0 -j ACCEPT
-A FORWARD -p gre -j ACCEPT
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-
pmtu
-A FORWARD -i tap0 -j ACCEPT
-A FORWARD -i ipsec0 -j ACCEPT
-A OUTPUT -p tcp -m tcp --tcp-flags SYN,RST SYN -j TCPMSS --clamp-mss-to-
pmtu
COMMIT
# Completed on Mon Mar 18 17:06:41 2013
```

BACK

Figure 5-142: TOS rules generated in the Bzttonțs firewall

5.5 SYSTEM

Shows the current state of the Bytton LTE equipment and the logs, also allowing you to perform several system-related operations.



System Configuration Pages

Configuration sections:

Status	View current status (Internet connection, traffic counters, etc.)
Logs	View or save system log files
Update	Firmware update
Password	Change the administrator password
Defaults	Restore factory defaults
Save	Save current configuration
Load	Load a configuration file

When you are done, please use the COMMIT button to activate your settings

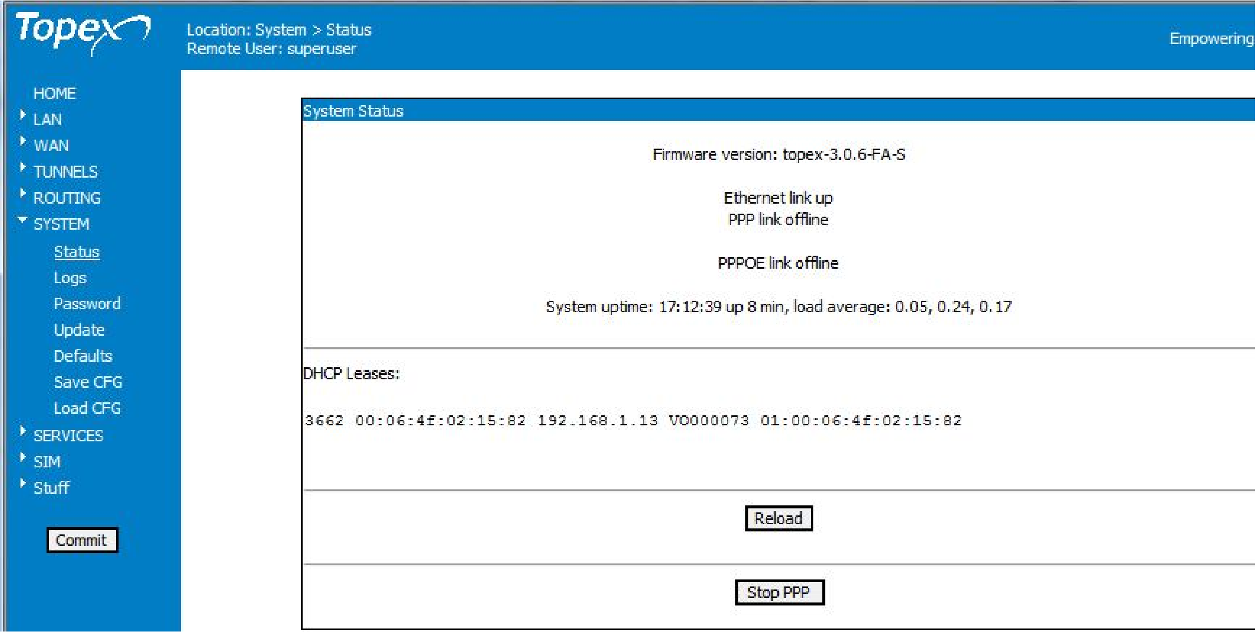
Figure 5-143: Aspect of the SYSTEM Web Page.

The system configuration pages include these settings:

- Status, displays the current status of the BYTTON LTE equipment
- Logs, shows the log file
- Update, you may perform firmware update
- Password, allows modification of the password
- Defaults, restores the factory default settings
- Save, saves the current configuration of Bytton LTE
- Load, loads a configuration previously saved.

5.5.1 Status

Shows the current state of the Bytton LTE system:



Firmware version: topex-3.0.6-FA-S

Ethernet link up
PPP link offline

PPPOE link offline

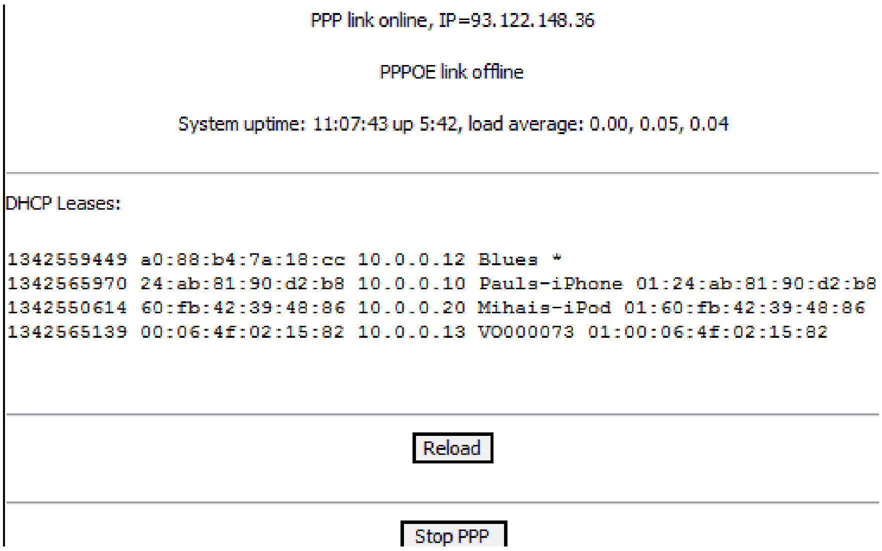
System uptime: 17:12:39 up 8 min, load average: 0.05, 0.24, 0.17

DHCP Leases:

```
3662 00:06:4f:02:15:82 192.168.1.13 VO000073 01:00:06:4f:02:15:82
```

Figure 5-144: Aspects of System Status Web Page with Ethernet link up.

Or:



PPP link online, IP=93.122.148.36

PPPOE link offline

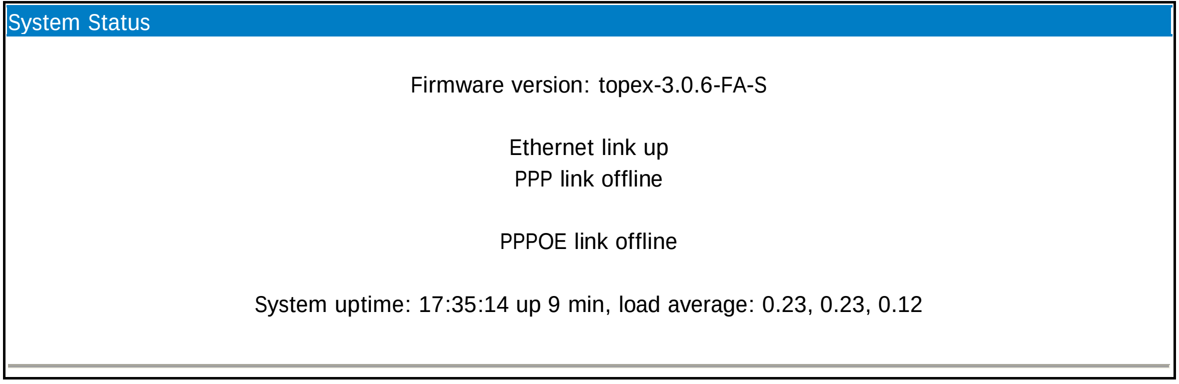
System uptime: 11:07:43 up 5:42, load average: 0.00, 0.05, 0.04

DHCP Leases:

```
1342559449 a0:88:b4:7a:18:cc 10.0.0.12 Blues *
1342565970 24:ab:81:90:d2:b8 10.0.0.10 Pauls-iPhone 01:24:ab:81:90:d2:b8
1342550614 60:fb:42:39:48:86 10.0.0.20 Mihais-iPod 01:60:fb:42:39:48:86
1342565139 00:06:4f:02:15:82 10.0.0.13 VO000073 01:00:06:4f:02:15:82
```

Figure 5-144: Aspects of SYSTEM Status Web Page with PPP link online.

Other example, with the PPP link offline, this time:

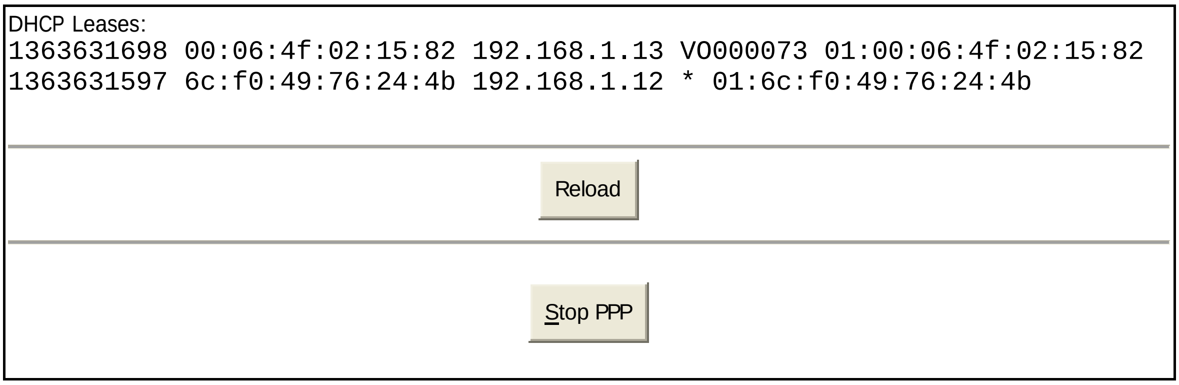


Firmware version: topex-3.0.6-FA-S

Ethernet link up
PPP link offline

PPPOE link offline

System uptime: 17:35:14 up 9 min, load average: 0.23, 0.23, 0.12



```
DHCP Leases:
1363631698 00:06:4f:02:15:82 192.168.1.13 VO000073 01:00:06:4f:02:15:82
1363631597 6c:f0:49:76:24:4b 192.168.1.12 * 01:6c:f0:49:76:24:4b
```

Figure 5-145: Alternate example of Status sub-page for System, with two DHCP clients conected.

This System Status page displays information about the following items:

- **Firmware version**: version of the firmware running on Bytton LTE: you may see “Firmware version is company-1.2.3 –NETWORK-xyz” in the above example, and so on. The company may be topex MobileCarrierB or omniacom, the firmware version can be 2.7.1 or 3.0.6, while the final letters (such as FA_S) indicate the type, model (kind of mobile module, fitted with additional options) or customized software.

o **State of the PPP data lin**k, which uses the embedded modem of the Bytton equipment. It may be in one of these states: online (active), offline or stopped. Stopped means it is Disabled, while Offline may indicate temporary connection hang-up, but it activates when Bytton sends/receives data traffic. If the PPP link is online, the IP allotted by your provider will also be shown. o State of the PPPOE data link, which uses the WAN Ethernet port for the PPP connection.	PPP link online, IP=172.23.5.161 o PPPOE link PPP link starting o PPPOE link Ethernet link up PPP link online, IP=93.122.148.36 PPPOE link offline o PPP link online, IP=93.122.148.36

- **System uptime**: time since the last restart of the Topex Bytton LTE equipment, both in full format (hours:minutes:seconds) and short format (up 1 minute) “System uptime: 11:41:59 up 4:50”;
- **Load average**: “0.06, 0.04, 0.01” or “load average: 1.50, 1.67, 1.71 “ - info about system loading (maximum value / average value / number of active processes)
- **DHCP Leases**: temporary assigned IP addresses and their corresponding MAC, host name, validity period, etc.

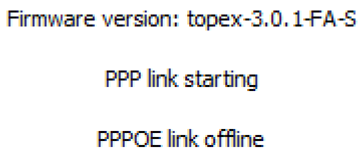
```
DHCP Leases:
1340747490 00:1d:e0:5e:c2:ab 10.0.0.16 DL *
1340747274 6c:f0:49:76:24:4b 10.0.0.15 VO000073 01:6c:f0:49:76:24:4b
1340747241 00:06:4f:02:15:82 10.0.0.13 * 01:00:06:4f:02:15:82
1340747209 60:fb:42:39:48:86 10.0.0.20 Mihais-iPod 01:60:fb:42:39:48:86
Or:
1342559449 a0:88:b4:7a:18:cc 10.0.0.12 Blues *
1342565970 24:ab:81:90:d2:b8 10.0.0.10 Pauls-iPhone 01:24:ab:81:90:d2:b8
1342550614 60:fb:42:39:48:86 10.0.0.20 Mihais-iPod 01:60:fb:42:39:48:86
1342566557 00:06:4f:02:15:82 10.0.0.13 VO000073 01:00:06:4f:02:15:82
```

Figure 5-146: Examples of DHCP leases in System Status.

The “**Reload**” button at the bottom of the page refreshes Bytton LTE's status information.

The “**Please reload**!” message appears when the internal PPP link is in a transition state: “PPP link starting”.

Since this state is by definition temporary, you **must** click the Reload button in order to get the current status of the PPP link.

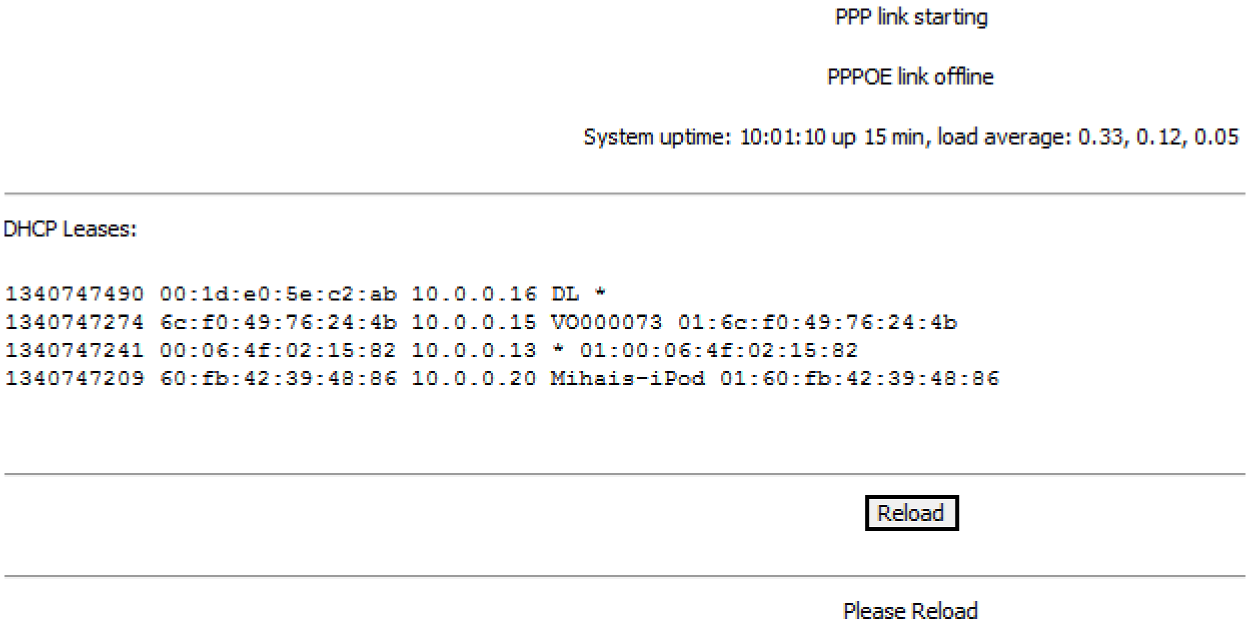


Firmware version: topex-3.0.1-FA-S

PPP link starting

PPPOE link offline

Or:



PPP link starting

PPPOE link offline

System uptime: 10:01:10 up 15 min, load average: 0.33, 0.12, 0.05

DHCP Leases:

```
1340747490 00:1d:e0:5e:c2:ab 10.0.0.16 DL *
1340747274 6c:f0:49:76:24:4b 10.0.0.15 VO000073 01:6c:f0:49:76:24:4b
1340747241 00:06:4f:02:15:82 10.0.0.13 * 01:00:06:4f:02:15:82
1340747209 60:fb:42:39:48:86 10.0.0.20 Mihais-iPod 01:60:fb:42:39:48:86
```

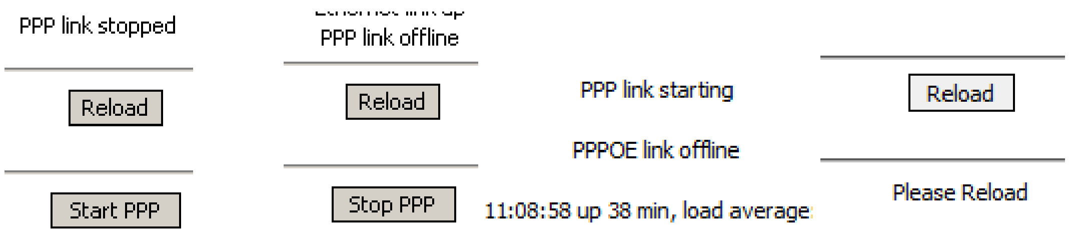
Please Reload

Figure 5-147: Using the “Reload” button located at the bottom.

Start/Stop PPP

This feature allows you to manually start and stop the PPP link.
When PPP link status is online, the button will display “Stop”, since it now allows you to stop the PPP link (break the connection).
After you have stopped the PPP connection, the same button changes its name to “Start PPP”, obliviously if the connection is stopped, you may want to start it again!

See below a few examples:



PPP link stopped

Ethernet link up

PPP link offline

PPP link starting

PPPOE link offline

11:08:58 up 38 min, load average

Please Reload

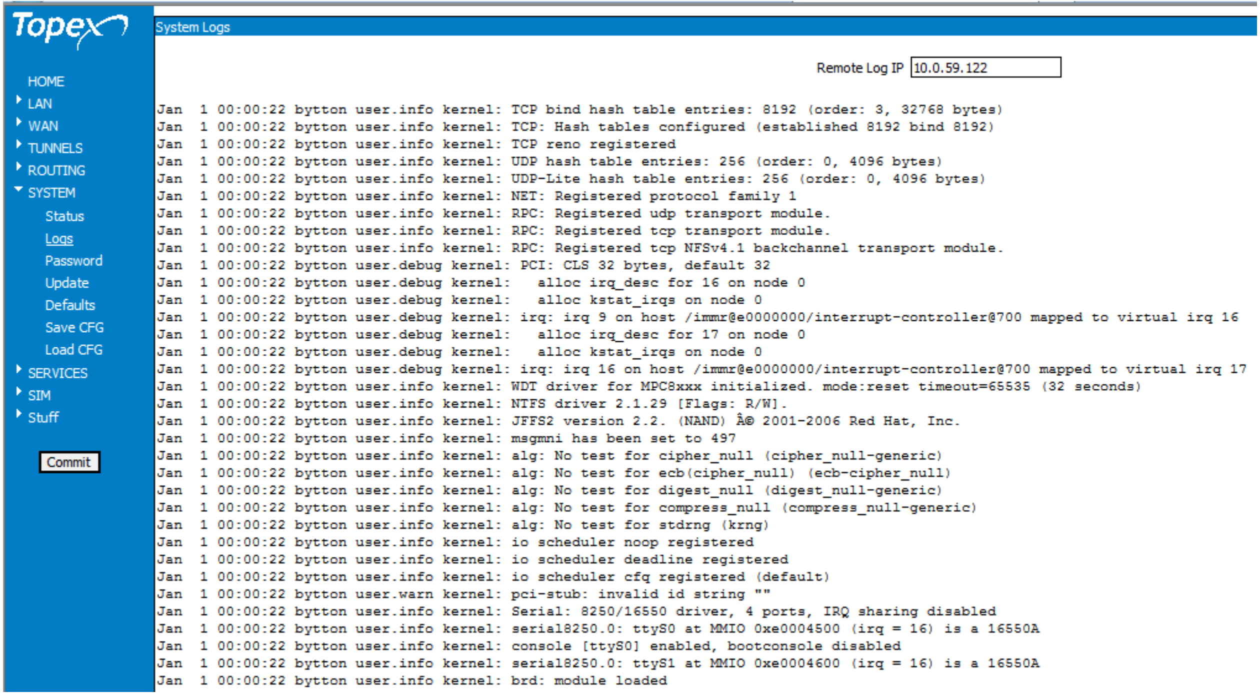
Figure 5-148: Examples of state of the PPP link and Start/Stop button.

The shutting down or restarting of the PPP mobile data link may be seen below in the extracts from the system logs:

```
Jun 26 10:01:49 bytton daemon.info pppd[5747]: CHAP authentication succeeded
Jun 26 10:01:49 bytton daemon.notice pppd[5747]: CHAP authentication succeeded
Jun 26 10:01:49 bytton daemon.debug pppd[5747]: sent [CCP ConfReq id=0x1   ]
Jun 26 10:01:49 bytton daemon.debug pppd[5747]: sent [IPCP ConfReq id=0x1    ]
Jun 26 10:01:49 bytton daemon.debug pppd[5747]: rcvd [LCP ProtRej id=0x2 80 fd 01 01 00
0f 1a 04 78 00 18 04 78 00 15 03 2f]
Jun 26 10:01:53 bytton daemon.warn pppd[5747]: Could not determine remote IP address:
defaulting to 10.64.64.65
Jun 26 10:01:53 bytton daemon.info dnsmasq[1199]: reading /etc/resolv.conf
Jun 26 10:01:53 bytton daemon.info dnsmasq[1199]: using nameserver 62.217.193.65#53
Jun 26 10:01:53 bytton daemon.notice pppd[5747]: local  IP address 93.122.148.36
Jun 26 10:01:53 bytton daemon.notice pppd[5747]: remote IP address 10.64.64.65
Jun 26 10:01:53 bytton daemon.notice pppd[5747]: primary   DNS address 62.217.193.1
Jun 26 10:01:53 bytton daemon.notice pppd[5747]: secondary DNS address 62.217.193.65
Jun 26 10:01:53 bytton daemon.debug pppd[5747]: Script /etc/ppp/ip-up started (pid
5777)
Jun 26 10:01:53 bytton daemon.info dnsmasq[1199]: read /etc/hosts - 1 addresses
Jun 26 10:02:16 bytton daemon.debug pppd[5747]: Script /etc/ppp/ip-up finished (pid
5777), status = 0x0
Jun 26 10:02:19 bytton user.notice root: RESTART SERVICES
Jun 26 10:36:32 bytton user.info kernel: br0: port 1(wlan0) entering forwarding state
Jun 26 10:38:57 bytton user.notice root: Stop PPP: user
Jun 26 10:38:57 bytton daemon.info pppd[3604]: Terminating on signal 2
Jun 26 10:38:57 bytton daemon.info pppd[3604]: Connect time 3.2 minutes.
Jun 26 10:38:57 bytton daemon.info pppd[3604]: Sent 319574 bytes, received 7986431
bytes.
Jun 26 10:38:57 bytton daemon.debug pppd[3604]: Script /etc/ppp/ip-down started (pid
4547)
Jun 26 10:38:57 bytton daemon.debug pppd[3604]: sent [LCP TermReq id=0x2 "User
request"]
Jun 26 10:38:57 bytton daemon.debug pppd[3604]: rcvd [LCP TermAck id=0x2]
Jun 26 10:38:57 bytton daemon.notice pppd[3604]: Connection terminated.
```

5.5.2 Logs

Shows the system log:



Remote Log IP 10.0.59.122

```
Jan  1 00:00:22 bytton user.info kernel: TCP bind hash table entries: 8192 (order: 3, 32768 bytes)
Jan  1 00:00:22 bytton user.info kernel: TCP: Hash tables configured (established 8192 bind 8192)
Jan  1 00:00:22 bytton user.info kernel: TCP reno registered
Jan  1 00:00:22 bytton user.info kernel: UDP hash table entries: 256 (order: 0, 4096 bytes)
Jan  1 00:00:22 bytton user.info kernel: UDP-Lite hash table entries: 256 (order: 0, 4096 bytes)
Jan  1 00:00:22 bytton user.info kernel: NET: Registered protocol family 1
Jan  1 00:00:22 bytton user.info kernel: RPC: Registered udp transport module.
Jan  1 00:00:22 bytton user.info kernel: RPC: Registered tcp transport module.
Jan  1 00:00:22 bytton user.info kernel: RPC: Registered tcp NFSv4.1 backchannel transport module.
Jan  1 00:00:22 bytton user.debug kernel: PCI: CLS 32 bytes, default 32
Jan  1 00:00:22 bytton user.debug kernel:   alloc irq_desc for 16 on node 0
Jan  1 00:00:22 bytton user.debug kernel:   alloc kstat_irqs on node 0
Jan  1 00:00:22 bytton user.debug kernel: irq: irq 9 on host /immr@e0000000/interrupt-controller@700 mapped to virtual irq 16
Jan  1 00:00:22 bytton user.debug kernel:   alloc irq_desc for 17 on node 0
Jan  1 00:00:22 bytton user.debug kernel:   alloc kstat_irqs on node 0
Jan  1 00:00:22 bytton user.debug kernel: irq: irq 16 on host /immr@e0000000/interrupt-controller@700 mapped to virtual irq 17
Jan  1 00:00:22 bytton user.info kernel: WDT driver for MPC8xxx initialized. mode:reset timeout=65535 (32 seconds)
Jan  1 00:00:22 bytton user.info kernel: NTFS driver 2.1.29 [Flags: R/W].
Jan  1 00:00:22 bytton user.info kernel: JFFS2 version 2.2. (NAND) Â© 2001-2006 Red Hat, Inc.
Jan  1 00:00:22 bytton user.info kernel: msgmni has been set to 497
Jan  1 00:00:22 bytton user.info kernel: alg: No test for cipher_null (cipher_null-generic)
Jan  1 00:00:22 bytton user.info kernel: alg: No test for ecb(cipher_null) (ecb-cipher_null)
Jan  1 00:00:22 bytton user.info kernel: alg: No test for digest_null (digest_null-generic)
Jan  1 00:00:22 bytton user.info kernel: alg: No test for compress_null (compress_null-generic)
Jan  1 00:00:22 bytton user.info kernel: alg: No test for stdrng (krng)
Jan  1 00:00:22 bytton user.info kernel: io scheduler noop registered
Jan  1 00:00:22 bytton user.info kernel: io scheduler deadline registered
Jan  1 00:00:22 bytton user.info kernel: io scheduler cfq registered (default)
Jan  1 00:00:22 bytton user.warn kernel: pci-stub: invalid id string ""
Jan  1 00:00:22 bytton user.info kernel: Serial: 8250/16550 driver, 4 ports, IRQ sharing disabled
Jan  1 00:00:22 bytton user.info kernel: serial8250.0: ttyS0 at MMIO 0xe0004500 (irq = 16) is a 16550A
Jan  1 00:00:22 bytton user.info kernel: console [ttyS0] enabled, bootconsole disabled
Jan  1 00:00:22 bytton user.info kernel: serial8250.0: ttyS1 at MMIO 0xe0004600 (irq = 16) is a 16550A
Jan  1 00:00:22 bytton user.info kernel: brd: module loaded
```

Figure 5-149: Aspect of the System Log of Bytton LTE.

The log is a place where all the applications running on the Bytton LTE equipment store their output messages: status reports, confirmation or error messages, activity, and so on.

It is a plain text (thus easy to interpret) record of actions taken by the software as it runs on Bytton LTE: changes made, devices and drivers detected, files added or deleted, communication with the modem, network settings, and so on.
See below some samples of this LOG file:

```
Jan  1 00:00:35 bytton user.info kernel: sierra 1-1:1.3: device disconnected
Jan  1 00:00:35 bytton user.info kernel: sierra ttyUSB4: Sierra USB modem converter now
disconnected from ttyUSB6
Jan  1 00:00:35 bytton user.info kernel: sierra 1-1:1.6: device disconnected
Jan  1 00:00:35 bytton user.info pbx: CONFIG FILE: /tmp/.pbx
Jan  1 00:00:35 bytton user.info pbx: wrong number of parameters request 7 - act ring = 0!
Jan  1 00:00:35 bytton user.info pbx: pbx 0.2.3 started
Jan  1 00:00:35 bytton user.info pbx: rmote run
Jan  1 00:00:35 bytton user.info pbx: voice run
Jan  1 00:00:35 bytton user.info pbx: modem run
Jan  1 00:00:35 bytton user.info pbx: voice port opened
Jan  1 00:00:36 bytton user.notice root: Selected sim: 0
Jan  1 00:00:37 bytton user.info kernel: br0: port 2(lan) entering forwarding state
Jan  1 00:00:37 bytton user.info pbx: clips active
Jan  1 00:00:40 bytton user.notice root: GSM MONI to CROND
Jan  1 00:00:42 bytton user.notice root: Start Quagga
Sep 28 07:50:56 bytton user.notice root: NTP SYNC to CROND
Sep 28 07:50:56 bytton user.info kernel: USB Serial support registered for pl2303
Sep 28 07:50:56 bytton user.info kernel: usbcore: registered new interface driver pl2303
Sep 28 07:50:56 bytton user.info kernel: pl2303: Prolific PL2303 USB to serial adaptor driver
Sep 28 07:50:57 bytton user.notice root: CK for USB - Serial
Sep 28 07:50:57 bytton user.notice root: Have USB - Serial port /dev/ttyS1
Sep 28 07:51:01 bytton user.info kernel: usb 1-1: Sierra USB modem converter now attached to
ttyUSB6
Sep 28 07:51:02 bytton user.info pbx: modem port opened
Sep 28 07:51:03 bytton user.info kernel: br0: port 3(wlan0) entering forwarding state
Sep 28 07:51:11 bytton user.notice root: Selected SIM0
Sep 28 07:51:11 bytton user.info pbx: clips active
```

……………………..etc.

At startup, the system log records how the Bytton LTE machine begins operation, so the first messages are those generated bu the “kernel” operationg system.
Also, the NTP client or other timekeeping ressources are not yet running, so the time stamps are always “Jan.1 00:00:xx”

```
Jan  1 00:00:22 bytton syslog.info syslogd started: BusyBox v1.11.2
Jan  1 00:00:22 bytton user.warn kernel: bio: create slab  at 0
Jan  1 00:00:22 bytton user.info kernel: vgaarb: loaded
Jan  1 00:00:22 bytton user.notice kernel: SCSI subsystem initialized
Jan  1 00:00:22 bytton user.info kernel: usbcore: registered new interface driver usbfs
Jan  1 00:00:22 bytton user.info kernel: usbcore: registered new interface driver hub
Jan  1 00:00:22 bytton user.info kernel: usbcore: registered new device driver usb
Jan  1 00:00:22 bytton user.info kernel: Freescale Elo / Elo Plus DMA driver
Jan  1 00:00:22 bytton user.info kernel: Sangoma WANPIPE Router v1.1 (c) 1995-2000 Sangoma
Technologies Inc.
Jan  1 00:00:22 bytton user.info kernel: cfg80211: Calling CRDA to update world regulatory domain
Jan  1 00:00:22 bytton user.info kernel: Switching to clocksource timebase
Jan  1 00:00:22 bytton user.info kernel: NET: Registered protocol family 2
Jan  1 00:00:22 bytton user.info kernel: IP route cache hash table entries: 2048 (order: 1, 8192
bytes)
Jan  1 00:00:22 bytton user.info kernel: TCP established hash table entries: 8192 (order: 4, 65536
bytes)
Jan  1 00:00:22 bytton user.info kernel: TCP bind hash table entries: 8192 (order: 3, 32768 bytes)
```

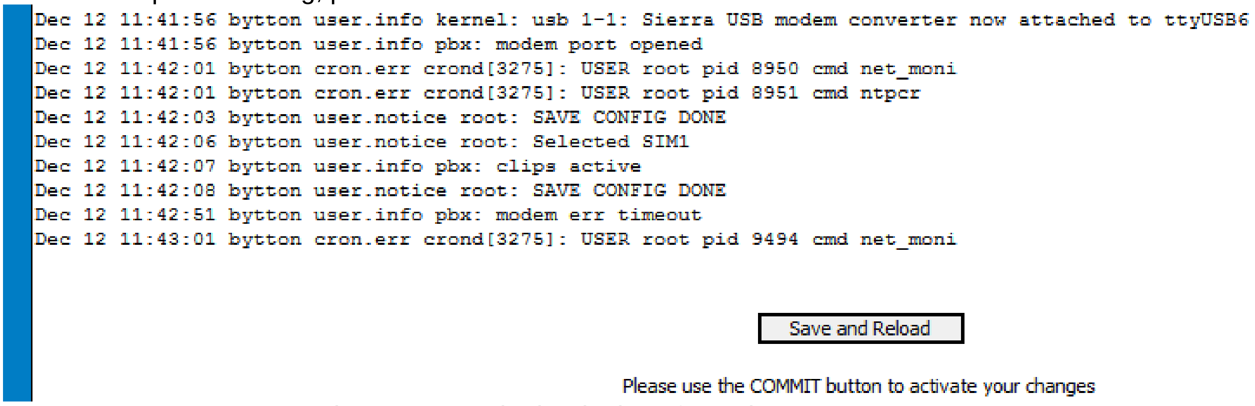
Figure 5-150: The beginning of a typical System Log.

Afterwards, the other application begiin to run on the equipment.
Correspondingly, in the log you will see records of the kernel or of the user, debug messages, info or warnings:

```
Dec 12 11:25:20 bytton user.info kernel: sierra 1-1:1.6: Sierra USB modem converter detected
Dec 12 11:25:20 bytton user.info kernel: usb 1-1: Sierra USB modem converter now attached to
ttyUSB6
Dec 12 11:25:20 bytton user.info pbx: modem port opened
Dec 12 11:25:26 bytton daemon.err openvpn[2801]: TCP: connect to 192.168.143.142:1194 failed, will
try again in 5 seconds: No route to host
Dec 12 11:25:30 bytton user.notice root: Selected SIM0
Dec 12 11:25:30 bytton user.info pbx: clips active
Dec 12 11:25:31 bytton user.info pbx: ONLINE
Dec 12 11:25:31 bytton user.info pbx: clips active
Dec 12 11:25:31 bytton user.info pbx: voice running
Dec 12 11:25:31 bytton user.notice root: Tring on SIM0:0
Dec 12 11:25:31 bytton daemon.notice pppd[1621]: pppd 2.4.4 started by root, uid 0
Dec 12 11:25:33 bytton user.notice root: DATA START
Dec 12 11:25:33 bytton daemon.info pppd[1621]: Serial port initialized.
Dec 12 11:25:33 bytton local2.info chat[1629]: timeout set to 20 seconds
Dec 12 11:25:33 bytton local2.info chat[1629]: abort on (BUSY)
Dec 12 11:25:33 bytton local2.info chat[1629]: abort on (NO CARRIER)
Dec 12 11:25:33 bytton local2.info chat[1629]: abort on (NO DIALTONE)
Dec 12 11:25:33 bytton local2.info chat[1629]: abort on (ERROR)
Dec 12 11:25:33 bytton local2.info chat[1629]: send (AT+CGDCONT=1,"IP","internet"^M)
Dec 12 11:25:33 bytton local2.info chat[1629]: expect (OK)
Dec 12 11:25:33 bytton local2.info chat[1629]: ^M
Dec 12 11:25:33 bytton local2.info chat[1629]: OK
```

The log is very helpful when troubleshooting. It may be saved on your PC (simply use “Save As” option of your browser) for further examination.

To update the Log, press the “Save and Reload” button located at the bottom of the screen.



```
Dec 12 11:41:56 bytton user.info kernel: usb 1-1: Sierra USB modem converter now attached to ttyUSB6
Dec 12 11:41:56 bytton user.info pbx: modem port opened
Dec 12 11:42:01 bytton cron.err crond[3275]: USER root pid 8950 cmd net_moni
Dec 12 11:42:01 bytton cron.err crond[3275]: USER root pid 8951 cmd ntpcr
Dec 12 11:42:03 bytton user.notice root: SAVE CONFIG DONE
Dec 12 11:42:06 bytton user.notice root: Selected SIM1
Dec 12 11:42:07 bytton user.info pbx: clips active
Dec 12 11:42:08 bytton user.notice root: SAVE CONFIG DONE
Dec 12 11:42:51 bytton user.info pbx: modem err timeout
Dec 12 11:43:01 bytton cron.err crond[3275]: USER root pid 9494 cmd net_moni
```

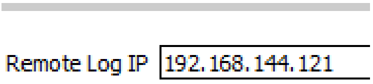
Please use the COMMIT button to activate your changes

Figure 5-151: The beginning of a typical System Log.

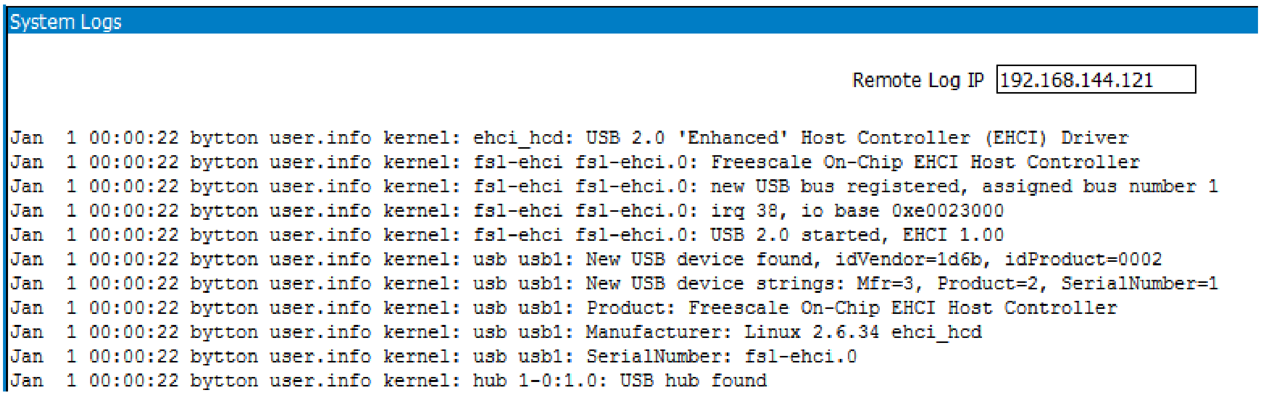
Remote Log IP:

There you enter the address where the log will be sent upon occurrence of events.

Use this IP setting to send the log messages to a remote location.



Remote Log IP 192.168.144.121



Remote Log IP 192.168.144.121

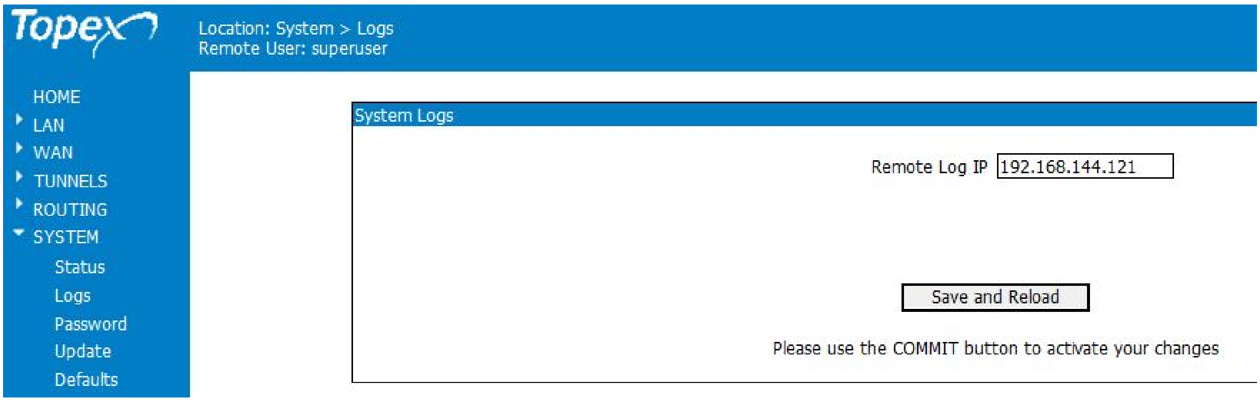
```
Jan  1 00:00:22 bytton user.info kernel: ehci_hcd: USB 2.0 'Enhanced' Host Controller (EHCI) Driver
Jan  1 00:00:22 bytton user.info kernel: fsl-ehci fsl-ehci.0: Freescale On-Chip EHCI Host Controller
Jan  1 00:00:22 bytton user.info kernel: fsl-ehci fsl-ehci.0: new USB bus registered, assigned bus number 1
Jan  1 00:00:22 bytton user.info kernel: fsl-ehci fsl-ehci.0: irq 38, io base 0xe0023000
Jan  1 00:00:22 bytton user.info kernel: fsl-ehci fsl-ehci.0: USB 2.0 started, EHCI 1.00
Jan  1 00:00:22 bytton user.info kernel: usb usb1: New USB device found, idVendor=1d6b, idProduct=0002
Jan  1 00:00:22 bytton user.info kernel: usb usb1: New USB device strings: Mfr=3, Product=2, SerialNumber=1
Jan  1 00:00:22 bytton user.info kernel: usb usb1: Product: Freescale On-Chip EHCI Host Controller
Jan  1 00:00:22 bytton user.info kernel: usb usb1: Manufacturer: Linux 2.6.34 ehci_hcd
Jan  1 00:00:22 bytton user.info kernel: usb usb1: SerialNumber: fsl-ehci.0
Jan  1 00:00:22 bytton user.info kernel: hub 1-0:1.0: USB hub found
```

Figure 5-152: Setting Remote Log IP for the System Log.

When you leave this address to the default “0.0.0.0” it means the log won’t be sent, it will be available only locally.

After issuing a “Commit”, the Bytton LTE will restart operation, with the log sent to the remote machine.

The System>Logs window the Web browser will be empty, since the log is sent only to the specified IP address”



Location: System > Logs
Remote User: superuser

System Logs

Remote Log IP 192.168.144.121

Please use the COMMIT button to activate your changes

Figure 5-153: System Log running with “Remote” settings.

Note: The remote machine must run a Syslog client, such as the “syslogd” daemon under Linux or a corresponding syslog client application for Windows.

An example of a free Syslog Daemon program for Windows is **Kiwi** , from Kiwi Enterprises:

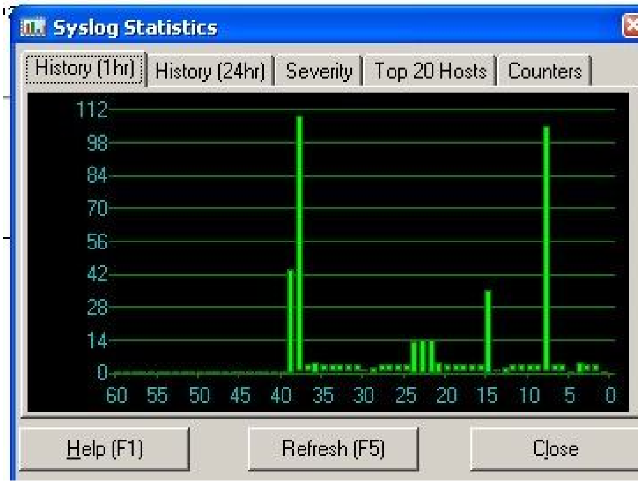
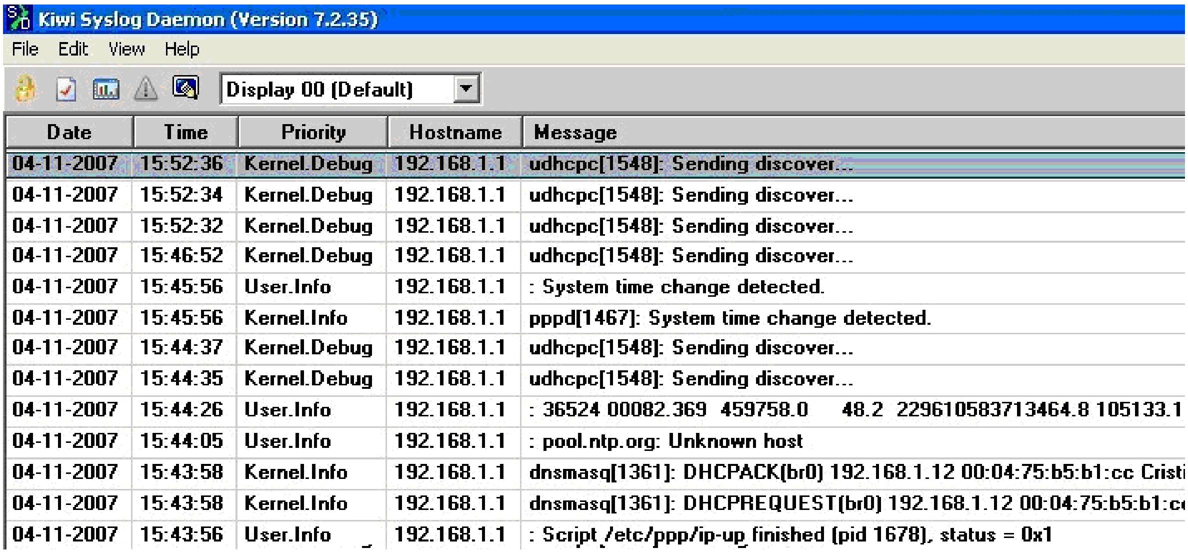


Figure 5-154: Syslog Statistics in Kiwi Syslog Daemon.

See below an extract form the screen of the Kiwi program, which runs on the destination PC and receives the Syslog sent out by Bytton LTE device:

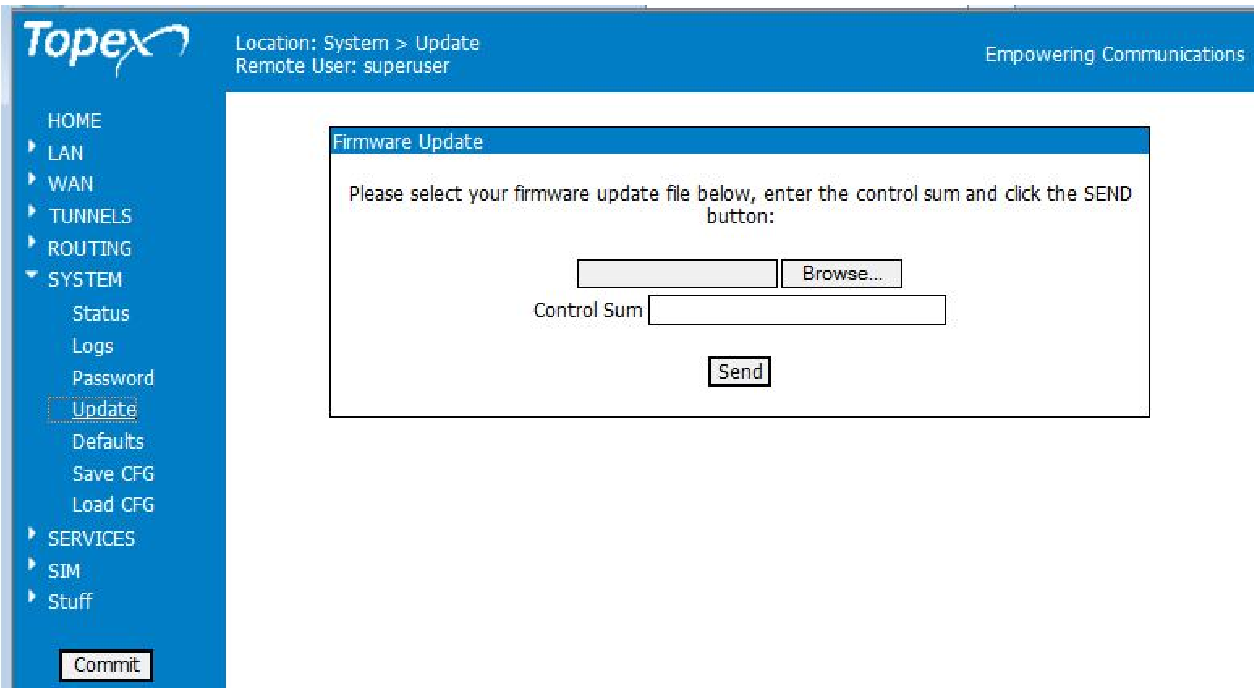


Date	Time	Priority	Hostname	Message
04-11-2007	15:52:36	Kernel.Debug	192.168.1.1	udhcpc[1548]: Sending discover...
04-11-2007	15:52:34	Kernel.Debug	192.168.1.1	udhcpc[1548]: Sending discover...
04-11-2007	15:52:32	Kernel.Debug	192.168.1.1	udhcpc[1548]: Sending discover...
04-11-2007	15:46:52	Kernel.Debug	192.168.1.1	udhcpc[1548]: Sending discover...
04-11-2007	15:45:56	User.Info	192.168.1.1	: System time change detected.
04-11-2007	15:45:56	Kernel.Info	192.168.1.1	pppd[1467]: System time change detected.
04-11-2007	15:44:37	Kernel.Debug	192.168.1.1	udhcpc[1548]: Sending discover...
04-11-2007	15:44:35	Kernel.Debug	192.168.1.1	udhcpc[1548]: Sending discover...
04-11-2007	15:44:26	User.Info	192.168.1.1	: 36524 00082.369 459758.0 48.2 229610583713464.8 105133.1
04-11-2007	15:44:05	User.Info	192.168.1.1	: pool.ntp.org: Unknown host
04-11-2007	15:43:58	Kernel.Info	192.168.1.1	dnsmasq[1361]: DHCPACK(br0) 192.168.1.12 00:04:75:b5:b1:cc Cristi
04-11-2007	15:43:58	Kernel.Info	192.168.1.1	dnsmasq[1361]: DHCPREQUEST(br0) 192.168.1.12 00:04:75:b5:b1:c
04-11-2007	15:43:56	User.Info	192.168.1.1	: Script /etc/ppp/ip-up finished (pid 1678), status = 0x1

Figure 5-155: Kiwi Syslog Daemon showing the remote System Log for Bytton LTE.

5.5.3 Update

It allows you to perform an update or upgrade of the firmware running on Bytton LTE.

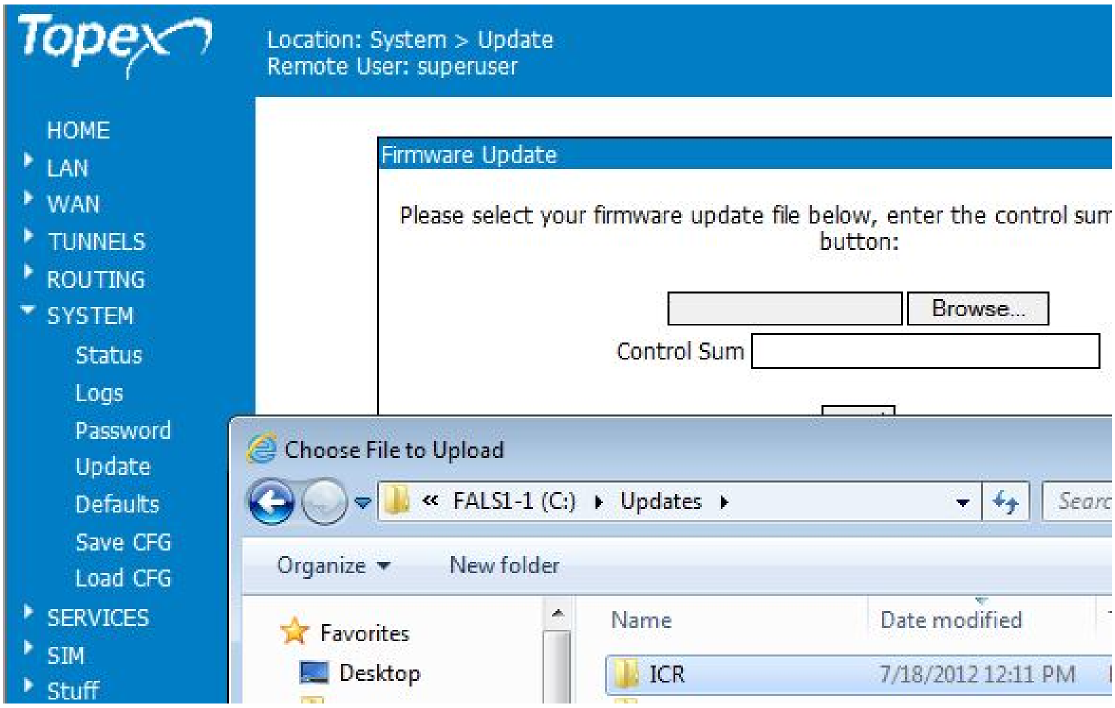


Please select your firmware update file below, enter the control sum and click the SEND button:

Figure 5-156: Update feature in the System webpage of Bytton LTE.

The update (firmware image) must be on your PC. The image files have the extension “trx”. You may download the image files from the ROHDE & SCHWARZ TOPEX S.A. website.

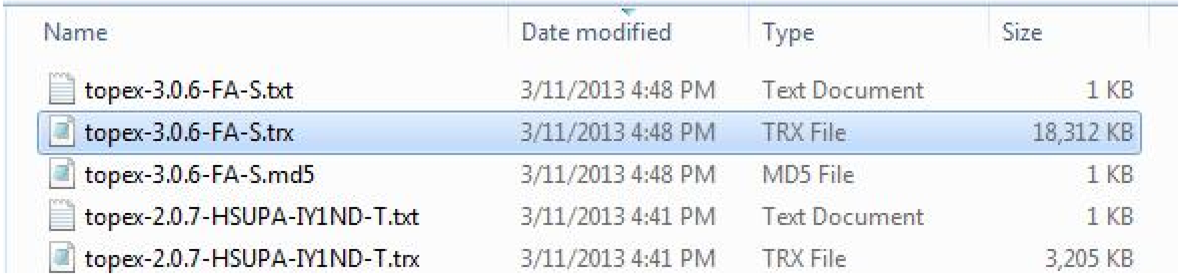
Enter the name of the update file or click the button “Browse” to search your system for it.



Please select your firmware update file below, enter the control sum button:

Figure 5-157: Search for the image file to update into Bytton LTE.

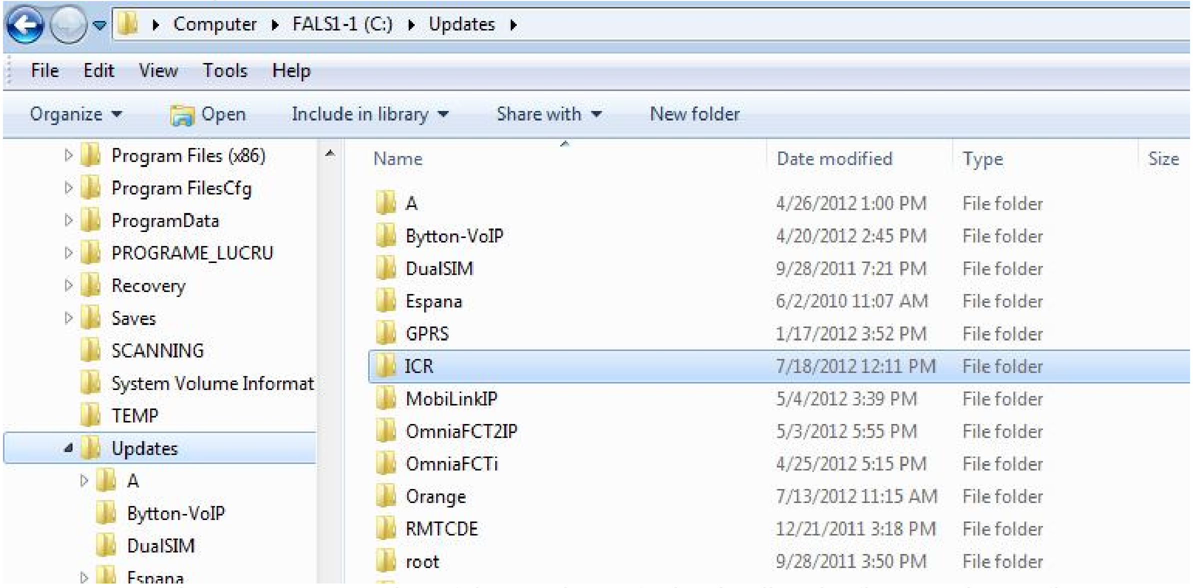
The update (firmware image) files are called “company.-1.2.3--x.y.z-S.trx”, where 1.2.3. is the version number, for instance 2.7.5 or 3.0.6, xyz refers to the mobile data network and equipping of Bytton LTE, or detail th hardware model, such as : ***topex-3.0.5-FA-S, vodafone-3.0.4-FA-V*** or ***MobileCarrierB-3.0.7-FA-O*** .



Name	Date modified	Type	Size
topex-3.0.6-FA-S.txt	3/11/2013 4:48 PM	Text Document	1 KB
topex-3.0.6-FA-S.trx	3/11/2013 4:48 PM	TRX File	18,312 KB
topex-3.0.6-FA-S.md5	3/11/2013 4:48 PM	MD5 File	1 KB
topex-2.0.7-HSUPA-IY1ND-T.txt	3/11/2013 4:41 PM	Text Document	1 KB
topex-2.0.7-HSUPA-IY1ND-T.trx	3/11/2013 4:41 PM	TRX File	3,205 KB

Figure 5-158: Listing of a directory holding several firmware image files.

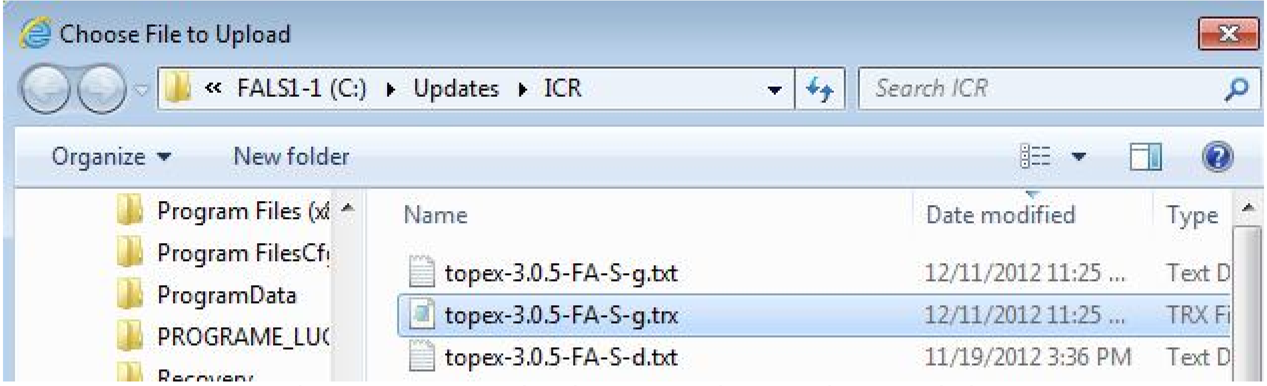
For instance, the firmware image files as shown above may be located in the folder “Updates” located on the C: partition of the hard drive of the PC:



Name	Date modified	Type	Size
A	4/26/2012 1:00 PM	File folder	
Bytton-VoIP	4/20/2012 2:45 PM	File folder	
DualSIM	9/28/2011 7:21 PM	File folder	
Espana	6/2/2010 11:07 AM	File folder	
GPRS	1/17/2012 3:52 PM	File folder	
ICR	7/18/2012 12:11 PM	File folder	
MobiLinkIP	5/4/2012 3:39 PM	File folder	
OmniaFCT2IP	5/3/2012 5:55 PM	File folder	
OmniaFCTi	4/25/2012 5:15 PM	File folder	
Orange	7/13/2012 11:15 AM	File folder	
RMTCDE	12/21/2011 3:18 PM	File folder	
root	9/28/2011 3:50 PM	File folder	

Figure 5-159: Location of the “Updates” folder, holding the firmware image files.

Select the file you want.



Name	Date modified	Type
topex-3.0.5-FA-S-g.txt	12/11/2012 11:25 ...	Text D
topex-3.0.5-FA-S-g.trx	12/11/2012 11:25 ...	TRX Fi
topex-3.0.5-FA-S-d.txt	11/19/2012 3:36 PM	Text D

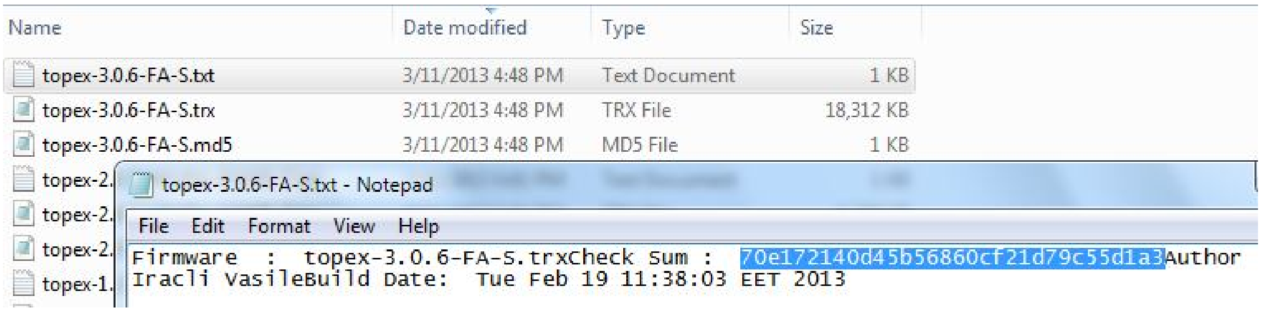
Figure 5-160: Selecting the software image to be uploaded.

In this case “**topex-3.0.6-FA-S.tr**x” and press Open:

Note:

*Each firmware file has an associated **Control Sum.** The control sum is a string of hexadecimal figures, such as “f2209c63972be34f55d4e69d90042d93” and it is stored in a text file (with .txt extension), with the same name as the firmware image. Using a control sum prevents you from loading a corrupted image. The Control Sum is located in a txt with the same name as the firmware.*

This associated text file may be viewed (opened) for instance with the Notepad text editor of Windows:

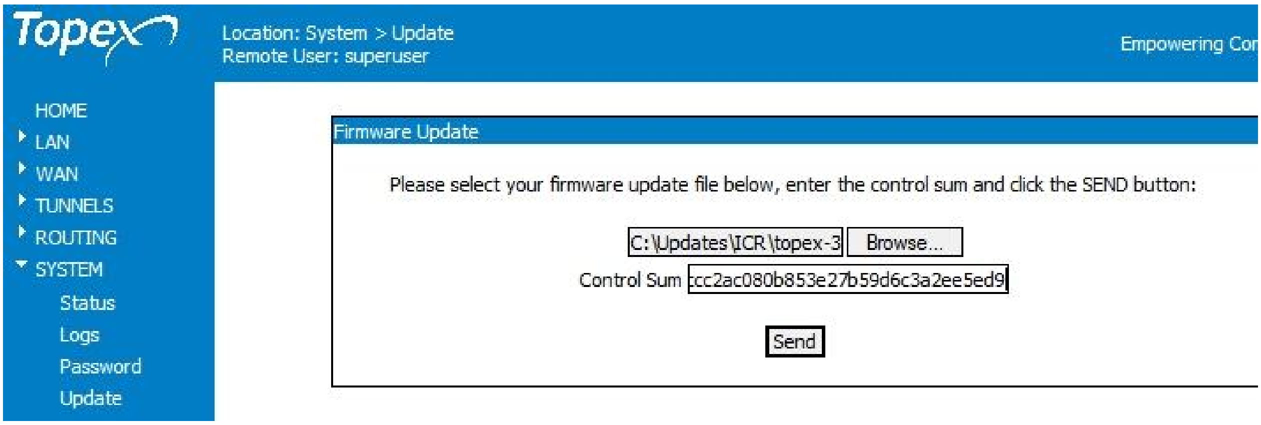


Name	Date modified	Type	Size
topex-3.0.6-FA-S.txt	3/11/2013 4:48 PM	Text Document	1 KB
topex-3.0.6-FA-S.trx	3/11/2013 4:48 PM	TRX File	18,312 KB
topex-3.0.6-FA-S.md5	3/11/2013 4:48 PM	MD5 File	1 KB
topex-2.			
topex-2.			
topex-2.			
topex-1.			

```
Firmware  :  topex-3.0.6-FA-S.trxCheck Sum :  70e172140d45b56860cf21d79c55d1a3Author
Iracli VasileBuild Date:  Tue Feb 19 11:38:03 EET 2013
```

Figure 5-161: Opening in Notepad the associated file with Check Sum.

Copy the value of Control Sum from this file and paste it in the Firmware update web-page in the field named “Control Sum”:



Location: System > Update
Remote User: superuser

Firmware Update

Please select your firmware update file below, enter the control sum and click the SEND button:

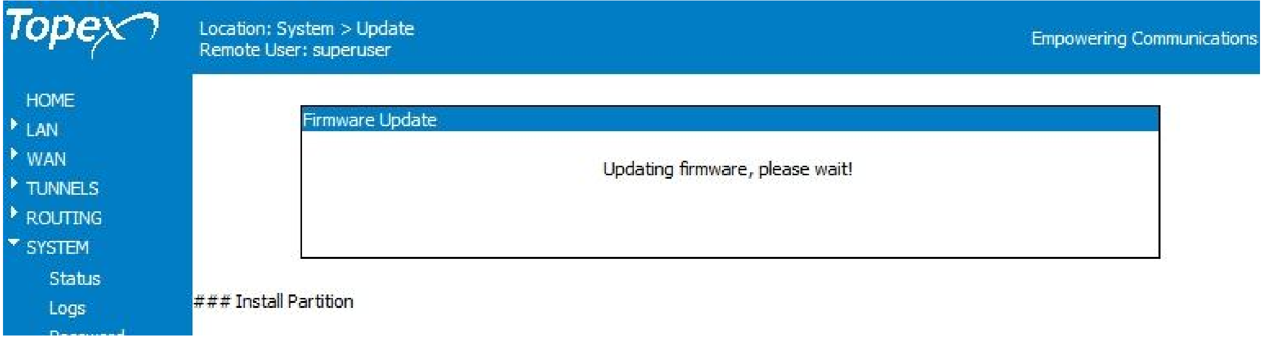
C:\Updates\ICR\topex-3 [Browse...]

Control Sum: cc2ac080b853e27b59d6c3a2ee5ed9

[Send]

Figure 5-162: “Firmware Update” window with the control sum filled-in.

Now click the “Send” button to perform the update.
A “Firmware Update” window shows up, you can see a progress indicator under the message “Firmware is updating, please wait!”



Location: System > Update
Remote User: superuser

Firmware Update

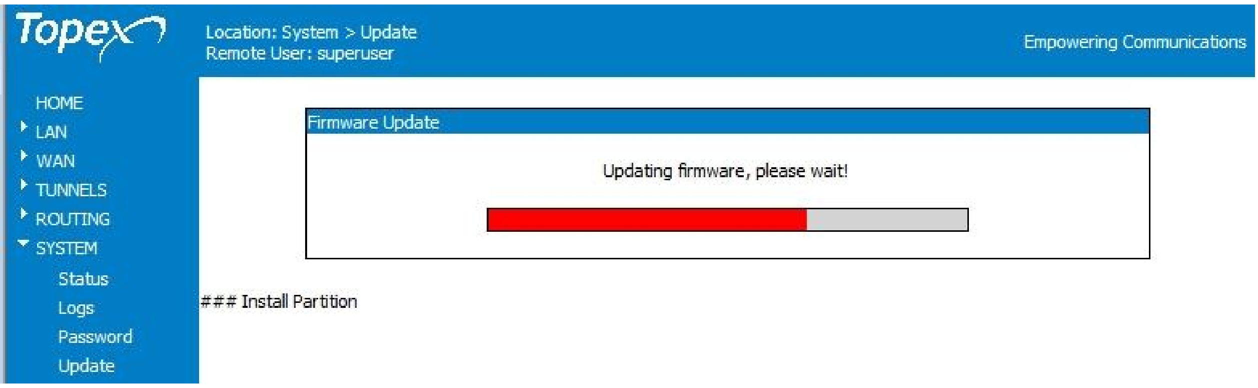
Updating firmware, please wait!

Install Partition

Figure 5-163: The “Firmware Update” window with progress bar that shows uploading of a new firmware version for Bytton.

Note that there are **two** distinct, successive phases of updating the firmware image:

- in the first one, while the message “Updating firmware” is blinking, the equipment just checks the program image to be loaded against its checksum.
- if the result is OK, the Bytton LTE device goes to the second phase, it really loads the new firmware into its Flash memory. In this phase, the progress indicator is colored in red and additional messages are show: `#### Install Partition` and the red indicator bar can be seen as it “grows” toward the right!



Updating firmware, please wait!

Install Partition

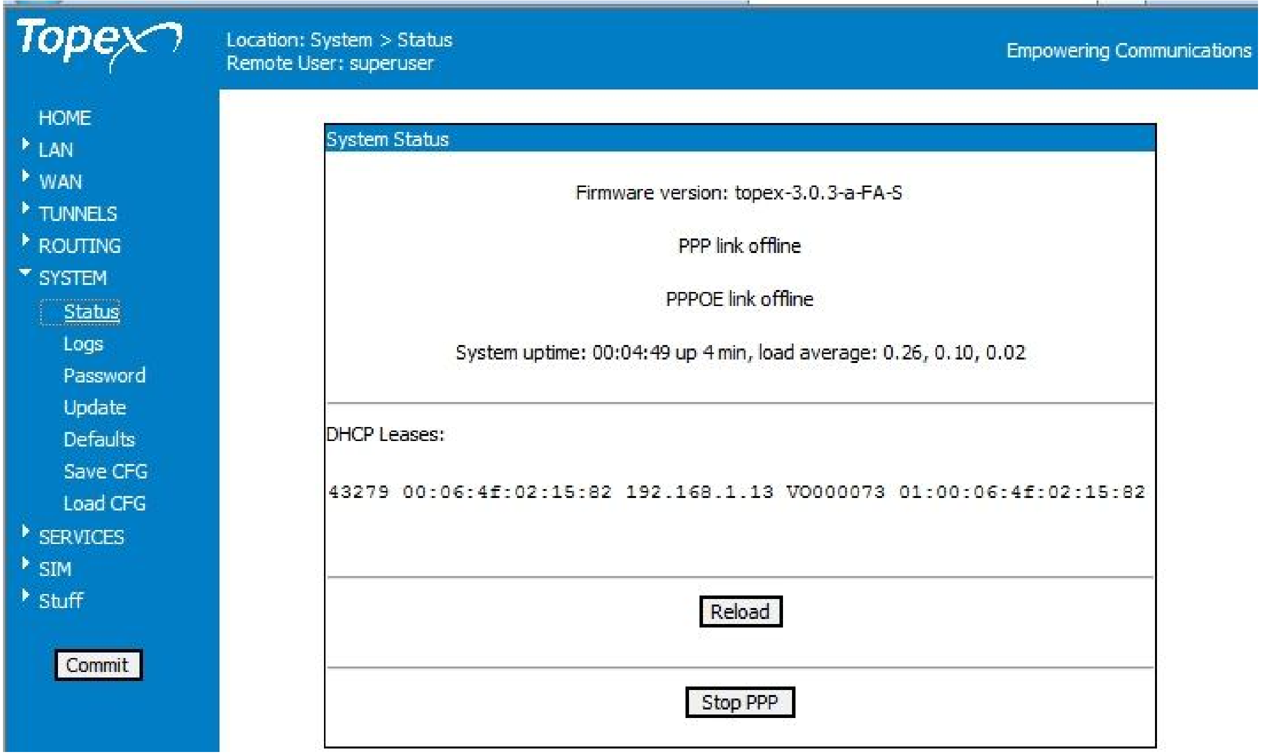
Figure 5-164: Red progress bar indicating actual upload of firmware.

Warning!
Do not update the firmware unless you have problems with the Bytton LTE mobile router or the new firmware has a feature that you need. Remember to backup your current configuration first. Be careful when you load an update file. If you select a wrong file, or if for different reasons firmware upgrading fails, the equipment may no longer operate correctly. You will need to perform an update using the “kernel” mode.

To avoid this, follow carefully the rules indicated here.

- don’t turn off the Bytton LTE equipment or the computer while the firmware is being overwritten
- Equipment does not work while firmware update is in progress.
- after successful updating, verify the upgraded firmware
- remember that updating the firmware on the Bytton LTE equipment could cause some or all of the configuration settings to be lost, depending on the degree of change in the firmware.
  Therefore it is highly recommended that you **save** your current configuration before updating, then you restore it.
  To backup your settings, perform a Save, update the firmware, and then Load the saved settings, after you have the equipment operating with the updated firmware.

To compare, look at the information displayed in the **System>Status** page before the firmware update:



Firmware version: topex-3.0.3-a-FA-S

PPP link offline

PPPOE link offline

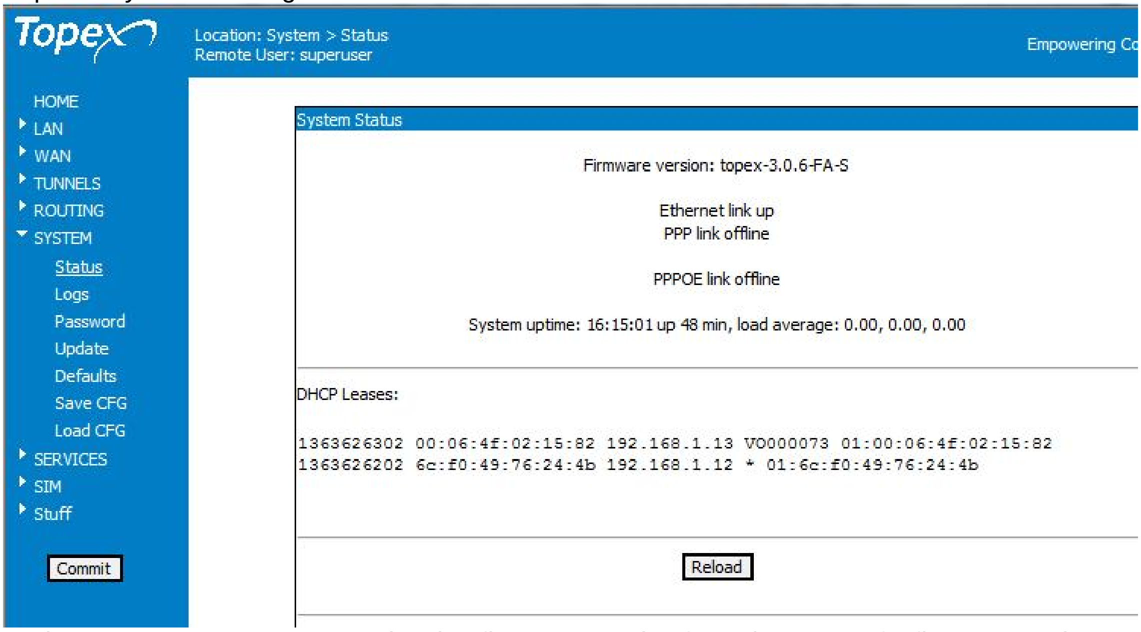
System uptime: 00:04:49 up 4 min, load average: 0.26, 0.10, 0.02

DHCP Leases:

```
43279 00:06:4f:02:15:82 192.168.1.13 VO000073 01:00:06:4f:02:15:82
```

Figure 5-165: System Status showing firmware version prior to the upload of firmware.

And respectively **after** loading the latest firmware version:



Location: System > Status
Remote User: superuser

System Status

Firmware version: topex-3.0.6-FA-S

Ethernet link up
PPP link offline

PPPOE link offline

System uptime: 16:15:01 up 48 min, load average: 0.00, 0.00, 0.00

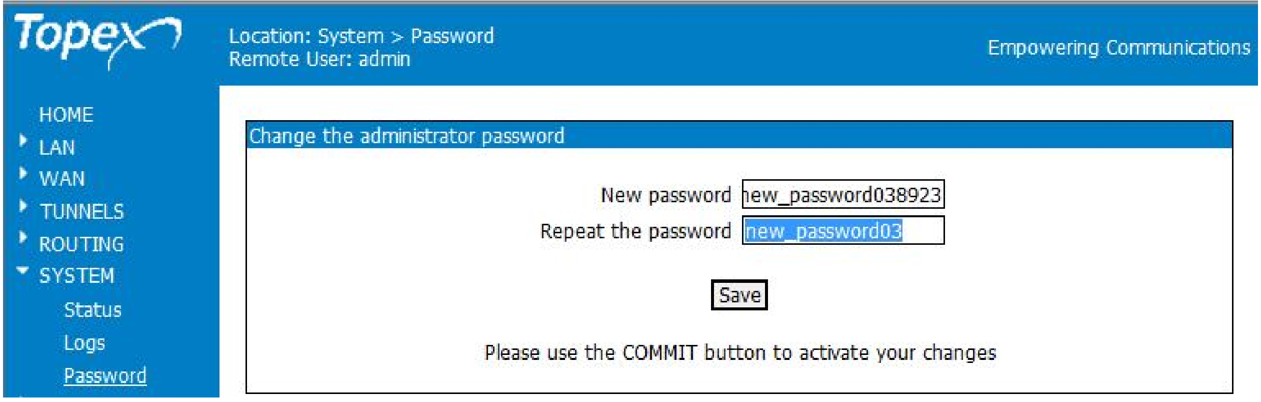
DHCP Leases:

```
1363626302 00:06:4f:02:15:82 192.168.1.13 V0000073 01:00:06:4f:02:15:82
1363626202 6c:f0:49:76:24:4b 192.168.1.12 * 01:6c:f0:49:76:24:4b
```

Figure 5-166: System Status showing firmware version following succesful firmware update.

5.5.4 Password

Allows you to modify passwords for the log-in accounts.



Location: System > Password
Remote User: admin

Change the administrator password

New password: new_password038923
Repeat the password: new_password03

Please use the COMMIT button to activate your changes

Figure 5-167: Password – changing the login password for Bytton.

Type the new password, then enter it again on the second row to confirm it.
“Save” saves the new password.

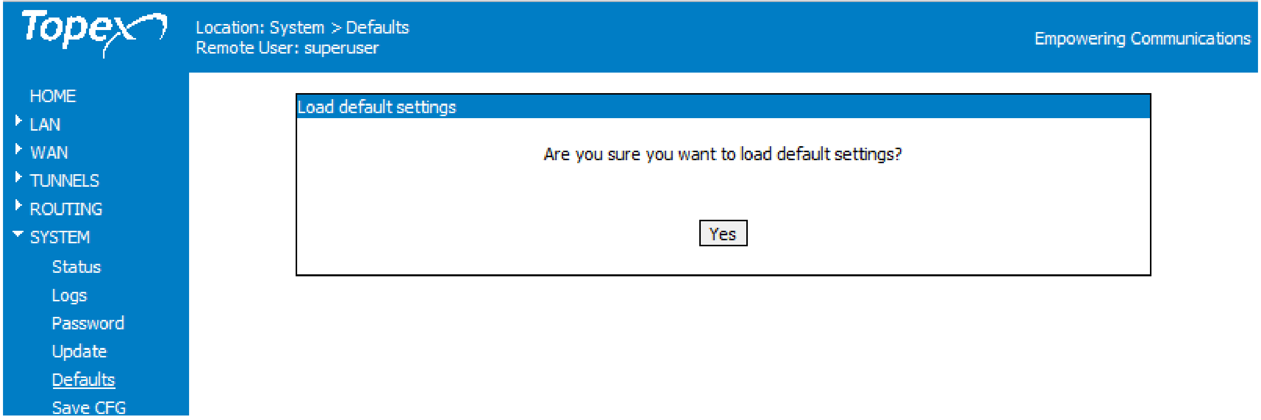
You should replace as soon as possible the default, generic password (99admin11 for Admin) with one specific to you, which will be communicated only to authorized users.

Please choose a password with **minimum** six characters. In order to effectively prevent unauthorized access, the password must be long enough and include both letters and numbers.
Note that the password is **case-sensitive**.

Remember that you should change both passwords, the one for the ordinary user “admin” and respectively the one for “superuser” (in the example above is shown the change of password for “admin”).

5.5.5 Defaults

This option restores the system settings to factory defaults. When you select “Defaults”, a confirmation window shows up, asking you “Are you sure?”.

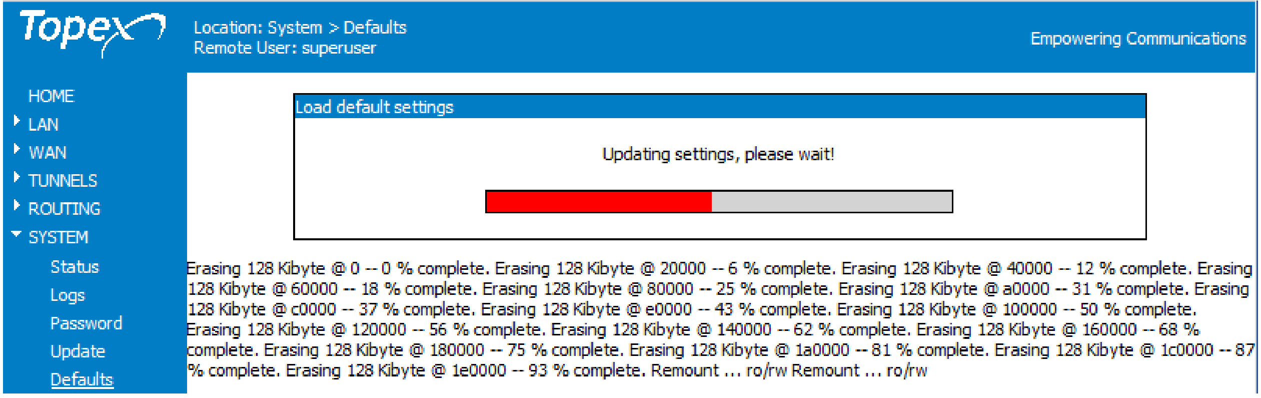


Are you sure you want to load default settings?

Figure 5-168: Defaults – loading the factory default settings.

If you want to proceed, click the YES button and the equipment will revert to the factory default settings. Following a reset, it will start operating with the factory default values for all parameters.

During the process you will see on screen the blinking message “Updating settings, please wait!” and a red progress bar, as shown below:



Updating settings, please wait!

```
Erasing 128 Kibyte @ 0 -- 0 % complete. Erasing 128 Kibyte @ 20000 -- 6 % complete. Erasing 128 Kibyte @ 40000 -- 12 % complete. Erasing
128 Kibyte @ 60000 -- 18 % complete. Erasing 128 Kibyte @ 80000 -- 25 % complete. Erasing 128 Kibyte @ a0000 -- 31 % complete. Erasing
128 Kibyte @ c0000 -- 37 % complete. Erasing 128 Kibyte @ e0000 -- 43 % complete. Erasing 128 Kibyte @ 100000 -- 50 % complete.
Erasing 128 Kibyte @ 120000 -- 56 % complete. Erasing 128 Kibyte @ 140000 -- 62 % complete. Erasing 128 Kibyte @ 160000 -- 68 %
complete. Erasing 128 Kibyte @ 180000 -- 75 % complete. Erasing 128 Kibyte @ 1a0000 -- 81 % complete. Erasing 128 Kibyte @ 1c0000 -- 87
% complete. Erasing 128 Kibyte @ 1e0000 -- 93 % complete. Remount ... ro/rw Remount ... ro/rw
```

Figure 5-169: Loading Defaults – the progress bar “Updating Settings, please wait!”.

Under the window “Load default settings” with its progress bar, the equipment displays messages showing detailed information concerning the progress of the operation (“Erasing 128 Kbyte Flash: 0%, 6% … 93% complete” and finally , “Remount”).

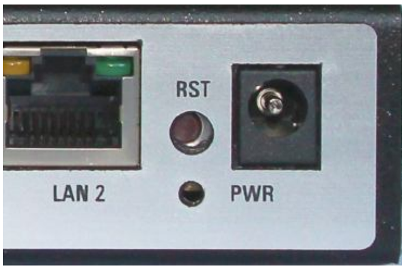
Then Bytton ICRE reboots and start operation with the factory default settings.

CAUTION!
Use this option carefully.
During the process, Bytton LTE will not be available for routing and connecting to the 3G network. For a few moments, the LAN icon in the status bar will be barred with a red “x” and the message “A network cable is unplugged” will show up, indicating that Bytton LTE is unavailable.

5.5.6 Hardware factory defaults

This is not a menu item, but the function is the same as the software reset to factory defaults described above. If you want, you can also perform the "Return to Defaults" operation via **hardware**.
This means you do not need to use the Web interface!

As mentioned, the recessed button labeled "RST" is located on the front panel, near the PWR jack of Bytton LTE (see the illustration).



But simply pressing the **Reset** button for a short time won't work!

You must follow the reset procedure described below:

a. First, you must stop the equipment. Take out the plug from the PWR jack connector;
b. Wait for at least five seconds to be sure that capacitors are discharged;
c. Press the RST button and keep it pressed, then power up Bytton LTE (insert back the supply jack);
d. The green PWR indicator lights up immediately, keep the button still depressed;
e. Wait at least six seconds, until the two center green LEDs (labeled DATA and Wi-Fi) light up continuously (all theree indicator LEDs must be turned ON);
f. Now you can quit pressing the RST button!
g. Bytton will perform a hardware reset to factory defaults; it will shut down and then start again operation, with the factory default settings.

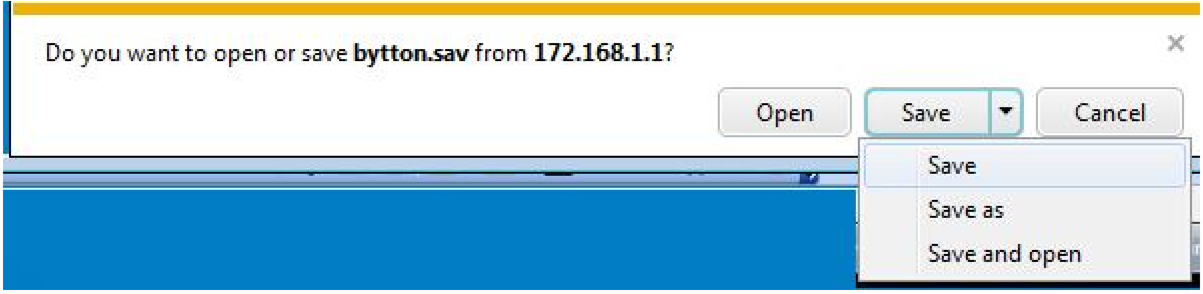
This way of restoring the factory default settings is faster than using the Web interface, but you should exercise the same care.

Note: *the "Return to Defaults" option is quite useful when incorrect settings have been performed or when you have forgotten the IP of the Bytton ICR router. If you don't know the IP address or if you have incorrect settings for iptables, you won't be able to connect to the wireless router to administer it. So you should perform a hardware "factory defaults", and Topex Bytton will revert to its original settings, including the IP address of 192.168.1.1*

5.5.7 Save CFG

Makes a backup copy of the current configuration (all the settings you made) of the Bytton LTE equipment.
The configuration file is called by default “bytton.sav”.

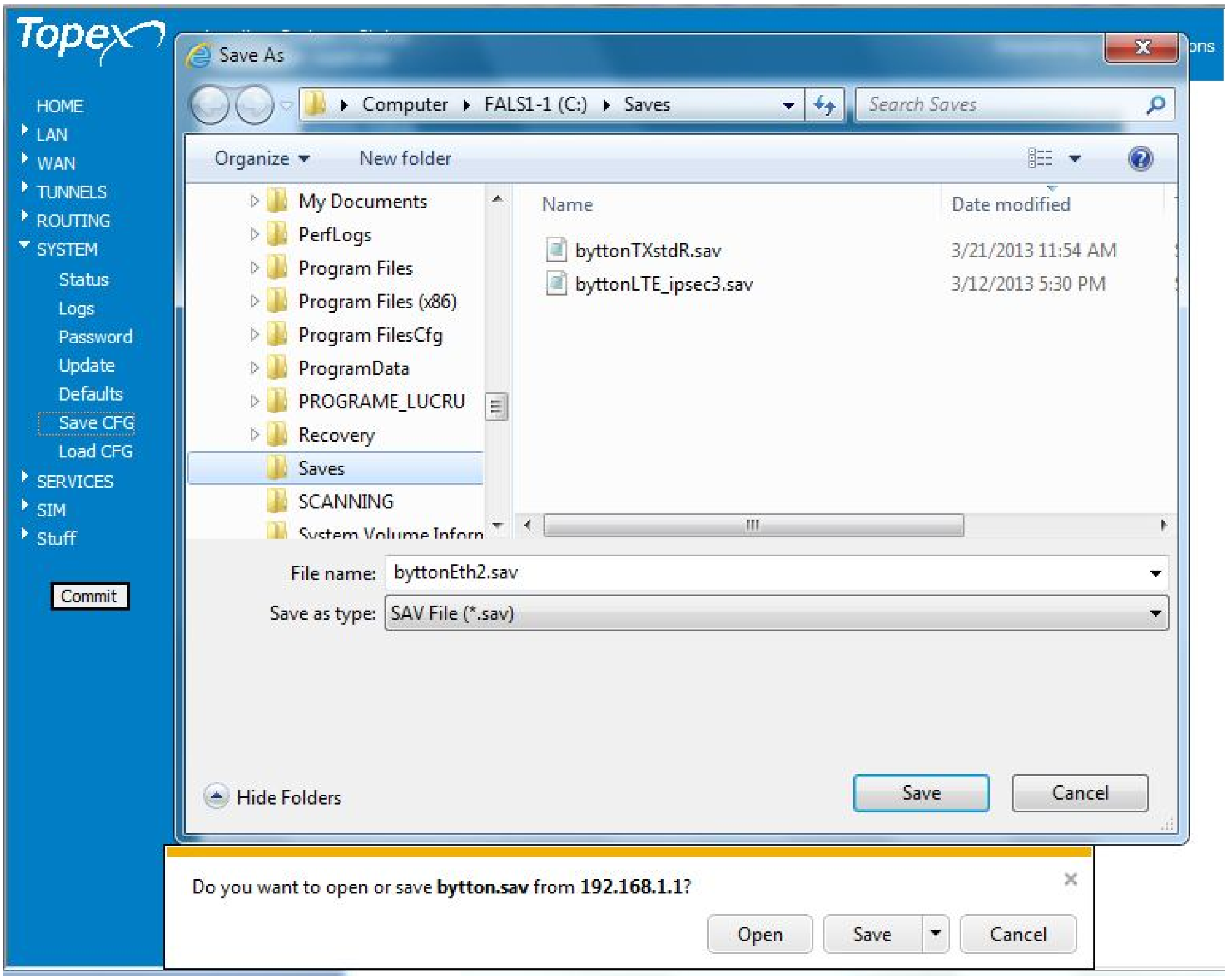
You will see a message similar to the one shown in this image:



Do you want to open or save **bytton.sav** from **172.168.1.1**?

Figure 5-170: The Save command – Saving the “bytton.sav” file.

Or like this:



Name	Date modified
byttonTXstdR.sav	3/21/2013 11:54 AM
byttonLTE_ipsec3.sav	3/12/2013 5:30 PM

File name: byttonEth2.sav

Save as type: SAV File (*.sav)

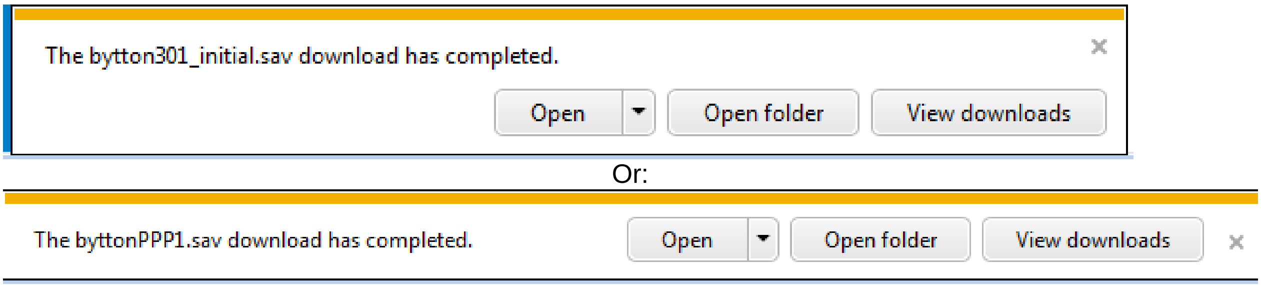
Do you want to open or save **bytton.sav** from **192.168.1.1**?

Figure 5-171: Saving the configuration file with the option “Save As“.

Instead of simply clicking “Save” , it is highly recommended to use “Save File” or “Save it to disk”.
This way you may choose both the name of the configuration file to be saved and the location on the HDD (the folder “Saves” on disk drive C: in the above example), instead of the default setting of the Internet browser.
When you manage not a single Bytton ICR, but many routers and you have to maintain different configurations, you can divide the “Saves” folder into several sub-folders for specific applications or machine.

The simplest way is to keep a single folder, but to change the default name “bytton.sav” into a name meaningful for your actual configuration that you need to save.

After the downloading of the configuration file has ended successfully, the operating system will show a confirmation message such as these:



The bytton301_initial.sav download has completed.

Or:

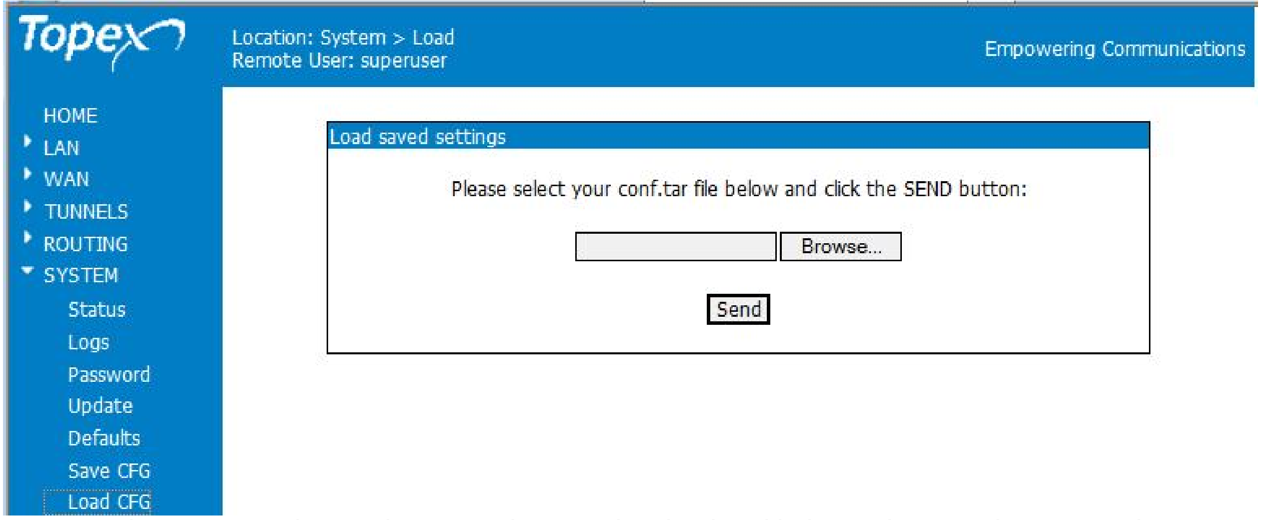
The byttonPPP1.sav download has completed.

Figure 5-172: Message that confirms the saving the configuration file for Bytton ICR.

Note: *It is highly recommended that you backup your configuration from time to time. This way you can always load the saved configuration, if there is need. For instance, when you perform a “Restore to factory defaults”, all previous settings are lost. If you have saved the configuration, you can load it back to perform changes.*
Also, you should perform a “Save” before using “Update” to load a new software image, since the new firmware could erase some of the settings.

5.5.8 Load CFG

This option loads a configuration file that you have previously saved or restores a backup.



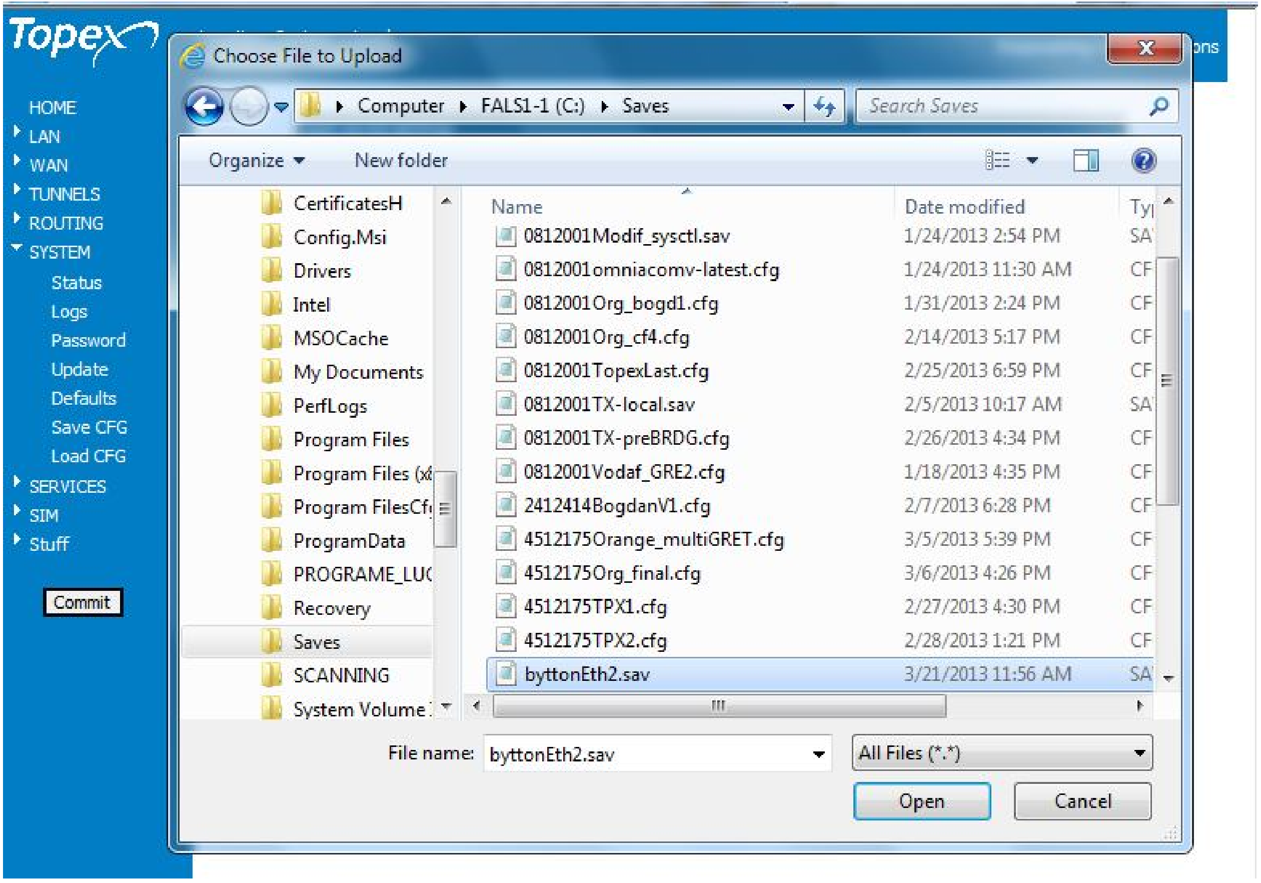
Location: System > Load
Remote User: superuser

Load saved settings

Please select your conf.tar file below and click the SEND button:

Figure 5-173: The Load command – selecting the file with the settings previously saved.

Use “Browse” to navigate to the location where you saved the configuration file.



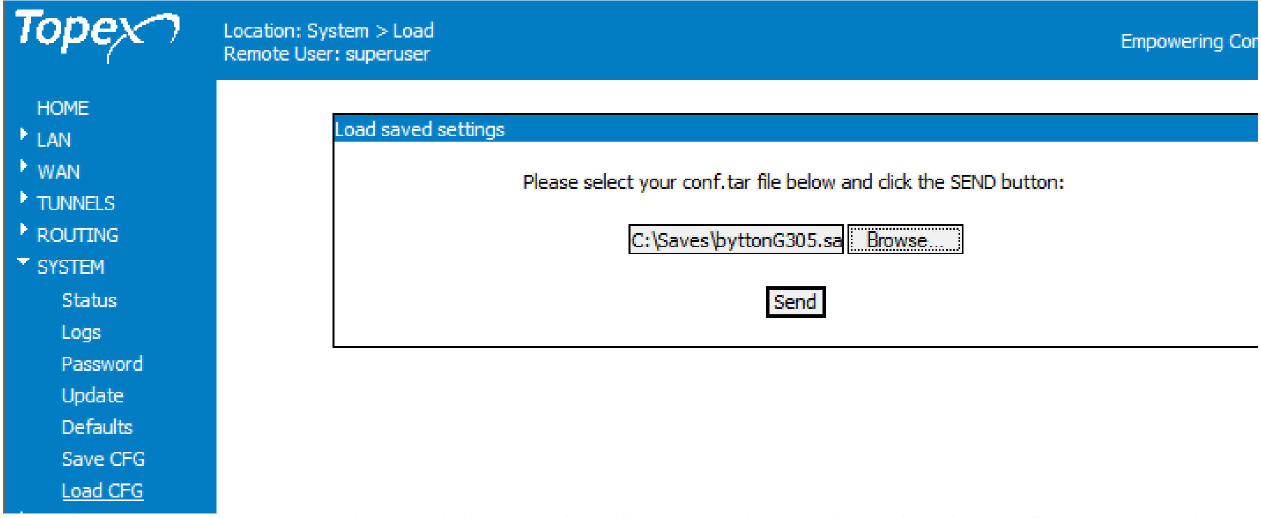
Name	Date modified	Ty
0812001Modif_sysctl.sav	1/24/2013 2:54 PM	SA
0812001omniacomv-latest.cfg	1/24/2013 11:30 AM	CF
0812001Org_bogd1.cfg	1/31/2013 2:24 PM	CF
0812001Org_cf4.cfg	2/14/2013 5:17 PM	CF
0812001TopexLast.cfg	2/25/2013 6:59 PM	CF
0812001TX-local.sav	2/5/2013 10:17 AM	SA
0812001TX-preBRDG.cfg	2/26/2013 4:34 PM	CF
0812001Vodaf_GRE2.cfg	1/18/2013 4:35 PM	CF
2412414BogdanV1.cfg	2/7/2013 6:28 PM	CF
4512175Orange_multiGRET.cfg	3/5/2013 5:39 PM	CF
4512175Org_final.cfg	3/6/2013 4:26 PM	CF
4512175TPX1.cfg	2/27/2013 4:30 PM	CF
4512175TPX2.cfg	2/28/2013 1:21 PM	CF
byttonEth2.sav	3/21/2013 11:56 AM	SA

File name: byttonEth2.sav

All Files (*.*)

Figure 5-174: “Choose File to Upload” – navigating for the configuration file you want.

Press Open, then click “Send” to send the file to the Bytton ICR equipment.



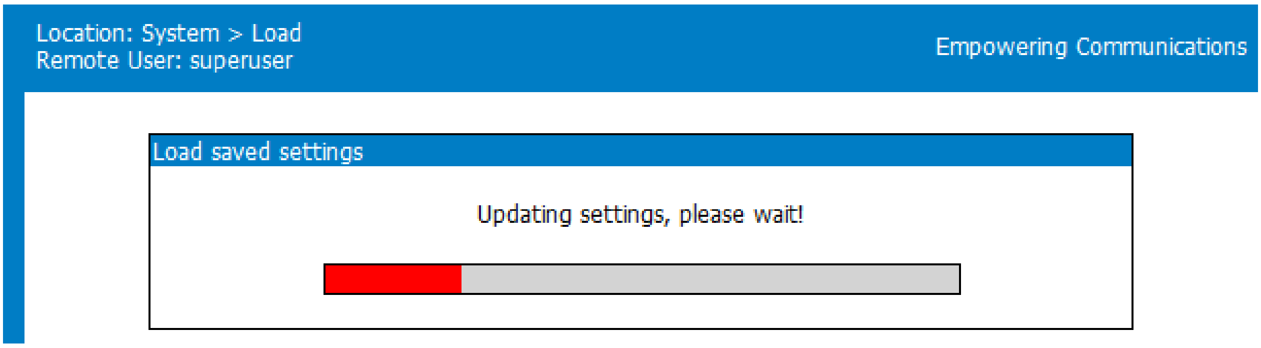
Location: System > Load
Remote User: superuser

Please select your conf.tar file below and click the SEND button:

C:\Saves\byttonG305.sa

Figure 5-175: Press Send to load the saved settings form the configuration file you have selected.

A red progress bar will be displayed, and above it you will see the blinking message “Updating settings, please wait”:

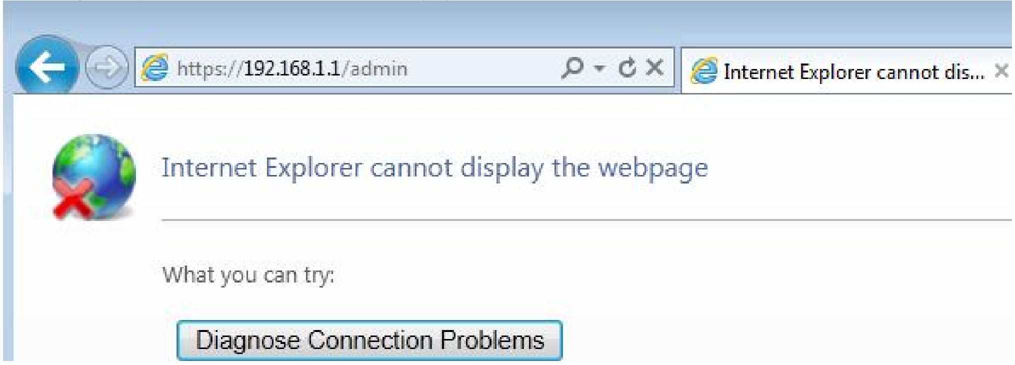


Updating settings, please wait!

Figure 5-176: System Load – progress bar while loading a file holding the saved settings.

Here also, beneath the “Load saved settings” window with its red progress bar, you will see detailed messages about the progress of the operation, from
“ Erasing 128 Kbyte @0 --0% complete” up to **“Erasing 128 Kbyte @1e0000 -- 93% complete”**.

While loading the saved configuration, the connection to Bytton ICR stop for a short time (voice calls are interruped, you see an error message):

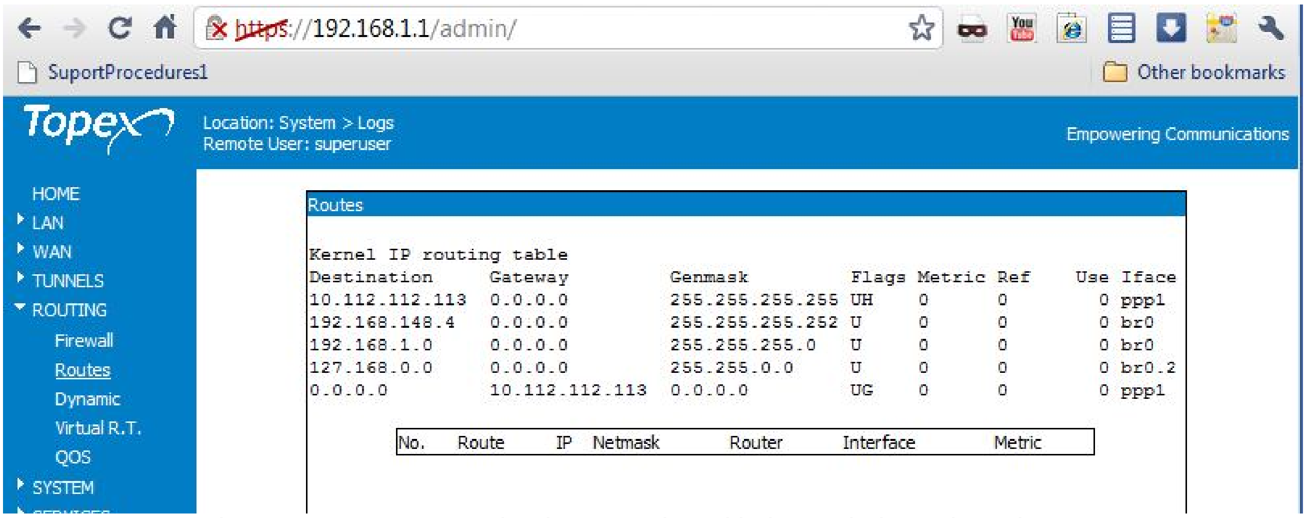

https://192.168.1.1/admin
Internet Explorer cannot dis...
Diagnose Connection Problems

Internet Explorer cannot display the webpage

What you can try:

Figure 5-177: The Web interface is unavailable while Bytton ICR restarts with the new configuration.

and after reboot, Bytton LTE begins operating with the set of parameters (Configuration) that you have loaded!



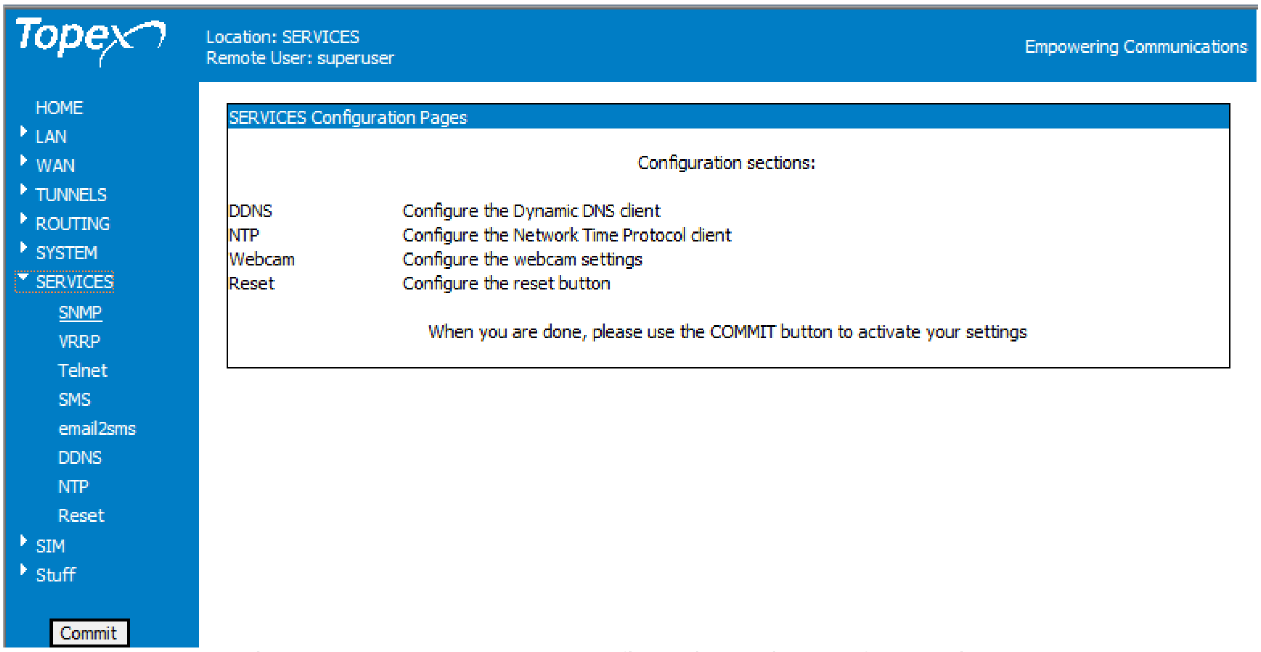
```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.112.112.113  0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
192.168.148.4   0.0.0.0         255.255.255.252 U     0      0        0 br0
192.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
127.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 br0.2
0.0.0.0         10.112.112.113  0.0.0.0         UG    0      0        0 ppp1
```

No.	Route	IP	Netmask	Router	Interface	Metric

Figure 5-178 Bytton LTE begins operation with the loaded configuration.

5.6 SERVICES

Here you may configure settings for the “services” provided by Bytton LTE, such as VRRP, SNMP, Telnet, configuration and activation of serial ports, control via SMS, Dynamic DNS, Client for NTP, and finally the function of the RST button:



SERVICES Configuration Pages

Configuration sections:

DDNS	Configure the Dynamic DNS client
NTP	Configure the Network Time Protocol client
Webcam	Configure the webcam settings
Reset	Configure the reset button

When you are done, please use the COMMIT button to activate your settings

Figure 5-179: SERVICES – configuration web page for “services”.

Depending upon different factors, all of the “services” features may be available to you, or only the most basic ones, which are to be found in any software version, such as SNMP, DDNS, NTP and Reset.

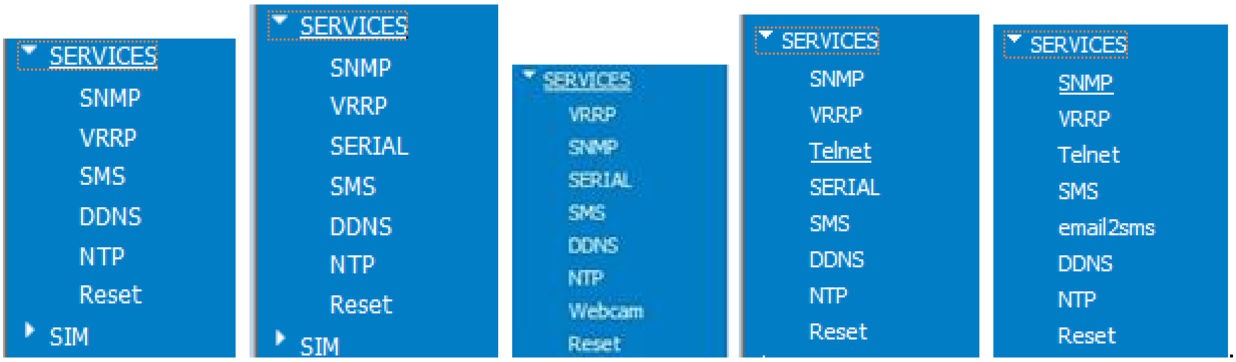


Figure 5-180: Illustration of different menus for SERVICES.

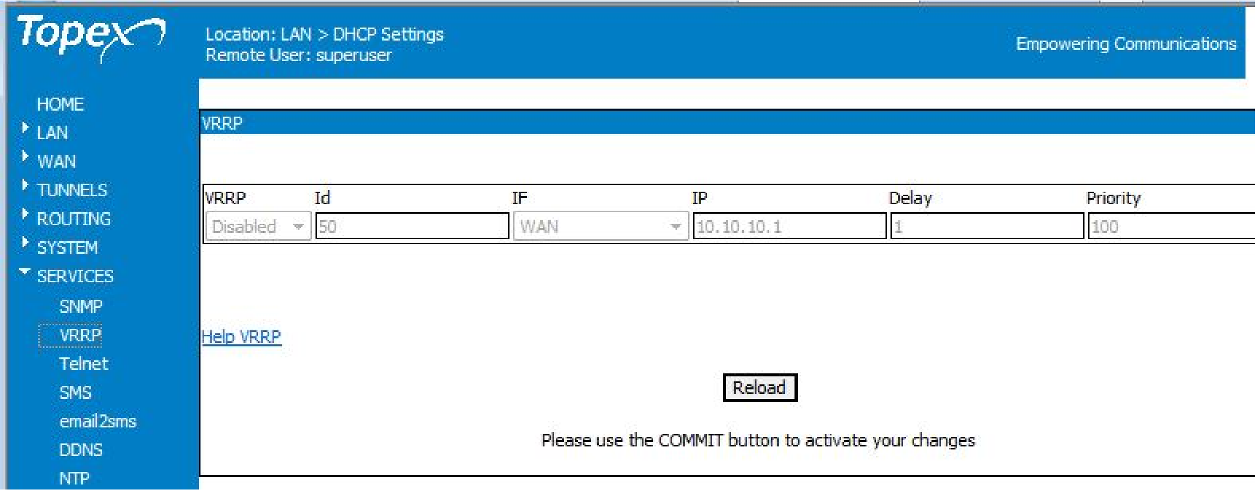
These “factors” include:

- the actual firmware version or variant, which may contain a lower or higher number of features;
- the hardware equipping of your Bytton device: SERIAL is available only if it is fitted with one or two serial interfaces, Webcam makes sense only when the device has an active USB slot, and so on.
- the mode of login: a simple user, which logs in as “admin”, has less rights, so he sees only to the basic features, while the “superuser” may get access also to the advanced features, such as VRRP or Telnet!

Typically, SNMP, SMS, DDNS, NTP and of course “Reset” are available in all versions, while the rest of the features depend upon the current hardware and firmware configuration of your particular Bytton LTE equipment.

5.6.1 VRRP

Establishes how Virtual Router Redundancy Protocol works on Bytton LTE (by default it is Disabled):



Location: LAN > DHCP Settings
Remote User: superuser

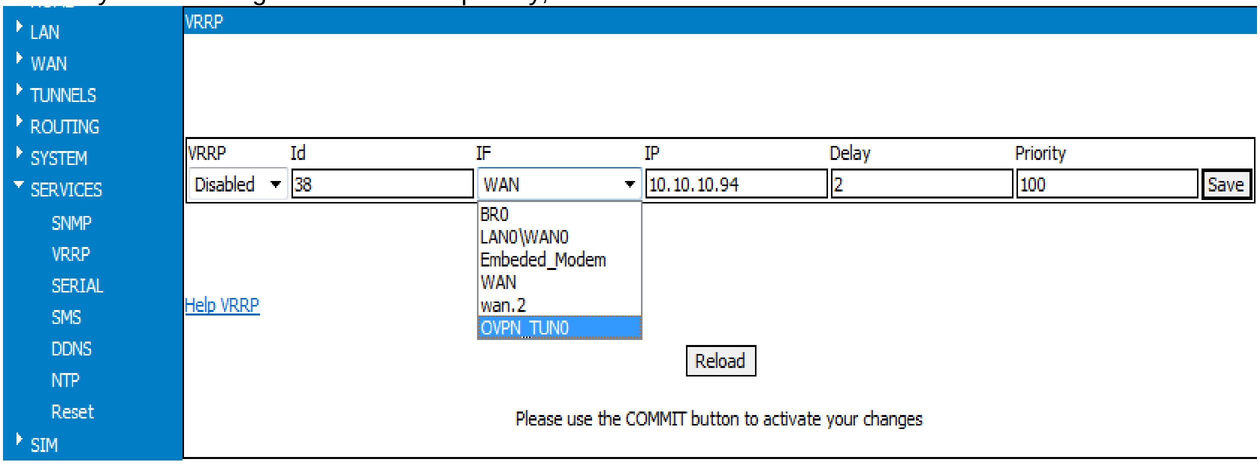
VRRP	Id	IF	IP	Delay	Priority
Disabled	50	WAN	10.10.10.1	1	100

Please use the COMMIT button to activate your changes

Figure 5-181: VRRP Services – setting the virtual router protocol.

Virtual Router Redundancy Protocol (**VRRP**) is a simple, yet robust practice that can provide additional availability in your network. It provides gateway redundancy by allowing each router within the redundant router topology to share a virtual Ethernet MAC address and a virtual IP address. It shares a virtual IP address among two router, the one that has active Internet connection gets it.
When the connection of the primary router fails, the virtual IP is given to the secondary (backup) router.
When the virtual addresses are active on a particular router, the router is said to be the master.
Routers without control of the virtual addresses are referred to as backups.

This page lets you configure the ID, the interface to be used for VRRP and the corresponding IP address, the delay for switching routers and the priority, as shown below:



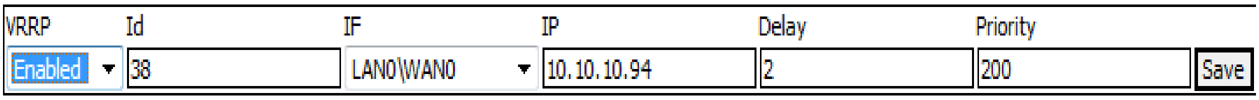
VRRP	Id	IF	IP	Delay	Priority
Disabled	38	WAN	10.10.10.94	2	100

Please use the COMMIT button to activate your changes

Figure 5-182: Configuring VRRP – edit the setting for the virtual router.

VRRP runs on top of the Internet as its own protocol (i.e., it does not use TCP or UDP) and sends its announcements to a multicast address for outer VRRP routers to listen.

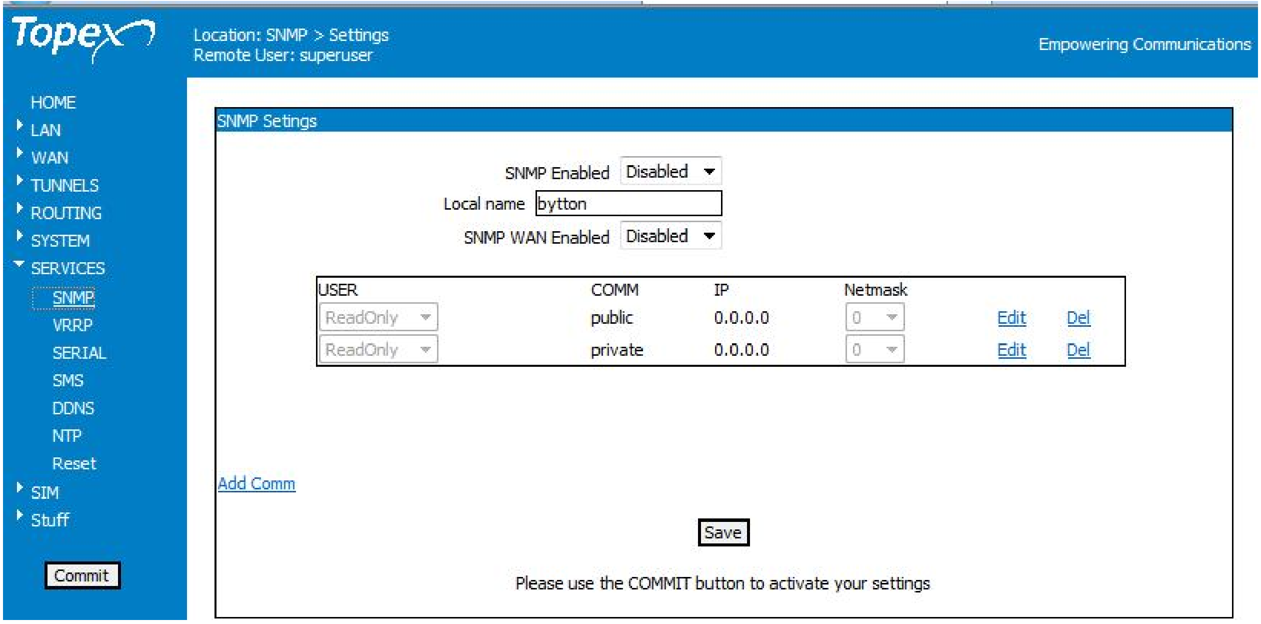
If a backup does not hear from the master after the established delay, then the backup will take over through an election process whereby the router with the highest priority within the VRRP routers.



VRRP	Id	IF	IP	Delay	Priority
Enabled	38	LAN0\WAN0	10.10.10.94	2	200

5.6.2 SNMP

Settings for the Simple Network Management Protocol. This is a set of protocols for managing complex networks and works by sending messages to different parts of a network.



SNMP Enabled: Disabled
Local name: bytton
SNMP WAN Enabled: Disabled

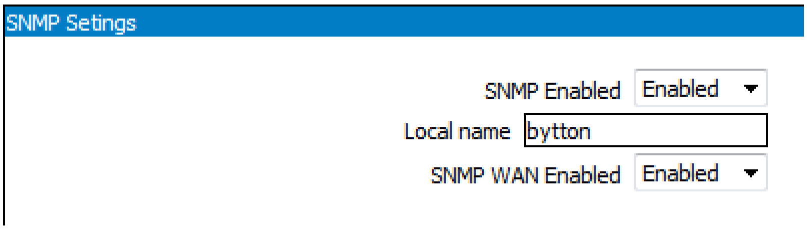
USER	COMM	IP	Netmask		
ReadOnly	public	0.0.0.0	0	Edit	Del
ReadOnly	private	0.0.0.0	0	Edit	Del

Please use the COMMIT button to activate your settings

Figure 5-183: SERVICES SNMP – enable and configure the network management.

By default, the SNMP service of Bytton LTE is disabled, and there are two empty entries, for public and respectively private.

You may also enable or disable the SNMP feature on the remote (WAN) side of the Bytton router.
By default, this one is disabled too.



SNMP Enabled: Enabled
Local name: bytton
SNMP WAN Enabled: Enabled

What about SNMP?

This Simple Network Management Protocol **(SNMP)** is used as the transport protocol for network management. This "Network management" business generally consists of network management stations communicating with network elements such as hosts, routers, servers, or printers.

The agent is the software on the Bytton LTE router that runs the network management software. Therefore when the word agent is used, it is referring to the network element. This agent store information in a management information base (MIB).

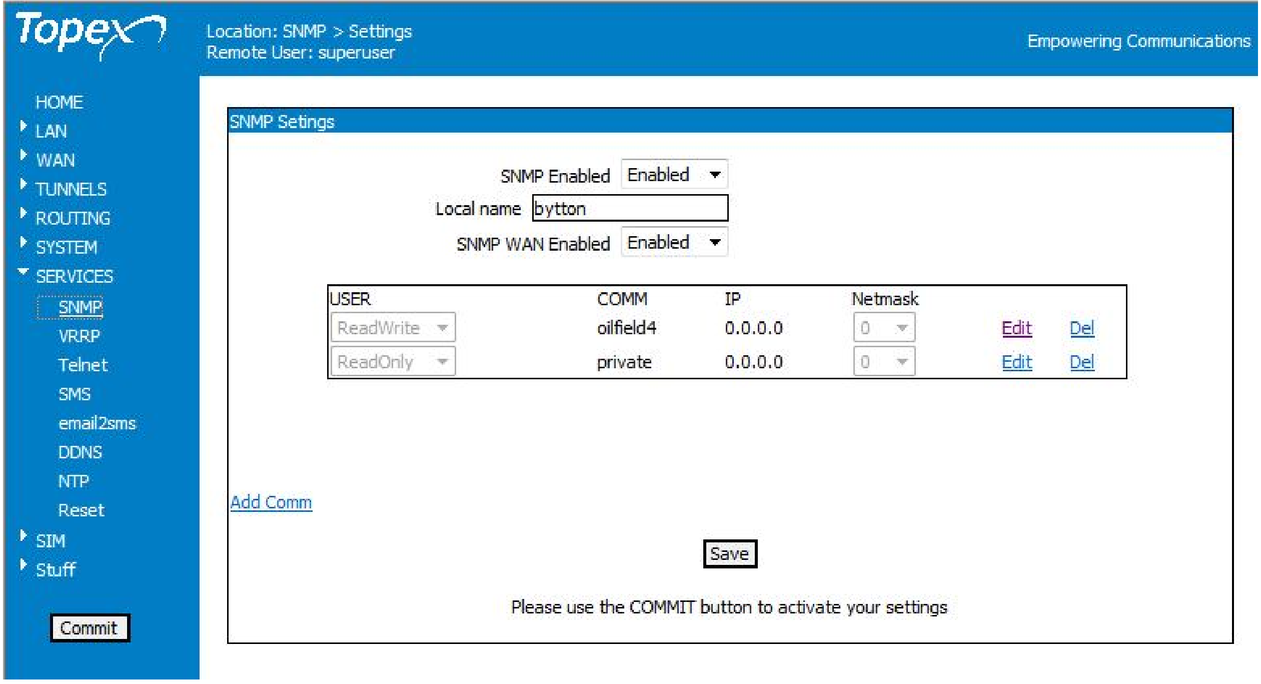
The network manager can set the threshold of the monitored event that will trigger the sending of the trap message. Among other applications, SNMP enables monitoring the performance of the network, when used in conjunction with different performance monitoring programs.

SNMP Communities are groups that devices and management stations running SNMP belong to. It helps define where information is sent. The community name is used to identify the group. A SNMP device or agent may belong to more than one SNMP community.

It will not respond to requests from management stations that do not belong to one of its communities.

SNMP default communities are either private (**read/write**) or public (**read only**), choose the adequate setting for each community you define.

You can Edit the two predefined “communities” on Bytton LTE, then create define additional ones, by using the “Add Community” link, as shown below:



Location: SNMP > Settings
Remote User: superuser

SNMP Setings

SNMP Enabled: Enabled
Local name: bytton
SNMP WAN Enabled: Enabled

USER	COMM	IP	Netmask		
ReadWrite	oilfield4	0.0.0.0	0	Edit	Del
ReadOnly	private	0.0.0.0	0	Edit	Del

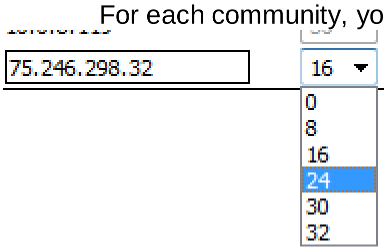
Add Comm

Save

Please use the COMMIT button to activate your settings

Figure 5-184: Define and configure SNMP Communities.

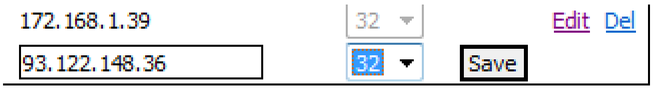
For each community, you must enter the **IP address** and the corresponding **net mask**.



For each community, you must enter the **IP address such as 193.74.245.106 for a public network or 10.0.58.7 for a local , non-routable network,** and then select the corresponding **net mask** from the drop list (values are 0, 8, 16, 24, 30 and respectively 32).

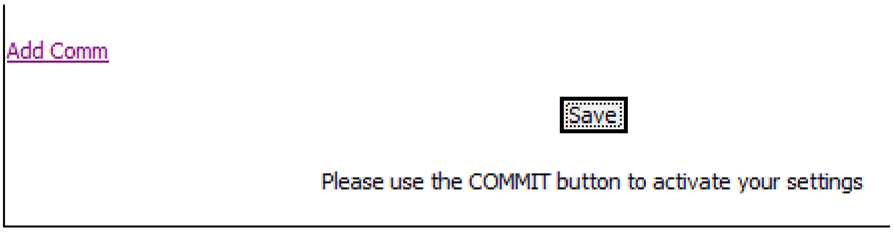
Figure 5-185: Set up IP and netmask for a SNMP Community.

For each entry in the table, use at first the individual **Save** button to the left to save it:



172.168.1.39	32	Edit	Del
93.122.148.36	32	Save	

And then the button Save located at the bottom of the page, which saves all the settings in this section.



Add Comm

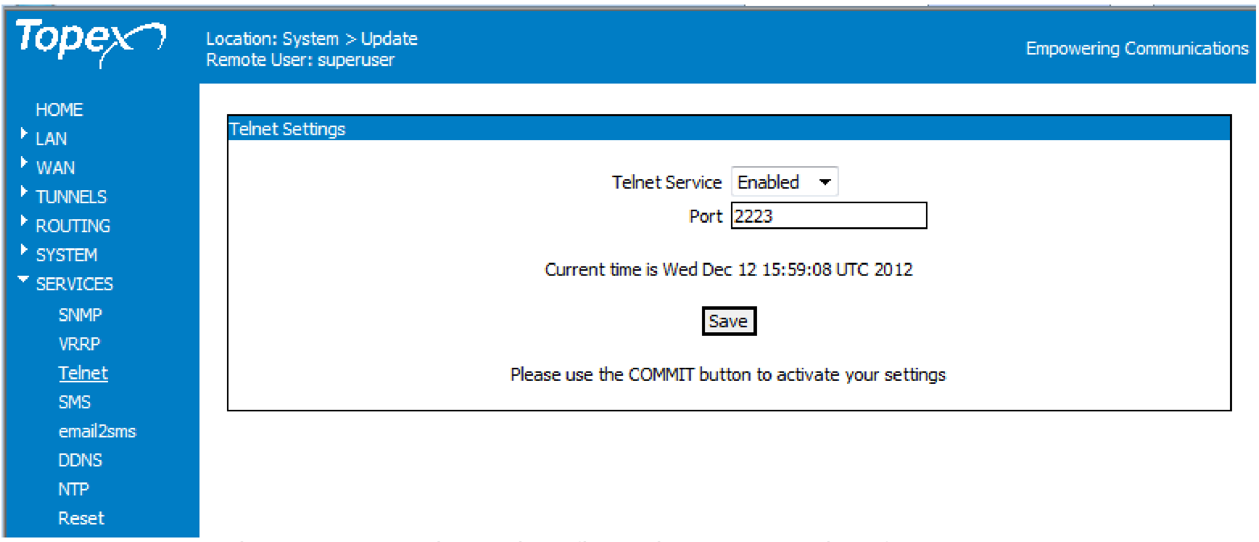
Save

Please use the COMMIT button to activate your settings

Figure 5-186: Using local and global “Save” buttons for the SNMP Communities created.

5.6.3 TELNET

Enables the Telnet feature of Bytton LTE and sets the port over which it will operate:



Telnet Settings

Telnet Service Enabled

Port 2223

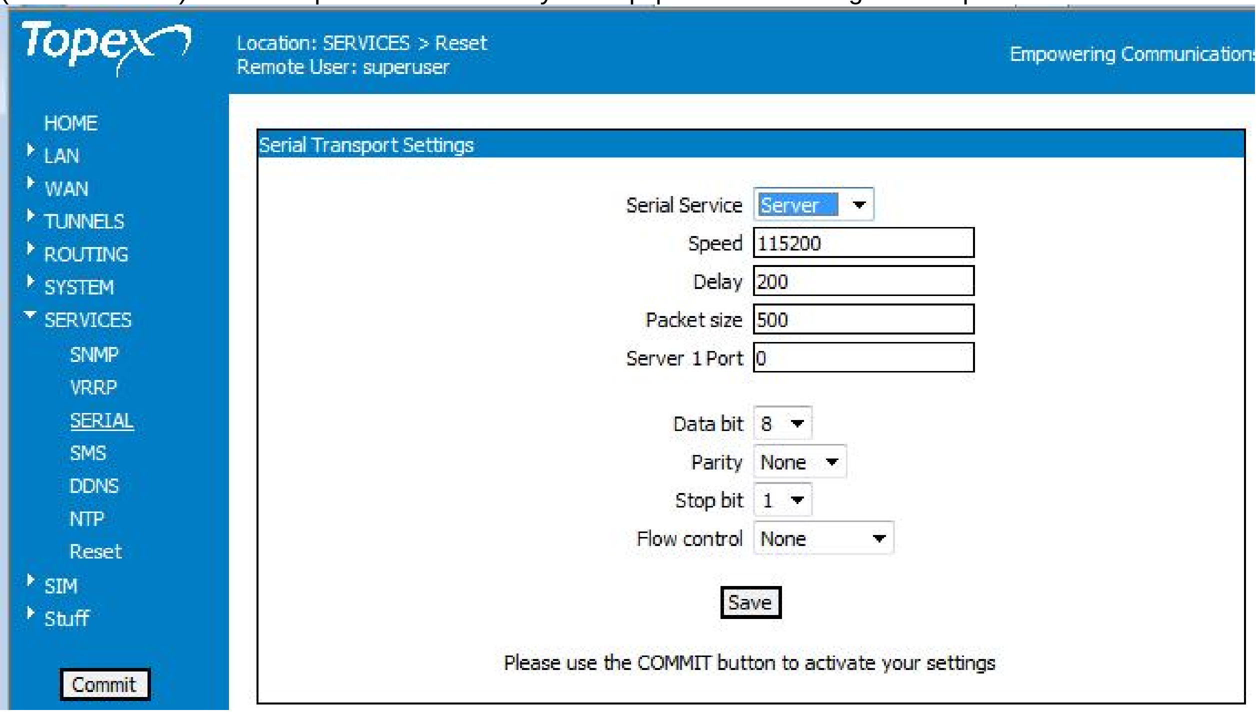
Current time is Wed Dec 12 15:59:08 UTC 2012

Please use the COMMIT button to activate your settings

Figure 5-187: Enable and configure the Telnet service of Bytton LTE.

5.6.4 SERIAL

This page shows up only in case of Bytton LTE devices fitted with one or two serial interfaces (RS232/RS485).The example below is for a Bytton equipment with a single serial port.



Serial Transport Settings

Serial Service Server

Speed 115200

Delay 200

Packet size 500

Server 1 Port 0

Data bit 8

Parity None

Stop bit 1

Flow control None

Please use the COMMIT button to activate your settings

Figure 5-188: Enable and Configure Serial ports of Bytton LTE.

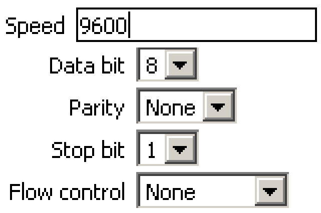
By means of this menu you may control the one or two serial interfaces (RS232) of Bytton LTE and their “remote port” (serial-over-IP) feature.
For each of the one or two serial ports of the equipment, you can set the following parameters:

Serial Service 1 or 2 – select Disabled to de-activate or Server to activate the respective RS-232 port. By default they are both disabled.

Serial 2 Service Server

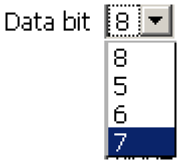
Parameters for the serial connection

Here you can set the usual parameters for a RS-232 serial connection, such as speed in bits per second (1200, 9600, 115200 etc), number of Data bits (8, 7, 5 etc) per byte , number of Stop bits, parity checking (Not used, Even or Odd), flow control (Not used, Xon-Xoff, Hardware). Current recommended settings are 9600 bps, 8-N-1.

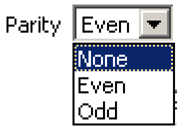


Speed 9600
Data bit 8
Parity None
Stop bit 1
Flow control None

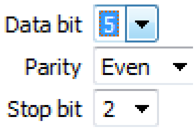
Figure 5-189: parameters for the serial connection(s).



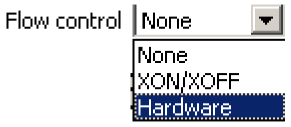
Data bit 8



Parity Even



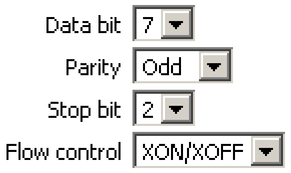
Data bit 5
Parity Even
Stop bit 2



Flow control None

Different port configurations

If your Bytton LTE has two RS-232 ports, they can be configured with different parameters, according to the requirements of the particular serial connection to the respective legacy equipment.



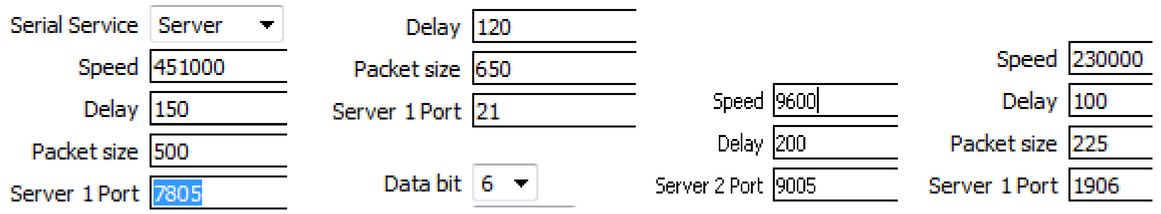
Data bit 7
Parity Odd
Stop bit 2
Flow control XON/XOFF

Remote connection parameters

In case of using the remote serial server, you must fill-in additional parameters for this feature **Delay**, the value, in milliseconds, of the buffers that stores the characters before sending them over the serial connection,

Packet Size, in bytes (default value 500) and **Server x Port**, the number of the IP port used for the remote serial connection.

See below a few examples of serial parameters configuration:



Serial Service Server
Speed 451000
Delay 150
Packet size 500
Server 1 Port 7805

Delay 120
Packet size 650
Server 1 Port 21
Data bit 6

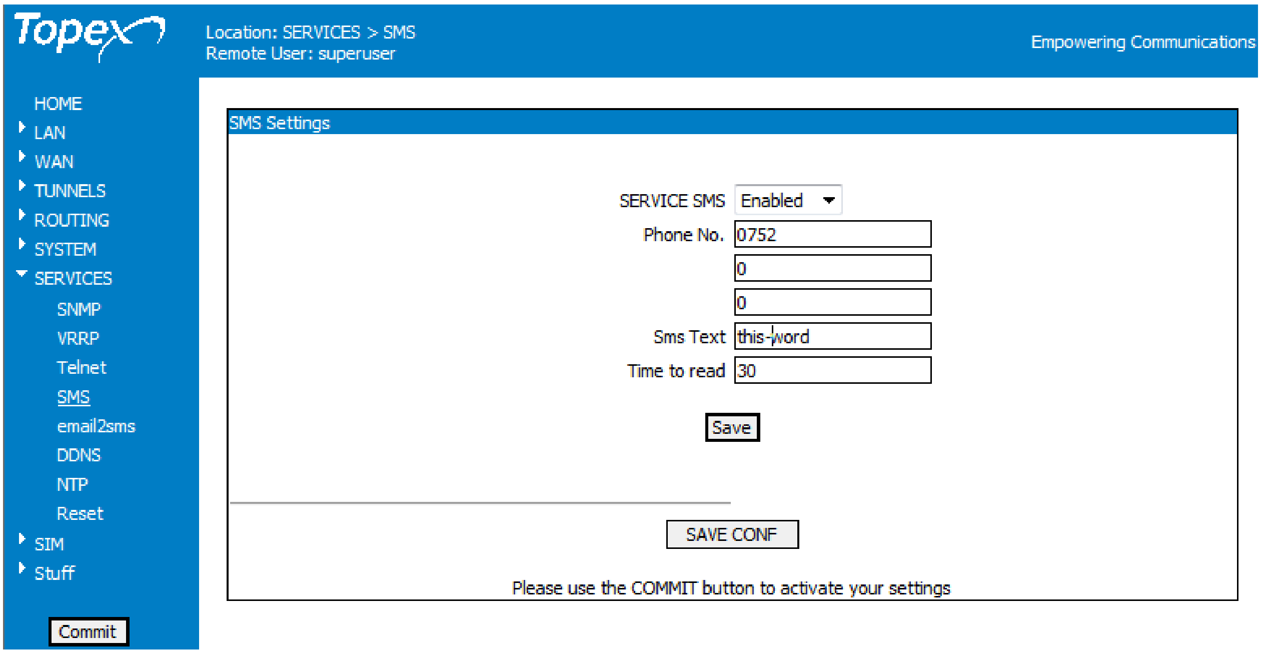
Speed 9600
Delay 200
Server 2 Port 9005

Speed 230000
Delay 100
Packet size 225
Server 1 Port 1906

Figure 5-190: Examples of remote connection parameter settings for the serial link.

5.6.5 SMS

Depending upon the actual firmware version, your equipment may have or not this menu item. With SERVICES>SMS", Bytton LTE implements a feature for remote administration and reporting via SMS:



Location: SERVICES > SMS
Remote User: superuser

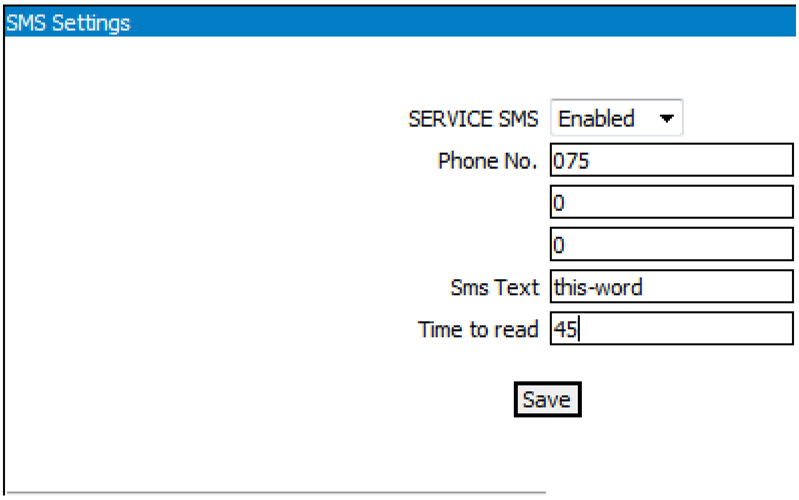
SERVICE SMS: Enabled
Phone No.: 0752
0
0
Sms Text: this-word
Time to read: 30

Please use the COMMIT button to activate your settings

Figure 5-191: Settings for SMS services**.**

Service SMS: select Enable to activate this feature. By default it is disabled.

Phone No.: enter a full mobile telephone number such as 074199….. in the above example, or just a prefix, "0741" or "075". Only text messages issued from this number or prefix will be taken into account!



SERVICE SMS: Enabled
Phone No.: 075
0
0
Sms Text: this-word
Time to read: 45

Figure 5-192: Establishing parameters for the SMS managemnt service**.**

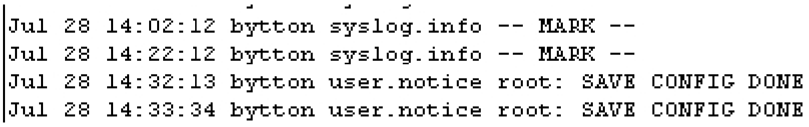
SMS text: enter here a word that will act as password.

Time to read: time period, in seconds, for Bytton LTE to check for SMS messages.

In the System>Log you will see the testing for received SMS messages upon corresponding intervals:

```
Jul  6 10:07:01 bytton cron.err crond[3442]: USER root pid 5971 cmd net_moni
Jul  6 10:07:05 bytton user.info pbx: test  AT  OK/NOK
Jul  6 10:07:06 bytton user.info pbx: sms len=2401
Jul  6 10:07:14 bytton user.info pbx: test  AT  OK/NOK
Jul  6 10:07:15 bytton user.info pbx: sms len=2334
Jul  6 10:07:21 bytton user.info pbx: test  AT  OK/NOK
Jul  6 10:07:22 bytton user.info pbx: sms len=2267
Jul  6 10:07:29 bytton user.info pbx: test  AT  OK/NOK
Jul  6 10:07:29 bytton user.info pbx: sms len=2200
```

SAVE CONFIG: button located at the bottom of the screen that saves the current configuration of Bytton LTE in a special partition of the Flash memory of the equipment.
This way, it can perform a sort of backup for all the settings.



```
Jul 28 14:02:12 bytton syslog.info -- MARK --
Jul 28 14:22:12 bytton syslog.info -- MARK --
Jul 28 14:32:13 bytton user.notice root: SAVE CONFIG DONE
Jul 28 14:33:34 bytton user.notice root: SAVE CONFIG DONE
```

Or:

```
Jul  6 10:14:01 bytton cron.err crond[3442]: USER root pid 8871 cmd net_moni
Jul  6 10:14:14 bytton user.notice root: SAVE CONFIG DONE
Jul  6 10:14:20 bytton user.notice root: SAVE CONFIG DONE
Jul  6 10:14:21 bytton user.notice root: SAVE CONFIG DONE
Jul  6 10:14:28 bytton daemon.info dnsmasq[1203]: read /etc/hosts - 1
addresses
```

When the “SMS management” service is enabled, you can manage remotely by means of SMS messages some features of the Topex Bytton router.

Load – if you send to the Bytton LTE, form the telephone number or prefix that you have previously entered, a short message with the text “load”, the equipment will load the backup configuration that was previously saved.

Info – after you send to the SIM used in the Bytton LTE equipment, form the telephone number or prefix that you have previously entered, a short message with the text “info”,

the equipment will answer back to you with a SMS which shows:

- the current state of the data link, such as started, then stopped in this examples
- the name and type (MobileCarrierB, 3G) of the mobile network where it is registered
- the value of the signal level, such as” -85dBm”
- the mobile cell where it is connected, like “2” or “2,1,"03F2".

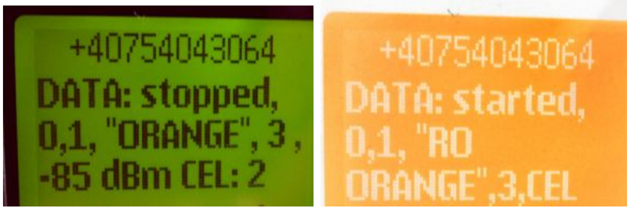
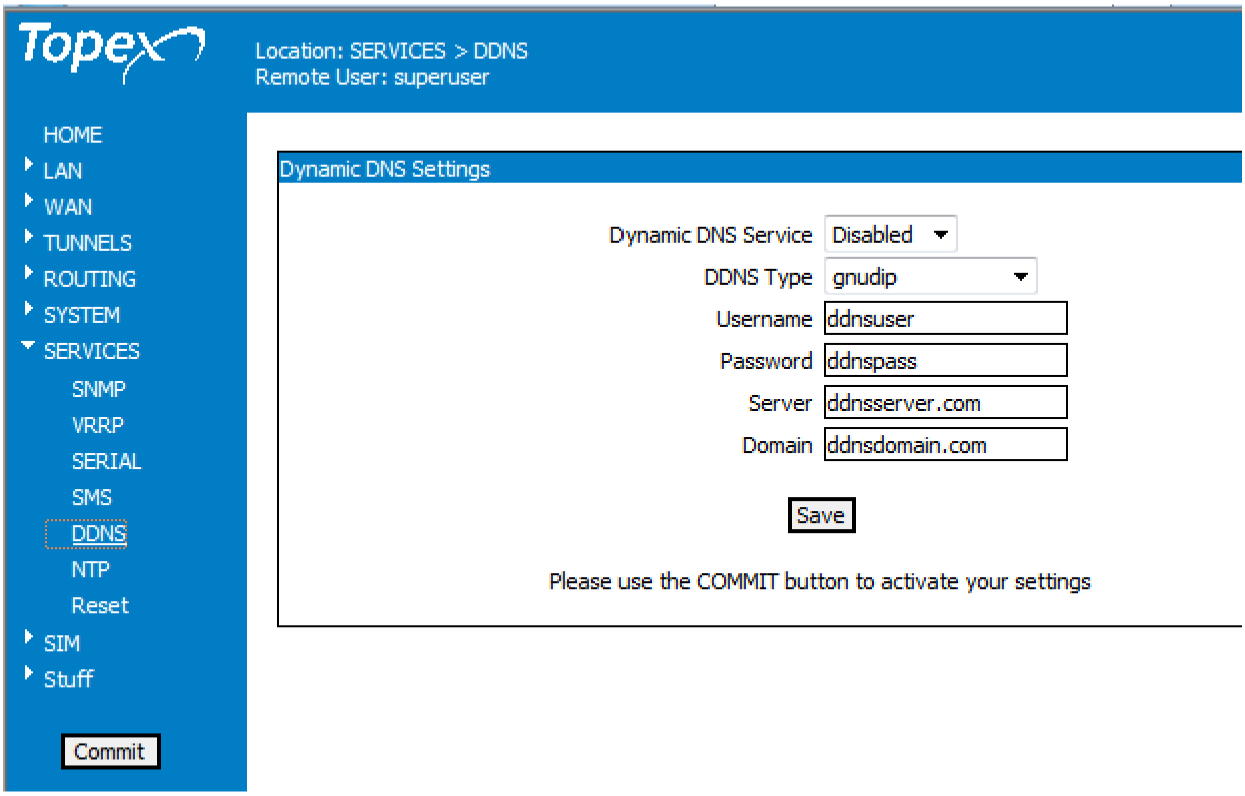


Figure 5-193: Examples of actual SMS received on a mobile phone, form the remote Bytton LTE equipment**.**

Reset - if you send to the Bytton LTE, form the telephone number or prefix that you have previously entered, a short message with the text “SMS text”, the data connection will be switched.
That means: if the connection was online, it will be stopped, and if it was stopped, it will be started.

5.6.6 DDNS

Here are located the settings for the Dynamic DNS Server.



Location: SERVICES > DDNS
Remote User: superuser

Dynamic DNS Settings

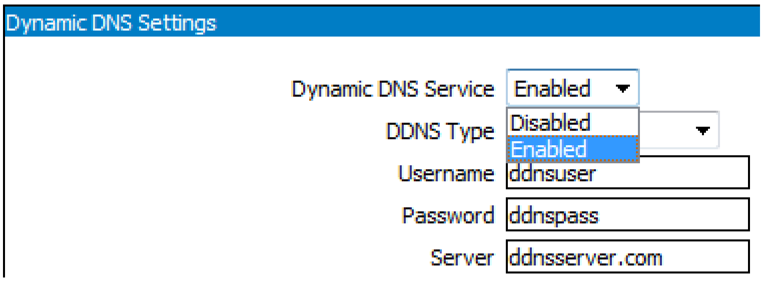
Dynamic DNS Service: Disabled
DDNS Type: gnudip
Username: ddnsuser
Password: ddnspass
Server: ddnsserver.com
Domain: ddnsdomain.com

Please use the COMMIT button to activate your settings

Figure 5-194: Services: Settings for the Dynamic DNS.

Dynamic DNS is a service that enables mapping of a dynamically assigned IP address to a static or permanent hostname.
This allows the use of applications that require a static IP address, such as web-hosting, FTP, etc.

Dynamic DNS Service: Enables or disables the DDNS service. By default it is disabled:



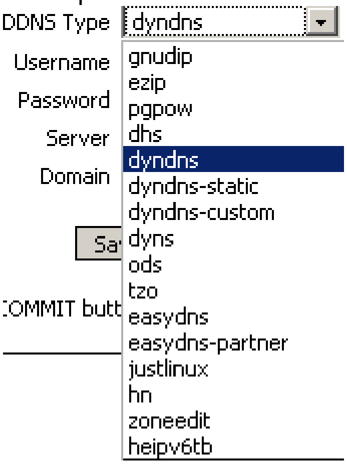
Dynamic DNS Settings

Dynamic DNS Service: Enabled
DDNS Type
Username: ddnsuser
Password: ddnspass
Server: ddnsserver.com

Figure 5-195: Enabling the Dynamic DNS Server.

This service allows you to export several hostnames by means of a Dynamic DNS provider.

DDNS Type:
Allows you to select the type of DDNS service. The drop-down list includes the major Dynamic DNS service providers.
The default is gnudip.



DDNS Type: dyndns

Figure 5-196: Drop list for selecting the name of Dynamic DNS Service.

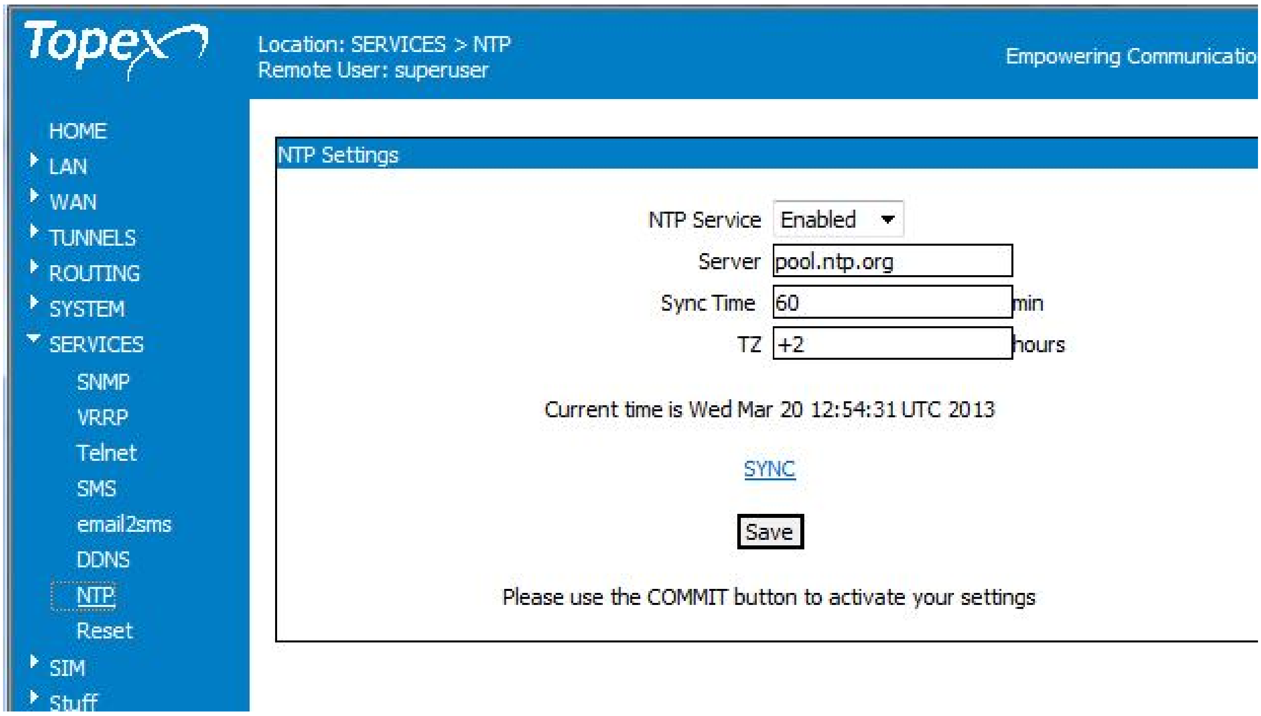
Username & Password: User name and password for authenticating to the DDNS.
Server: Full name of the Dynamic DNS server used to store your host and domain name information.
Domain: The domain name for DDNS.

You must have membership to one of the DDNS services providers.

Warning: *These factory default settings may not work in your area, you should change the DDNS parameters according to the specifications of your Internet provider.*

5.6.7 NTP

The **N**etwork **T**ime **P**rotocol is used to update the real-time clock in a computer, over Internet.
For this, it uses a dedicated Time server on the Internet that accurately synchronizes the system date and time.



Location: SERVICES > NTP
Remote User: superuser

NTP Settings

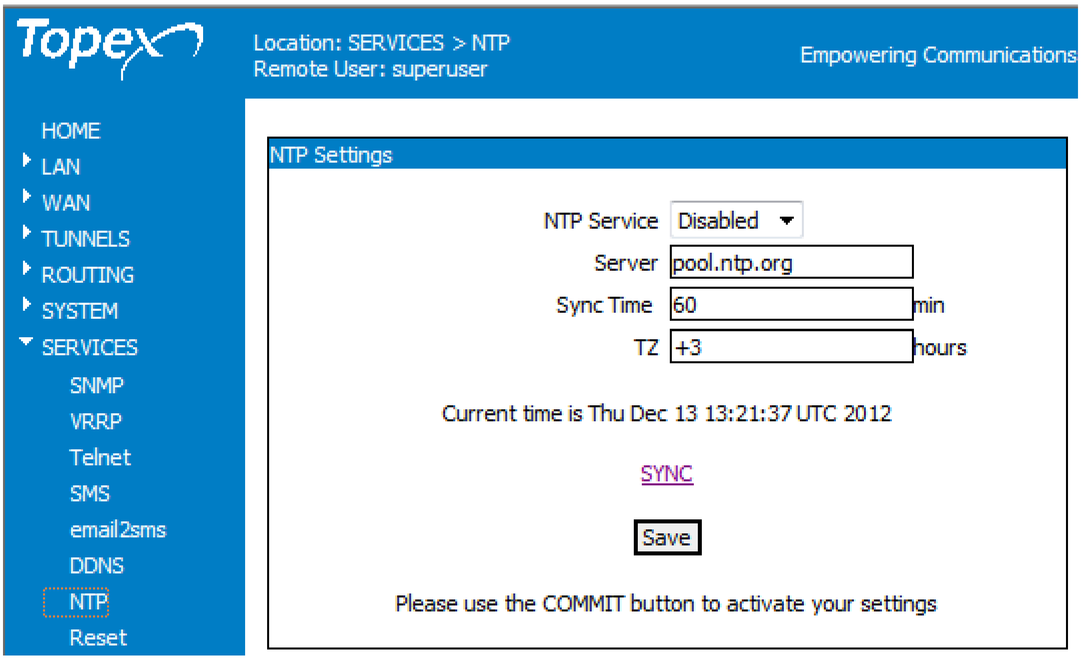
NTP Service: Enabled
Server: pool.ntp.org
Sync Time: 60 min
TZ: +2 hours

Current time is Wed Mar 20 12:54:31 UTC 2013

Please use the COMMIT button to activate your settings

Figure 5-197 Enabling and choosing server for the NTP Client service.

NTP Service: Enabled or Disabled. By default it is disabled:



Location: SERVICES > NTP
Remote User: superuser

NTP Settings

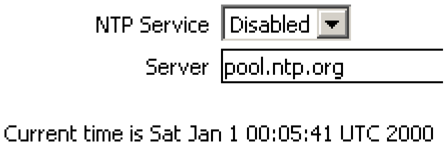
NTP Service: Disabled
Server: pool.ntp.org
Sync Time: 60 min
TZ: +3 hours

Current time is Thu Dec 13 13:21:37 UTC 2012

Please use the COMMIT button to activate your settings

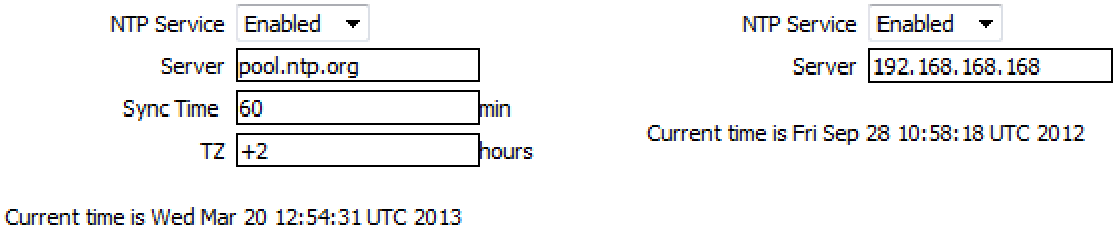
Server: enter the full name of the NTP server you want to use, such as “utcnist.colorado.edu” or “ro.pool.ntp.org”.
Even if the time server has a static IP address, it is always recommended to use DNS to resolve the name “timp.mcti.ro” or “ntp.sv2.ro” and not to enter the IP address, like **80.96.120.251** or **81.180.122.154** !

The “Current time” indicator shows the current UTC time (Universal Coordinated Time) of the system, with millisecond precision.
If NTP feature is not active (you have disabled it the selected server is not online, or you have no connection to the Internet) it will display the default UTC date/time, which is Jan 1, 2000 and 0:00.


NTP Service: Disabled
Server: pool.ntp.org

Current time is Sat Jan 1 00:05:41 UTC 2000

When it becomes active, it shows the current UTC time:


NTP Service: Enabled
Server: pool.ntp.org
Sync Time: 60 min
TZ: +2 hours

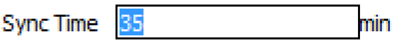
Current time is Wed Mar 20 12:54:31 UTC 2013

NTP Service: Enabled
Server: 192.168.168.168

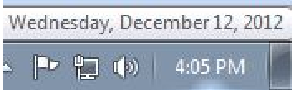
Current time is Fri Sep 28 10:58:18 UTC 2012

Figure 5-198: Examples of current time display when NTP Service is enabled**.**

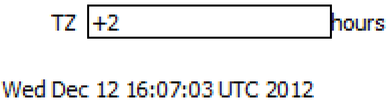
Sync time: the time interval, in minutes, after which the NTP client running on Bytton ICR will connect to the remote time server in order to perform sychronization.

The default value is 60 minutes (one hour) but you may set a smarller interval:	 Sync Time: 35 min

This UTC time may be different from the local time of your computer!


Wednesday, December 12, 2012
4:05 PM

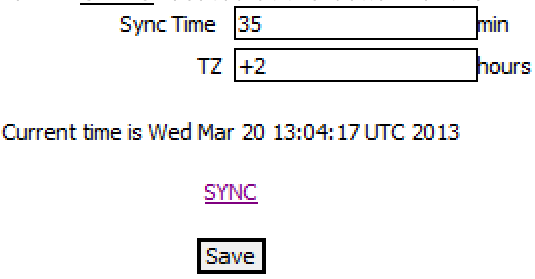
This is easily corrected by the **TZ** (Time Zone) field:


TZ: +2 hours

Wed Dec 12 16:07:03 UTC 2012

The field **TZ** allows you to enter the Time Zone correction, in hours. For instance, a value of +2 adds two hours to the UTC time (thus allowing to display the Bucharest time instead of GMT).

Finally, the link SYNC located at the bottom of the NTP page, above the “Save” button:



Sync Time: 35 min

TZ: +2 hours

Current time is Wed Mar 20 13:04:17 UTC 2013

Figure 5-199: The SYNC link located at the bottom of the NTP window.

forces an immediate synchronization using NTP, even if the time interval previously set has not yet finished:

Time events in System Log

In the system logs of the Bytton device you can see the moment when the applications running on Bytton connects to the Internet and the time jumps from the default “Jan 1 2000” to the actual date/time supplied by the selected NTP server:

```
Jan  1 00:00:46 bytton user.info kernel: usb 1-1: Sierra USB modem converter now
attached to ttyUSB6
Jan  1 00:00:47 bytton user.info pbx: modem port opened
Jan  1 00:00:56 bytton user.notice root: Selected SIM0
Jan  1 00:00:56 bytton user.info pbx: clips active
Dec 12 16:03:03 bytton user.info kernel: PHY: mdio@e0102120:05 - Link is Up - 100/Full
Dec 12 16:03:03 bytton daemon.info dnsmasq[1295]: DHCPREQUEST(br0) 172.168.1.13
00:06:4f:02:15:82
Dec 12 16:03:03 bytton daemon.info dnsmasq[1295]: DHCPACK(br0) 172.168.1.13
00:06:4f:02:15:82 VO000073
Dec 12 16:03:03 bytton daemon.warn dnsmasq[1295]: Ignoring domain topex.ro for DHCP
host name VO000073
Dec 12 16:03:03 bytton cron.err crond[1648]: time disparity of 22588802 minutes
detected
Dec 12 16:03:12 bytton daemon.info dnsmasq[1295]: DHCPINFORM(br0) 172.168.1.13
00:06:4f:02:15:82
Dec 12 16:03:12 bytton daemon.info dnsmasq[1295]: DHCPACK(br0) 172.168.1.13
00:06:4f:02:15:82 VO000073
Dec 12 16:03:55 bytton daemon.notice pppd[2212]: pppd 2.4.4 started by root, uid 0
Dec 12 16:03:56 bytton user.notice root: DATA START
Dec 12 16:03:56 bytton daemon.info pppd[2212]: Serial port initialized.
Dec 12 16:03:56 bytton local2.info chat[2246]: timeout set to 20 seconds
Dec 12 16:03:56 bytton local2.info chat[2246]: abort on (BUSY)
```

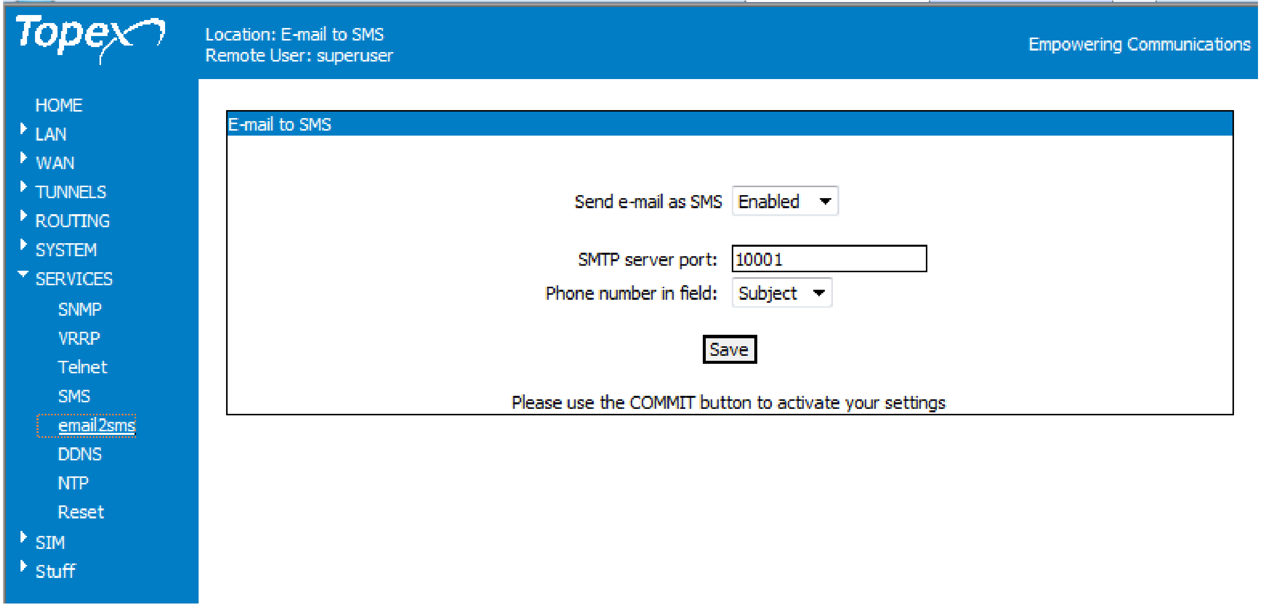
Or:

```
Jan  1 00:00:46 bytton user.info kernel: usb 1-1: Sierra USB modem converter now
attached to ttyUSB5
Jan  1 00:00:46 bytton user.info kernel: sierra 1-1:1.6: Sierra USB modem converter
detected
Jan  1 00:00:46 bytton user.info kernel: usb 1-1: Sierra USB modem converter now
attached to ttyUSB6
Jan  1 00:00:47 bytton user.info pbx: modem port opened
Jan  1 00:00:56 bytton user.notice root: Selected SIM0
Jan  1 00:00:56 bytton user.info pbx: clips active
Dec 13 09:27:03 bytton cron.err crond[1651]: time disparity of 22589846 minutes
detected
Dec 13 09:27:31 bytton daemon.info dnsmasq[1296]: reading /etc/resolv.conf
Dec 13 09:27:31 bytton daemon.info dnsmasq[1296]: using nameserver 172.27.168.70#53
Dec 13 09:27:31 bytton daemon.info dnsmasq[1296]: using nameserver 172.27.168.7#53
Dec 13 09:27:31 bytton daemon.info dnsmasq[1296]: using nameserver 192.168.1.88#53
Dec 13 09:27:31 bytton daemon.info dnsmasq[1296]: using nameserver 8.8.8.8#53
Dec 13 09:27:32 bytton daemon.info dnsmasq[1296]: read /etc/hosts - 1 addresses
Dec 13 09:27:51 bytton daemon.info dnsmasq[1296]: DHCPDISCOVER(br0) 00:06:4f:02:15:82
Dec 13 09:27:51 bytton daemon.info dnsmasq[1296]: DHCPOFFER(br0) 172.168.1.13
00:06:4f:02:15:82
Dec 13 09:27:53 bytton daemon.info dnsmasq[1296]: DHCPDISCOVER(br0) 00:06:4f:02:15:82
Dec 13 09:27:53 bytton daemon.info dnsmasq[1296]: DHCPOFFER(br0) 172.168.1.13
00:06:4f:02:15:82
Dec 13 09:27:53 bytton daemon.info dnsmasq[1296]: DHCPREQUEST(br0) 172.168.1.13
00:06:4f:02:15:82
Dec 13 09:27:53 bytton daemon.info dnsmasq[1296]: DHCPACK(br0) 172.168.1.13
00:06:4f:02:15:82 VO000073
Dec 13 09:27:53 bytton daemon.warn dnsmasq[1296]: Ignoring domain topex.ro for DHCP
host name VO000073
Dec 13 09:28:01 bytton cron.err crond[1651]: USER root pid 2050 cmd net_moni
Dec 13 09:28:20 bytton daemon.info dnsmasq[1296]: DHCPINFORM(br0) 172.168.1.13
00:06:4f:02:15:82
Dec 13 09:28:20 bytton daemon.info dnsmasq[1296]: DHCPACK(br0) 172.168.1.13
00:06:4f:02:15:82 VO000073
Dec 13 09:29:01 bytton cron.err crond[1651]: USER root pid 2269 cmd net_moni
```

Figure 5-200: Time jumps when NTP service become active, as seen in the system logs.

5.6.8 E-mail to SMS

This page alows you to set up the conversion from e-mail messages to SMS sent out via mobile module:



Location: E-mail to SMS
Remote User: superuser

E-mail to SMS

Send e-mail as SMS: Enabled

SMTP server port: 10001

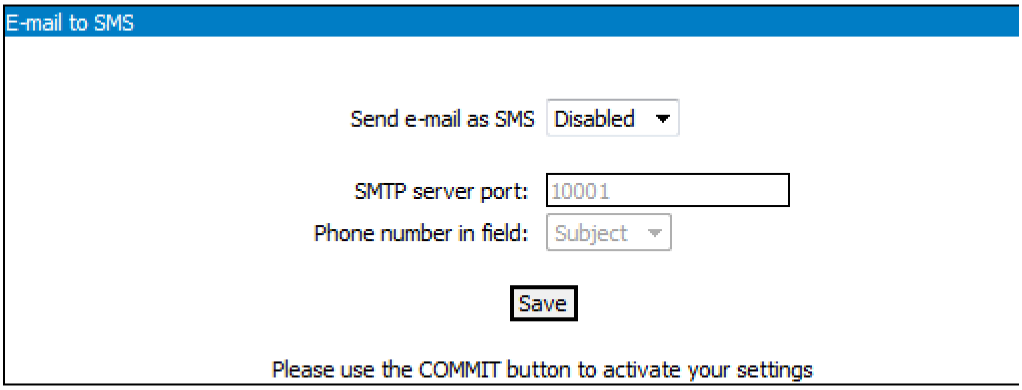
Phone number in field: Subject

Please use the COMMIT button to activate your settings

Figure 5-201: Configuration page for the E-mail to SMS feature of Bytton.

By default, it is disabled. The fields under it are gray, indicating that they are not editable – the feature is not available.

First, enable it to be able to use this service:



E-mail to SMS

Send e-mail as SMS: Disabled

SMTP server port: 10001

Phone number in field: Subject

Please use the COMMIT button to activate your settings

How it works:

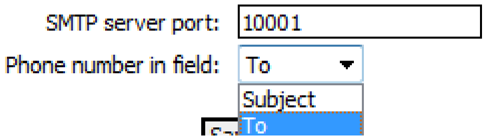
The mail server (using SMTP) sends an e-mail to the IP of the Bytton equipment.
Bytton sends out a SMS with the respective content, via mobile module, using the telephone number provided with the e-mail message.
The total length of the Subject + Body must be at most equal to the maximum text length for the respective mobile carrier. Typically, this is 160 ASCII characters, but it dorps to 70 when you need to send non-ASCII characters (such as şţî'âă or €©™∞μαΘ). Also, the limit may depend upon the region of the world, country, and mobile carrier (operator) used by the SIM card in your Bytton equipment.

SMTP

Simple **M**ail **T**ransfer **P**rotocol is a protocol widely used across the Internet for sending e-mail messages between servers. SMTP is generally used to send messages from a mail client to a mail server.

You must specify the port number to be used for SMTP.

Also, you must "tell" to the Bytton equipment if the destination telephone number is to be found in the "Subject" field or in the "To" field of the e-mail message.

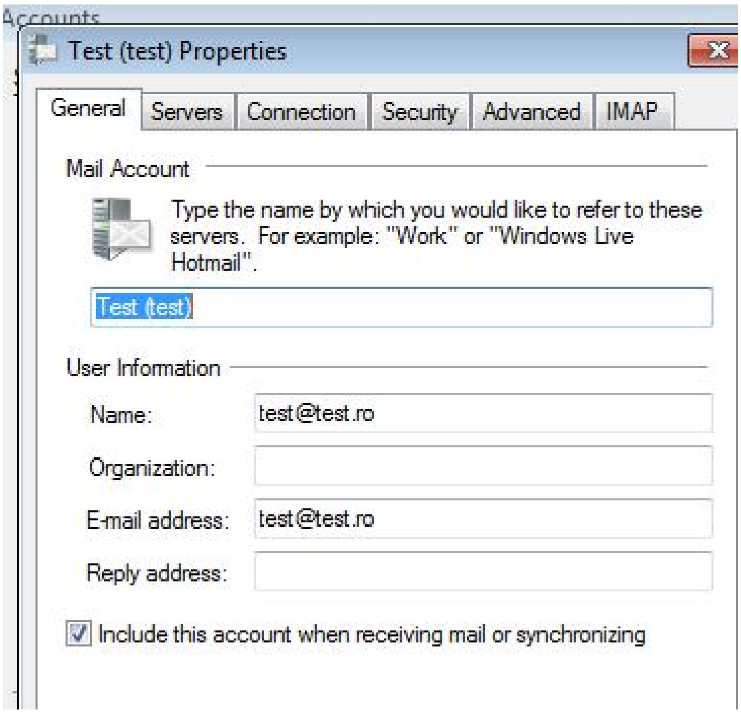


SMTP server port: 10001
Phone number in field: To

Figure 5-202: Configure the E-mail to SMS feature of Bytton**.**

To be able to use email2sms, you must create on your computer special mail account, dedicated for this feature.
In this example, the e-mail account is called "Test", ad uses a fake address test@test.ro

Figure 5-203: Preparing a dedicated E-mail account to be used with the SMS feature of Bytton**.**



Test (test) Properties

Mail Account

Type the name by which you would like to refer to these servers. For example: "Work" or "Windows Live Hotmail".

Test (test)

User Information

Name: test@test.ro

Organization:

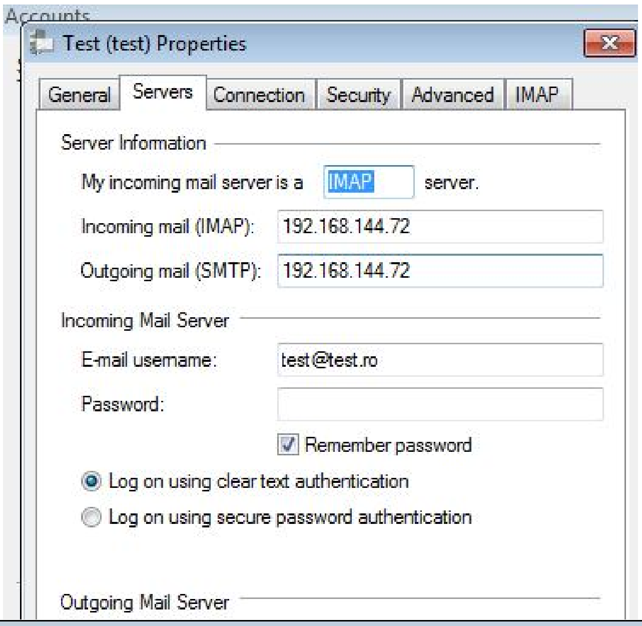
E-mail address: test@test.ro

Reply address:

☑ Include this account when receiving mail or synchronizing

The outgoing mail server (SMTP) must have as IP address the WAN address of the Bytton equipment, in this case 192.168.144.72

No password is used, the field is empty, but it must be completed, for compatibility



Server Information

My incoming mail server is a IMAP server.

Incoming mail (IMAP): 192.168.144.72

Outgoing mail (SMTP): 192.168.144.72

Incoming Mail Server

E-mail username: test@test.ro

Password:

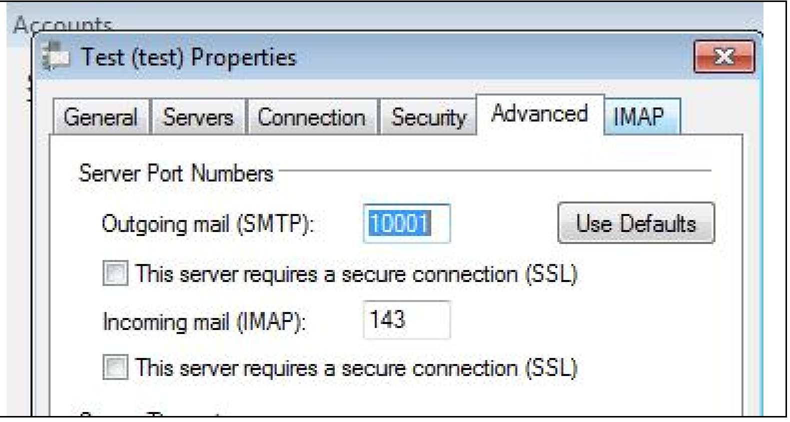
☑ Remember password

● Log on using clear text authentication

○ Log on using secure password authentication

Outgoing Mail Server

Finally, the number of the server port for outgoing mail must be set to the same value as the one used by Byttpn, in this case “100001”



Server Port Numbers

Outgoing mail (SMTP): 10001

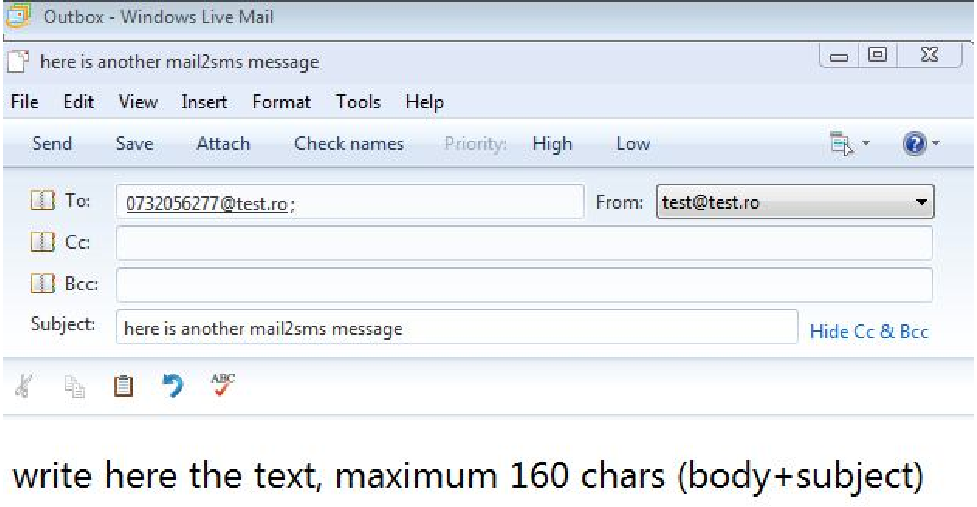
□ This server requires a secure connection (SSL)

Incoming mail (IMAP): 143

□ This server requires a secure connection (SSL)

Figure 5-204: Configure the E-mail to SMS feature of Bytton.

Use the respective e-mail accont (test@test.ro) to create the message that you want to be relayed by Bytton, as shown in the example below:



To: 0732056277@test.ro;

From: test@test.ro

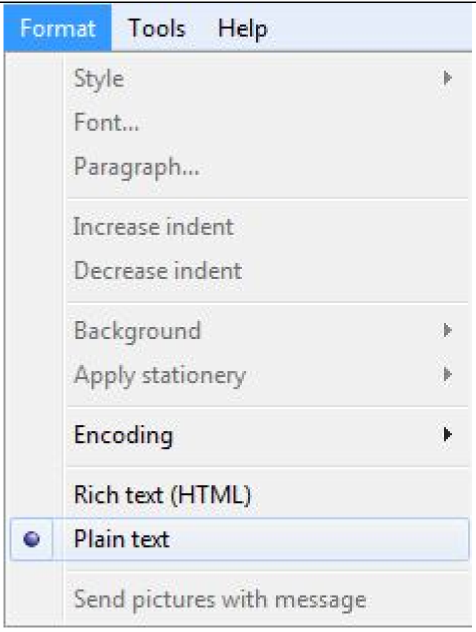
Cc:

Bcc:

Subject: here is another mail2sms message

write here the text, maximum 160 chars (body+subject)

The “To:” field must contain the destination telephone number, such as 0732056277 in this example. For compatibility, the entry in “To” must be structured like a correct e-maill address, that is **phonenumber@domain.ext**

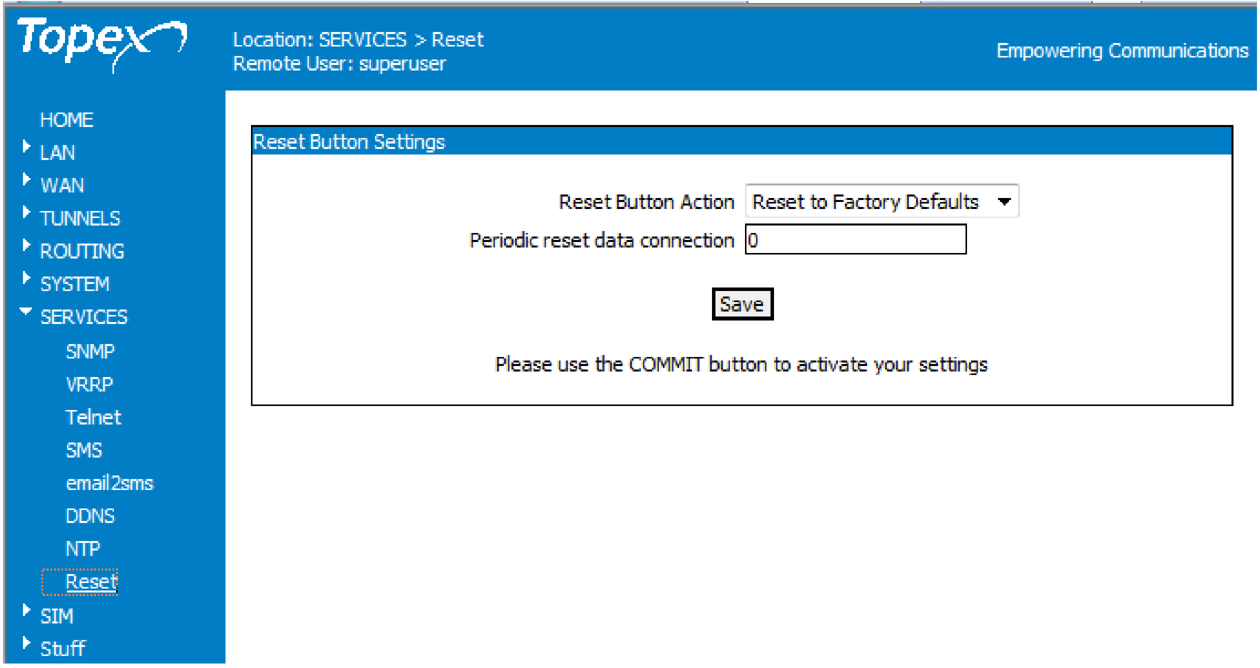
Remember that the <u>total</u> length (of Subject + Body) must respect the length limit for SMS message of the respective Mobile carrier **Format** – choose plain text. Also, the formatting of the message must be set to “plain text”. Be careful, currently may e-mail cliendt use by default Rich text or HTML formatting, you must set it instead to “Plain text”.	 Format Tools Help Style Font... Paragraph... Increase indent Decrease indent Background Apply stationery Encoding Rich text (HTML) ● Plain text Send pictures with message

See below an extract from the System Log, showing how Bytton receives (at 15:04:33) the e-mail message and sens out ot the destination phone number a corresponding SMS:

```
Dec 12 15:04:01 bytton cron.err crond[1649]: USER root pid 3685 cmd net_moni
Dec 12 15:04:33 bytton user.notice root: EMail to SMS > 0732056277
Dec 12 15:04:36 bytton user.info pbx: test  AT  OK/NOK
Dec 12 15:04:36 bytton user.info pbx: return AT  NOK
Dec 12 15:04:36 bytton user.info pbx: modem err timeout
Dec 12 15:05:01 bytton cron.err crond[1649]: USER root pid 3972 cmd net_moni
```

5.6.9 Reset

Here you can change the assignment of the “Reset” button located on the front panel:



Location: SERVICES > Reset
Remote User: superuser

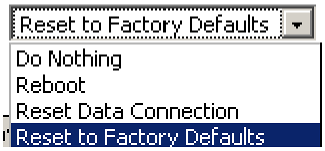
Reset Button Settings

Reset Button Action: Reset to Factory Defaults
Periodic reset data connection: 0

Please use the COMMIT button to activate your settings

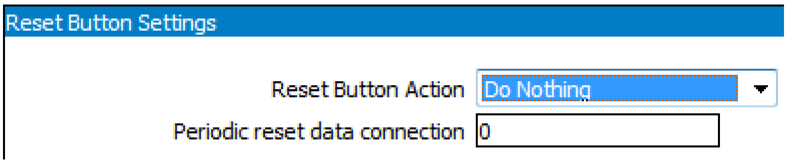
Figure 5-205: Settings for Reset button.

Reset Button Settings – you choose the option you want.
The function of the Reset (RST) button, located on the back panel among the connectors, can be changed according to your needs.



Do nothing – yes, this “do nothing” action may quite be useful. It may happen that the Reset button is touched by accident when you plug a cable into Topex Bytton LTE, so that Bytton equipment reboots and reverts to the factory default values, loosing your particular settings. When you want to avoid this incident, select “Do nothing”. Now, even if you accidentally press Reset, **nothing happens**. If you want, you can still perform Reset via software!

Note: *Even when the Reset button is disabled form software, you can still perform a hardware “Reset to factory defaults”, by following the prescribed procedure upon power-up*.



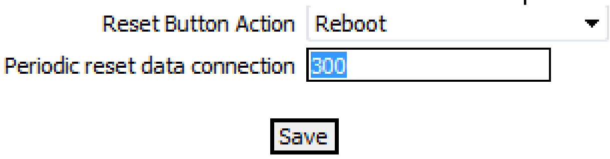
Reset Button Settings

Reset Button Action: Do Nothing
Periodic reset data connection: 0

Reboot – it performs a full reboot (restart) of Bytton LTE.
Reset Data Connection – only the data connection is resetted, the equipment does not stop operating.

Reset to Factory Defaults – after full reboot, Bytton LTE settings are restored to factory defaults.

Periodic reset data connection: after the specified number of seconds, the data connection will reset.



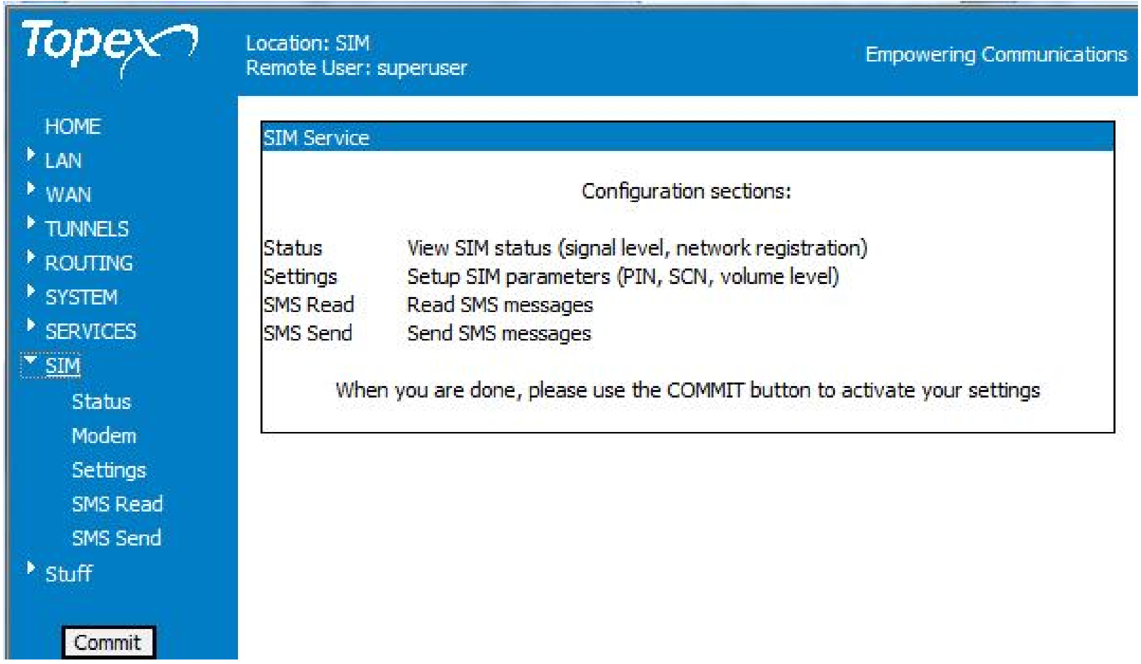
Reset Button Action: Reboot
Periodic reset data connection: 300

Figure 5-206: Entering time value for Periodical reset of the data connection.

The default value is 0 (zero), which means that the connection will never be restarted.

5.7 SIM

Here are the configuration pages related not only to the SIM card but also to the mobile module of the equipment. You can see the current state and change the parameters:



SIM Service

Configuration sections:

Status	View SIM status (signal level, network registration)
Settings	Setup SIM parameters (PIN, SCN, volume level)
SMS Read	Read SMS messages
SMS Send	Send SMS messages

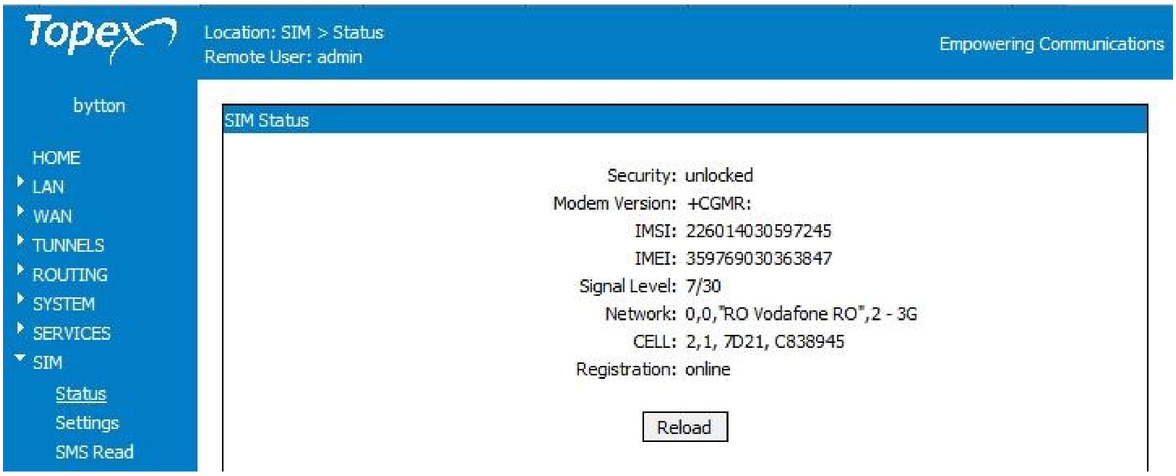
When you are done, please use the COMMIT button to activate your settings

Figure 5-207: General web page for the SIM Services**.**

Also, from here you may send or receive SMS messages from your PC, using the mobile module of Bytton LTE.

5.7.1 SIM Status

This page shows you the current state of the active SIM card and of the GSM/GPRS/EDGE, UMTS or HSPA+ module of Bytton LTE:

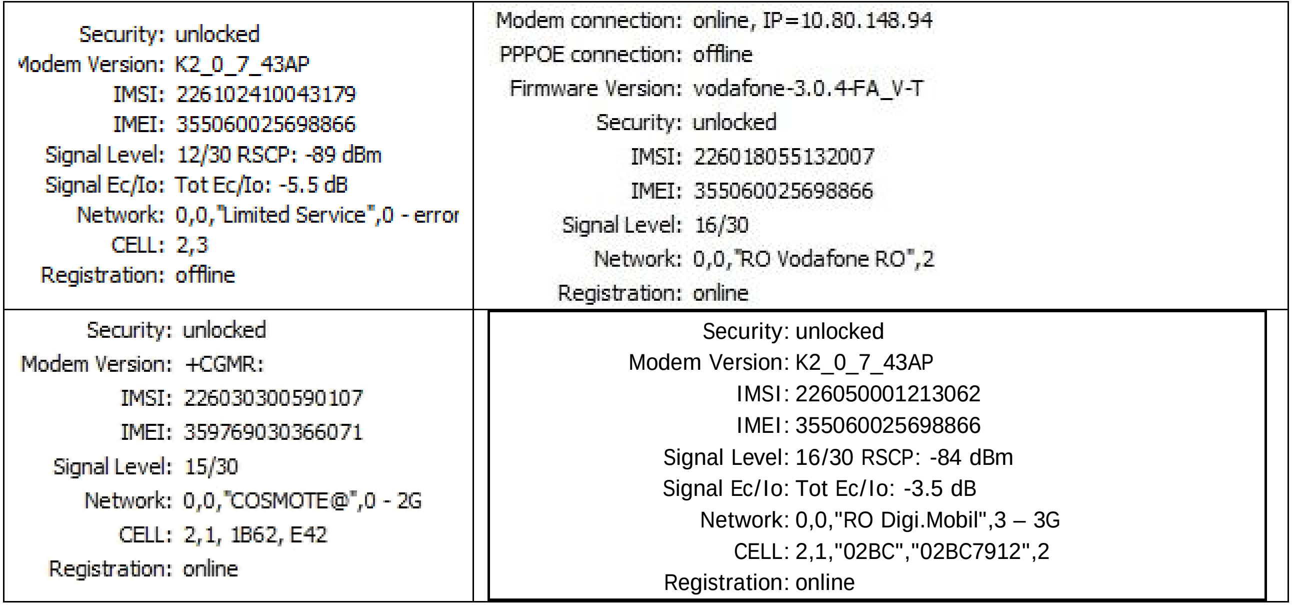


SIM Status

Security:	unlocked
Modem Version:	+CGMR:
IMSI:	226014030597245
IMEI:	359769030363847
Signal Level:	7/30
Network:	0,0,"RO Vodafone RO",2 - 3G
CELL:	2,1, 7D21, C838945
Registration:	online

Figure 5-208: Example of SIM Status display for Bytton LTE in HSPA mode**.**

Other actual SIM Status examples follow:



```
     Security: unlocked
Modem Version: K2_0_7_43AP
         IMSI: 226102410043179
         IMEI: 355060025698866
 Signal Level: 12/30 RSCP: -89 dBm
Signal Ec/Io: Tot Ec/Io: -5.5 dB
      Network: 0,0,"Limited Service",0 - error
         CELL: 2,3
 Registration: offline
```

```
Modem connection: online, IP=10.80.148.94
PPPOE connection: offline
Firmware Version: vodafone-3.0.4-FA_V-T
        Security: unlocked
            IMSI: 226018055132007
            IMEI: 355060025698866
    Signal Level: 16/30
         Network: 0,0,"RO Vodafone RO",2
    Registration: online
```

```
     Security: unlocked
Modem Version: +CGMR:
         IMSI: 226030300590107
         IMEI: 359769030366071
 Signal Level: 15/30
      Network: 0,0,"COSMOTE@",0 - 2G
         CELL: 2,1, 1B62, E42
 Registration: online
```

```
     Security: unlocked
Modem Version: K2_0_7_43AP
         IMSI: 226050001213062
         IMEI: 355060025698866
 Signal Level: 16/30 RSCP: -84 dBm
 Signal Ec/Io: Tot Ec/Io: -3.5 dB
      Network: 0,0,"RO Digi.Mobil",3 – 3G
         CELL: 2,1,"02BC","02BC7912",2
 Registration: online
```

Figure 5-209: SIM Status examples (for different Romanian carriers).

The examples above refers to SIM cards from different carriers, with the level of RF signal is lower or higher, having access to both 2G and 3G technologies. One Sim card has a higher signal level, but is not properly registered – it provides just "limited service", thus it is "offline".

Security: unlocked Modem Version: K2_0_7_43AP IMSI: 226102100414755 IMEI: 355060025698866 Signal Level: no signal Signal Ec/Io: Network: 0 - error CELL: 2,0 Registration: offline	Security: unlocked Modem Version: K2_0_7_43AP IMSI: 226102100414755 IMEI: 355060025698866 Signal Level: 14/30 RSCP: -85 dBm Signal Ec/Io: Tot Ec/Io: -4.0 dB Network: 0,0,"RO MOBILECARRIERB",2 - error CELL: 2,1,"03F2","00102CE3",2 Registration: online	Security: unlocked Modem Version: K2_0_7_43AP IMSI: 226102100414755 IMEI: 355060025698866 Signal Level: 14/30 RSCP: -84 dBm Signal Ec/Io: Tot Ec/Io: -4.5 dB Network: 0,0,"RO MobileCarrierB",2 - 1,UMTS,HSDPA/HSUPA CELL: 2,1,"03F2","00102CE3",2 Registration: online

Figure 5-210: Several examples of SIM Status for the "Mobile Carrier B" provider**.**

In the series of three examples above, the same Bytton equipment, fitted with the same 3G module and with the same mobile data subscription from the "MobileCarrierB" wireless voice/data operator, is shown in three situations, from left to the right: no signal at all (external Mobile antenna not connected) thus online and no signal or cell indication, with good signal and registration, but data net in error, and finally with data connection active (it show not just the network, but the 3G technologies actually available)
The status of the Sim card and mobile module is automatically read every five seconds.

The following information items are displayed:

- **Security**: "Unlocked" or "OK" means the SIM is active. "Locked by PIN" means the SIM card is asking the PIN code to perform unlock.

As an additional security measure, the SIM card is also provided with a PUK code, requested after three wrong PIN codes.

- **Modem Version**: it is read from the 3G+ module, displays a string such as N2_0_4_1AP. or K2_0_7_35AP, which is very useful as information for debugging or when you need to replace the equipment.

- **IMSI** (International Mobile Subscriber Identity), subscriber's identity (SIM card identity). This is a unique 15 digits code number that identifies a mobile subscriber to the network. When the Topex Bytton LTE's mobile module detects an active SIM card, it will query (and display) the IMSI code.

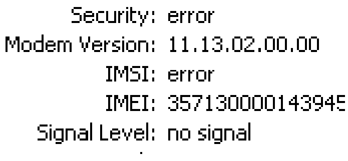
Since the IMSI code is related to the SIM, when you change the SIM card, or when a dual-SIM equipment selects the second SIM, you will have another IMSI code.

```
IMSI: 226102410043179
IMEI: 355060025698866
```

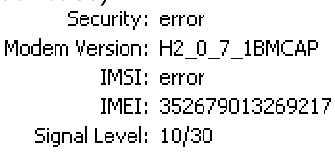
Figure 5-211: Actual examples of "SIM Status" page showing IMSI and respectively IMEI codes**.**

- **IMEI** (International Mobile Equipment Identifier). 15-digit number that uniquely identifies an individual mobile terminal device. While IMSI is specific to the subscriber (SIM card), IMEI in specific to the wireless equipment (the modem of Bytton LTE in our case).

When the SIM card is missing, the SIM Status window will show “error” in the Security, IMSI, Signal Level, Network and Registration fields.
But you will still see the version of the 3G modem and the **IMEI** code, since they are equipment-dependent, and not related to the SIM card.



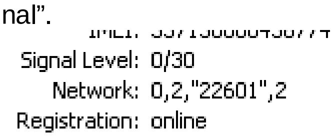
Security: error
Modem Version: 11.13.02.00.00
IMSI: error
IMEI: 357130000143945
Signal Level: no signal



Security: error
Modem Version: H2_0_7_1BMCAP
IMSI: error
IMEI: 352679013269217
Signal Level: 10/30

- **Signal Level**, displayed as two groups of two figures such as “15/30”.
The two digits indicate the level of the RF signal for the Mobile network on a scale from zero up to 30. When the SIM card is missing or isn't registered, its status will be: “no signal”.

- **Network**: the name of the mobile network which the equipment is registered to, as transmitted by the mobile carrier. It may also indicate the network type: 2G or 3G.



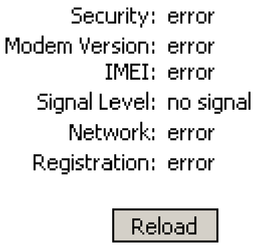
Signal Level: 0/30
Network: 0,2,"22601",2
Registration: online

- **Registration status**: indicates whether the SIM card is registered to the mobile network or not. Normally, it should display “Registration: online”

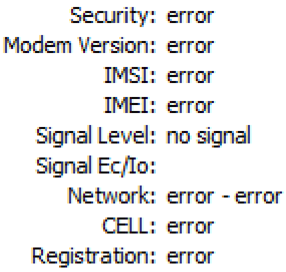
Warning! *When the mobile module is in a call, or while it is transmitting or receiving SMS, it* ***cannot be interrogated about its state****.*

“error” messages

Thus if you click “SIM Status” while in a voice call, you will get an error message (ERR).
This does not mean something is wrong, simply try again (click “Reload”) later, when you have finished the voice call or the transmission of SMS messages.



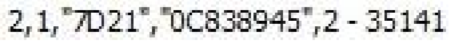
Security: error
Modem Version: error
IMEI: error
Signal Level: no signal
Network: error
Registration: error



Security: error
Modem Version: error
IMSI: error
IMEI: error
Signal Level: no signal
Signal Ec/Io:
Network: error - error
CELL: error
Registration: error

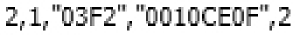
Figure 5-22: SIM Status with “error” messages, when the SIM card or module is busy**.**

Cell: when the mobile voice /data provider supports this feature, information is shown about the current cell where the Sim of the Bytton equipment is registered:



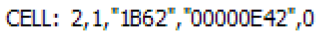
2,1,"7D21","0C838945",2 - 35141

2,1,"03F2","00102CE3",2

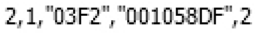


2,1,"03F2","0010CE0F",2

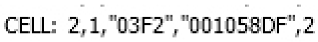
or



CELL: 2,1,"1B62","00000E42",0



2,1,"03F2","001058DF",2

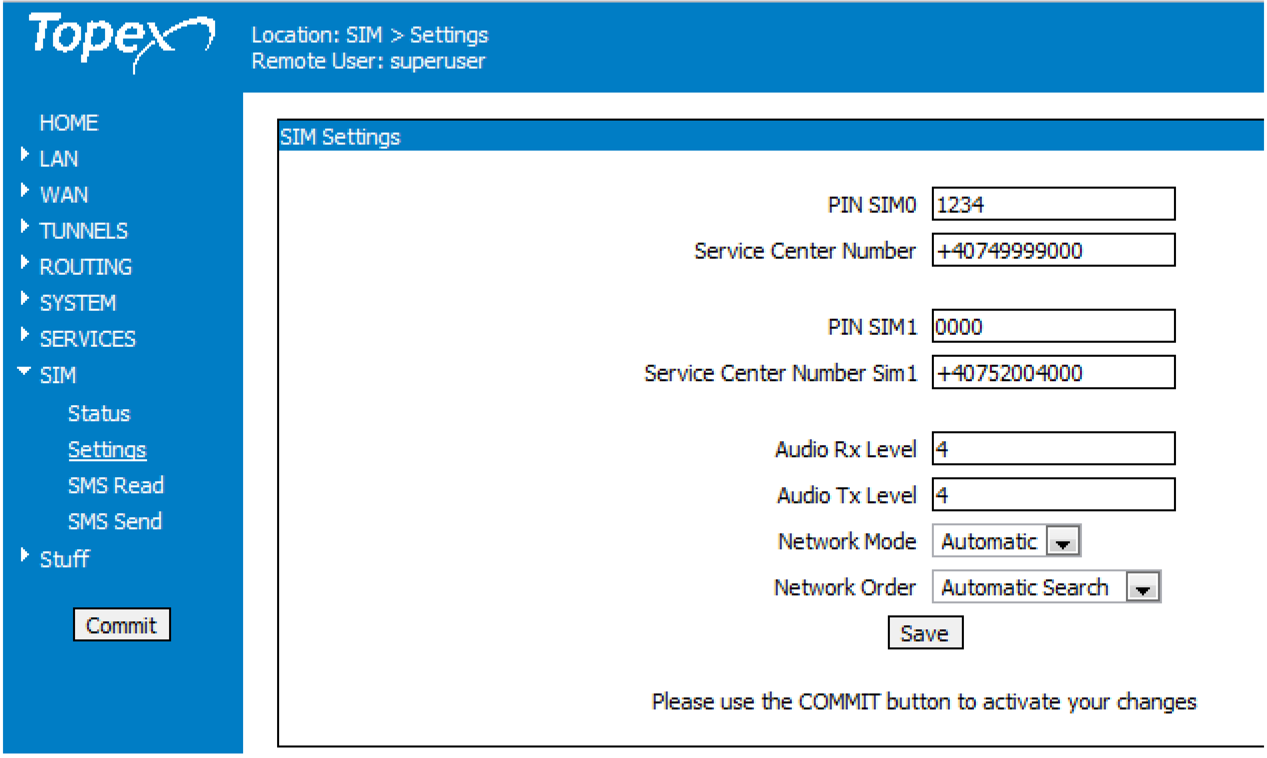


CELL: 2,1,"03F2","001058DF",2

Figure 5-213: Cell information in the SIM Status page**.**

5.7.2 SIM Settings

In this section you may perform several settings related to the mobile module and to the SIM card(s).



Location: SIM > Settings
Remote User: superuser

SIM Settings

PIN SIM0: 1234
Service Center Number: +40749999000

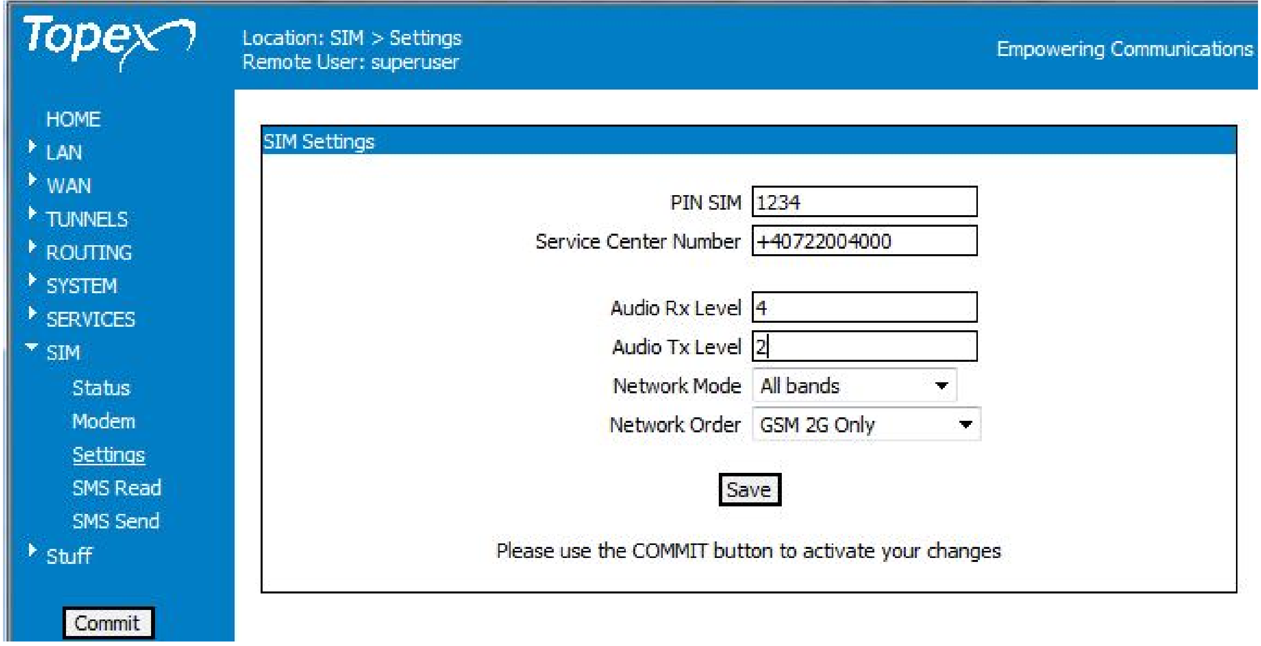
PIN SIM1: 0000
Service Center Number Sim1: +40752004000

Audio Rx Level: 4
Audio Tx Level: 4
Network Mode: Automatic
Network Order: Automatic Search

Please use the COMMIT button to activate your changes

Figure 5-214: SIM Settings for the dual-SIM Bytton ICR.

Respectively:



Location: SIM > Settings
Remote User: superuser
Empowering Communications

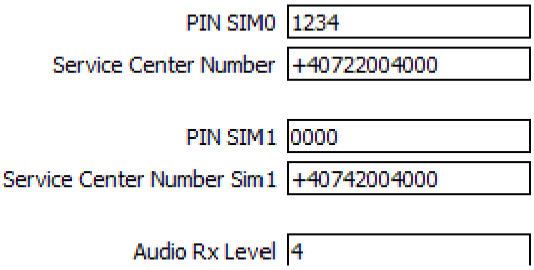
SIM Settings

PIN SIM: 1234
Service Center Number: +40722004000

Audio Rx Level: 4
Audio Tx Level: 2
Network Mode: All bands
Network Order: GSM 2G Only

Please use the COMMIT button to activate your changes

Figure 5-215: Sim Settings for the single SIM Bytton equipment.



PIN SIM0: 1234
Service Center Number: +40722004000

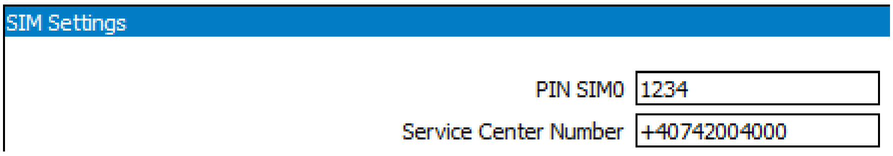
PIN SIM1: 0000
Service Center Number Sim1: +40742004000

Audio Rx Level: 4

SIM Settings for the Dual-SIM Bytton LTE

In case of equipments that have dual-SIM capability, the first two fields (PIN and SCN) will be doubled, since one is needed for each SIM.
Thus you will have **two** pairs. PIN SIM0 / SCN0 and respectively PIN SIM1 / SCN1, as shown!

PIN SIM0: enter PIN code for the first SIM card.
Service Center Number: full telephone number for the first SIM.
In order for the SMS facility to operate, you must set the correct number. This is the SMS center of the first GSM operator. Enter here the full phone number of the GSM carrier between quotes, like "+40744946000" in this example:



SIM Settings

PIN SIM0: 1234

Service Center Number: +40742004000

Figure 5-216: PIN for first SIM card and corresponding SC Number**.**

PIN SIM1: enter PIN code for the respective SIM card.

"**1234**" is the default value, which does NOT mean that the code is really 1234, instead it means "no PIN is required".
Thus , when the SIM has set a Pin code of "**0000**", you **must** use this value in the PIN SIM field, otherwise the SIM card will be locked!

Service Center Number Sim1: full telephone number for the second carrier.
In order for the SMS facility to operate, you must set the correct number.
This is the SMS center of the respective mobile operator.
Enter the full phone number of the GSM carrier between quotes, like "+407402004000" or "+40744946000" in these examples.

SIM Settings for the Single-SIM Bytton LTE

In case of equipments that a single slot for SIM cards, there is just one PIN and SCN entry, as shown.

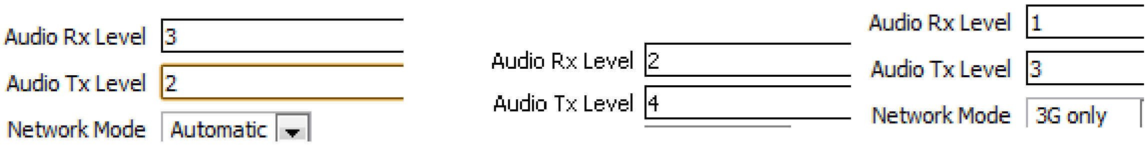
Audio Settings

The settings at the bottom are valid only for Bytton equipments with voice capabilities (the current model does not have an FXS port).

Volume level: for setting the volume (sound) level.
Of course, this setting has meaning only in case of Bytton LTE equipments with voice capabilities (that feature FXS interface)

Valid settings for the audio level are from 0 to 4, where 0 means "mute".

Depending of the type of modem module used, you may have a single Audio setting, or independent settings for transmission (Tx) and respectively reception (Rx).



Audio Rx Level: 3
Audio Tx Level: 2
Network Mode: Automatic

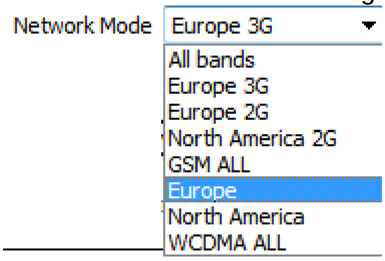
Audio Rx Level: 2
Audio Tx Level: 4

Audio Rx Level: 1
Audio Tx Level: 3
Network Mode: 3G only

Figure 5-217: Audio Settings for TX and RX**.**

Mobile Network selection
These two parameters allow you to establish the type of mobile network used and the order of searching for mobile networks.

Network Mode lets you choose mobile networks using 2G network or 3G technologies and different frequency bands. The default setting is “All bands” (no restictions) , but you can select to connect only to networks with certain technologies or frequencies.



You may choose Europe 2G, 3G or all, North America all or 2G only, all networks but only with GSM technology, or the reverese - all countries but only using WCDMA !

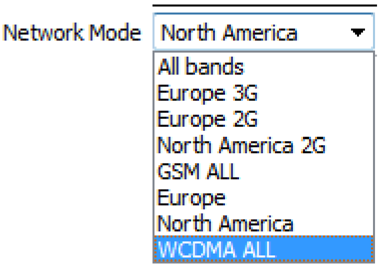


Figure 5-218: SIM Settings for Network Mode**.**

Mobile Network Order is for choosing the order in which Bytton will look for mobile networks.
The default is Automatic search, but you may select either 2G (GSM) only, orUMTS 3G only, or GSM and UMTS Only.

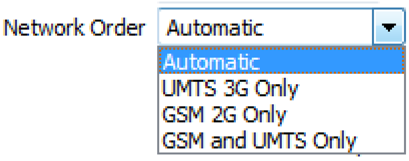
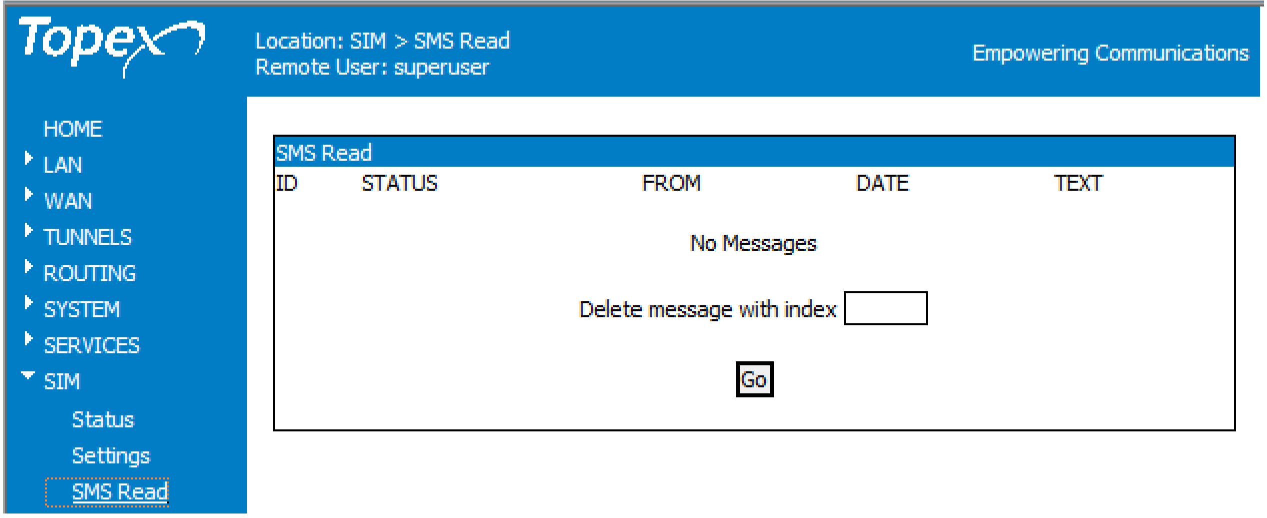


Figure 1-219: SIM Settings for the order of Mobile Network selection.

The "SMS" options that follow let you send or receive SMS messages from your computer to any GSM or 3G mobile terminal user, through the GSM/HSPA or LTE module of the Bytton LTE equipment.

5.7.3 SMS Read

Displays a list of received text messages.



Location: SIM > SMS Read
Remote User: superuser

Empowering Communications

SMS Read

ID	STATUS	FROM	DATE	TEXT

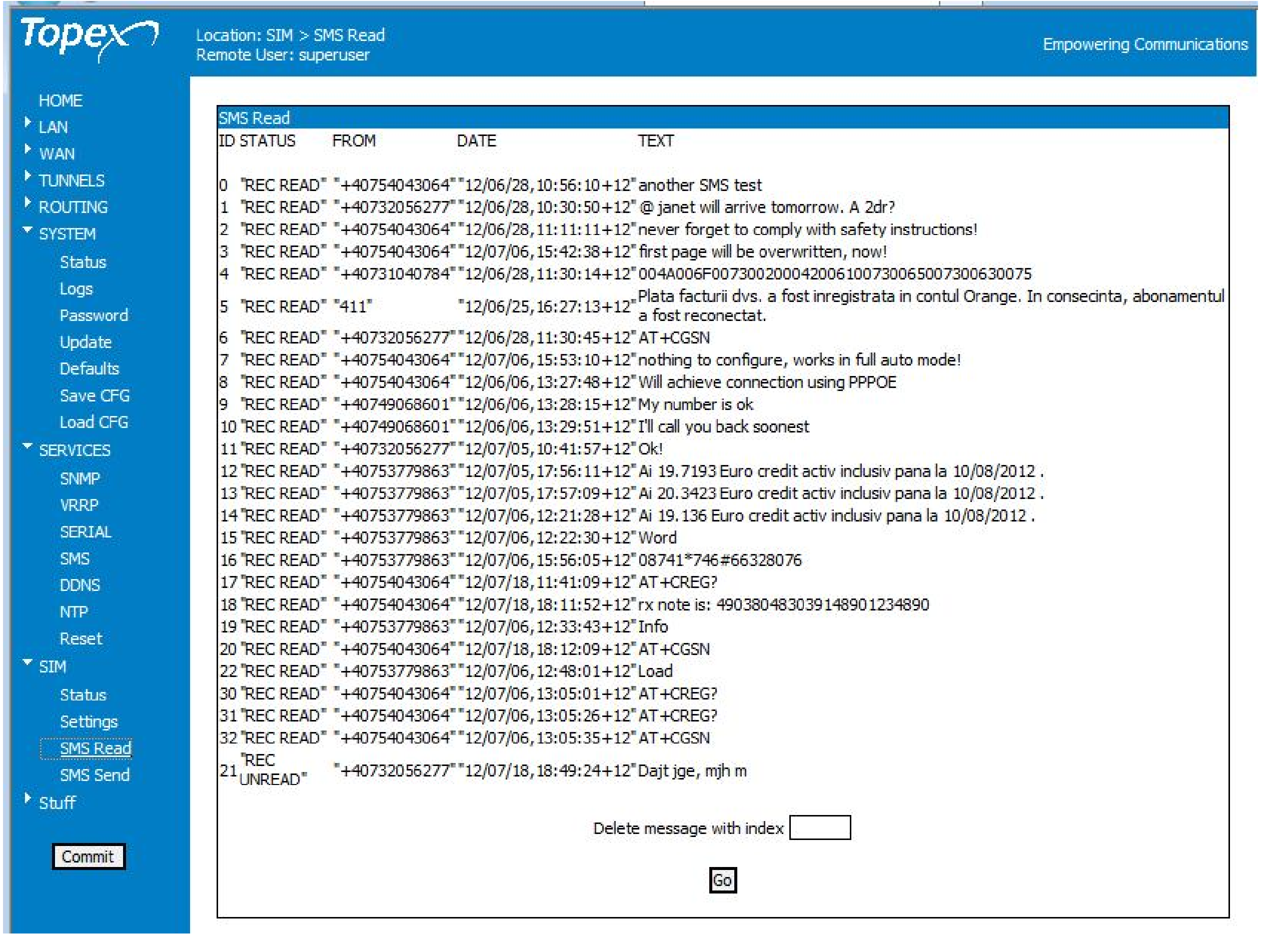
No Messages

Delete message with index □

Figure 5-220: SIM – “SMS Read” window, empty.

This list for displaying received SMS messages has the following columns:

h. ID : reference number: 1, 2, and so on up to 14;
i. STATUS: REC(Received), READ or UNREAD;
j. FROM: sender's phone number, such as “+40741664986”;
k. DATE: date and time when the message was received (after the “+” sign the tenths of seconds);
l. TEXT: the actual content of the message.



Location: SIM > SMS Read
Remote User: superuser

Empowering Communications

SMS Read

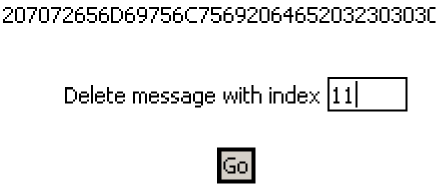
ID	STATUS	FROM	DATE	TEXT
0	"REC READ"	"+40754043064"	"12/06/28,10:56:10+12"	another SMS test
1	"REC READ"	"+40732056277"	"12/06/28,10:30:50+12"	@ janet will arrive tomorrow. A 2dr?
2	"REC READ"	"+40754043064"	"12/06/28,11:11:11+12"	never forget to comply with safety instructions!
3	"REC READ"	"+40754043064"	"12/07/06,15:42:38+12"	first page will be overwritten, now!
4	"REC READ"	"+40731040784"	"12/06/28,11:30:14+12"	004A006F007300200042006100730065007300630075
5	"REC READ"	"411"	"12/06/25,16:27:13+12"	Plata facturii dvs. a fost inregistrata in contul Orange. In consecinta, abonamentul a fost reconectat.
6	"REC READ"	"+40732056277"	"12/06/28,11:30:45+12"	AT+CGSN
7	"REC READ"	"+40754043064"	"12/07/06,15:53:10+12"	nothing to configure, works in full auto mode!
8	"REC READ"	"+40754043064"	"12/06/06,13:27:48+12"	Will achieve connection using PPPOE
9	"REC READ"	"+40749068601"	"12/06/06,13:28:15+12"	My number is ok
10	"REC READ"	"+40749068601"	"12/06/06,13:29:51+12"	I'll call you back soonest
11	"REC READ"	"+40732056277"	"12/07/05,10:41:57+12"	Ok!
12	"REC READ"	"+40753779863"	"12/07/05,17:56:11+12"	Ai 19.7193 Euro credit activ inclusiv pana la 10/08/2012 .
13	"REC READ"	"+40753779863"	"12/07/05,17:57:09+12"	Ai 20.3423 Euro credit activ inclusiv pana la 10/08/2012 .
14	"REC READ"	"+40753779863"	"12/07/06,12:21:28+12"	Ai 19.136 Euro credit activ inclusiv pana la 10/08/2012 .
15	"REC READ"	"+40753779863"	"12/07/06,12:22:30+12"	Word
16	"REC READ"	"+40753779863"	"12/07/06,15:56:05+12"	08741*746#66328076
17	"REC READ"	"+40754043064"	"12/07/18,11:41:09+12"	AT+CREG?
18	"REC READ"	"+40754043064"	"12/07/18,18:11:52+12"	rx note is: 490380483039148901234890
19	"REC READ"	"+40753779863"	"12/07/06,12:33:43+12"	Info
20	"REC READ"	"+40754043064"	"12/07/18,18:12:09+12"	AT+CGSN
22	"REC READ"	"+40753779863"	"12/07/06,12:48:01+12"	Load
30	"REC READ"	"+40754043064"	"12/07/06,13:05:01+12"	AT+CREG?
31	"REC READ"	"+40754043064"	"12/07/06,13:05:26+12"	AT+CREG?
32	"REC READ"	"+40754043064"	"12/07/06,13:05:35+12"	AT+CGSN
21	"REC UNREAD"	"+40732056277"	"12/07/18,18:49:24+12"	Dajt jge, mjh m

Delete message with index □

Figure 5-221 List of received text messages displayed in “SMS Read”.

Deleting SMSs

You may delete one or several messages by typing the index number in the box at the bottom and clicking “Go”



207072656D69756C7569206465203230303C

Delete message with index 11

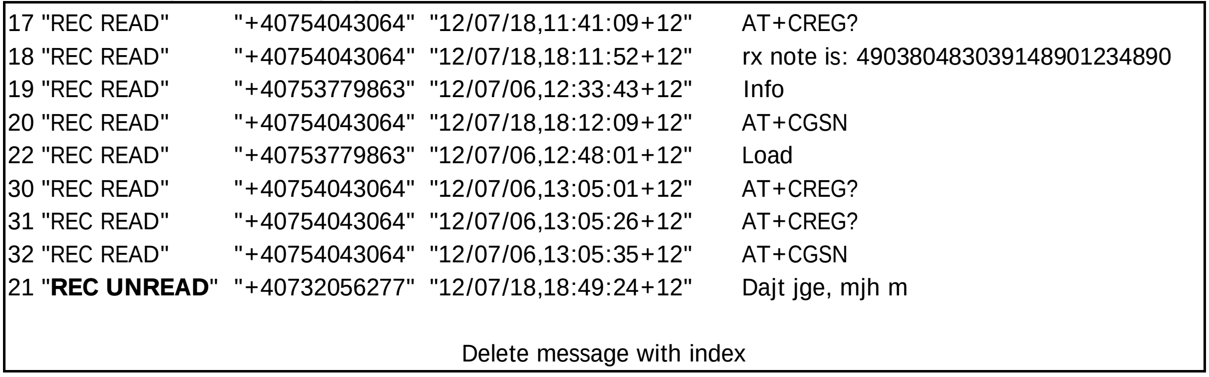
Figure 5-222: Deleting one of the messages in the list “SMS Read”.

Why delete?

Because after the maximum storage capacity (for instance, of 15 messages) is reached the BYTTON equipment won’t be able to receive newer SMS.

If you want to continue receiving messages, you must delete some of the older SMS.
After deletion, click “SMS Read” to collect your new messages from the server.

The new message will be displayed, at first at the bottom of the list, with the status “UNREAD”:



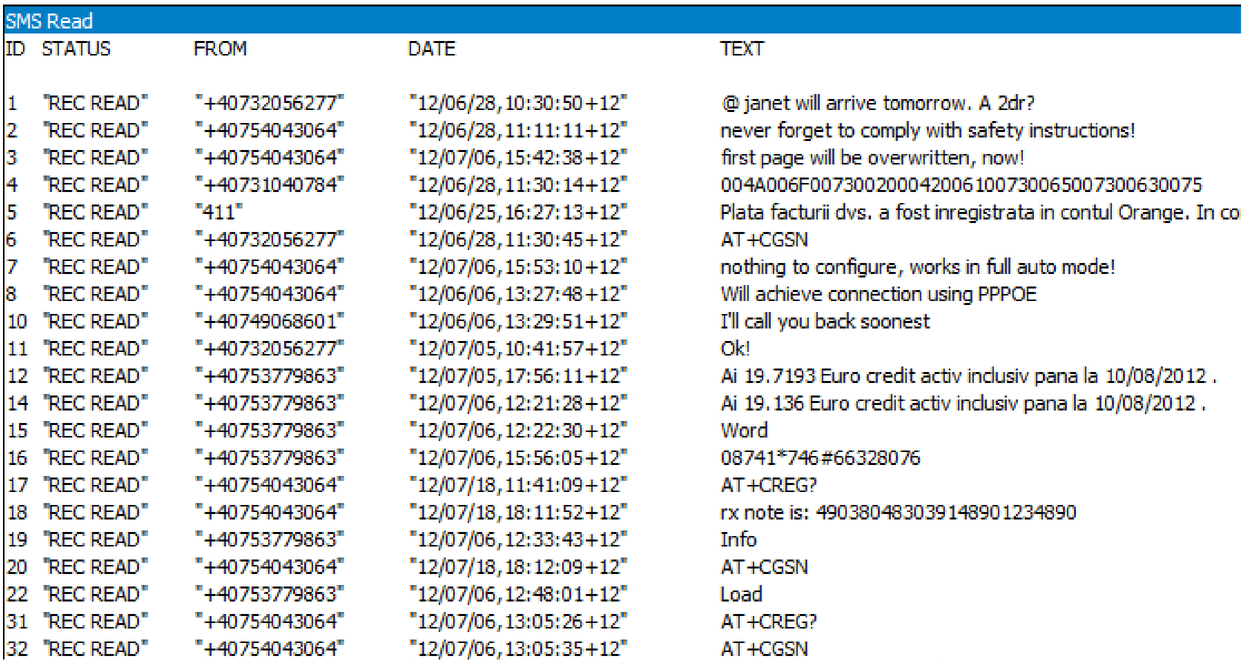
17 "REC READ"	"+40754043064"	"12/07/18,11:41:09+12"	AT+CREG?
18 "REC READ"	"+40754043064"	"12/07/18,18:11:52+12"	rx note is: 490380483039148901234890
19 "REC READ"	"+40753779863"	"12/07/06,12:33:43+12"	Info
20 "REC READ"	"+40754043064"	"12/07/18,18:12:09+12"	AT+CGSN
22 "REC READ"	"+40753779863"	"12/07/06,12:48:01+12"	Load
30 "REC READ"	"+40754043064"	"12/07/06,13:05:01+12"	AT+CREG?
31 "REC READ"	"+40754043064"	"12/07/06,13:05:26+12"	AT+CREG?
32 "REC READ"	"+40754043064"	"12/07/06,13:05:35+12"	AT+CGSN
21 "**REC UNREAD**"	"+40732056277"	"12/07/18,18:49:24+12"	Dajt jge, mjh m

Delete message with index

Figure 5-223: Displaying a new message at the bottom of the list “SMS Read”

and following the next “Read” command it will be sorted upon the “ID” field and placed in its proper (chronological) position.

Also, its status is now “RECeived and READ”



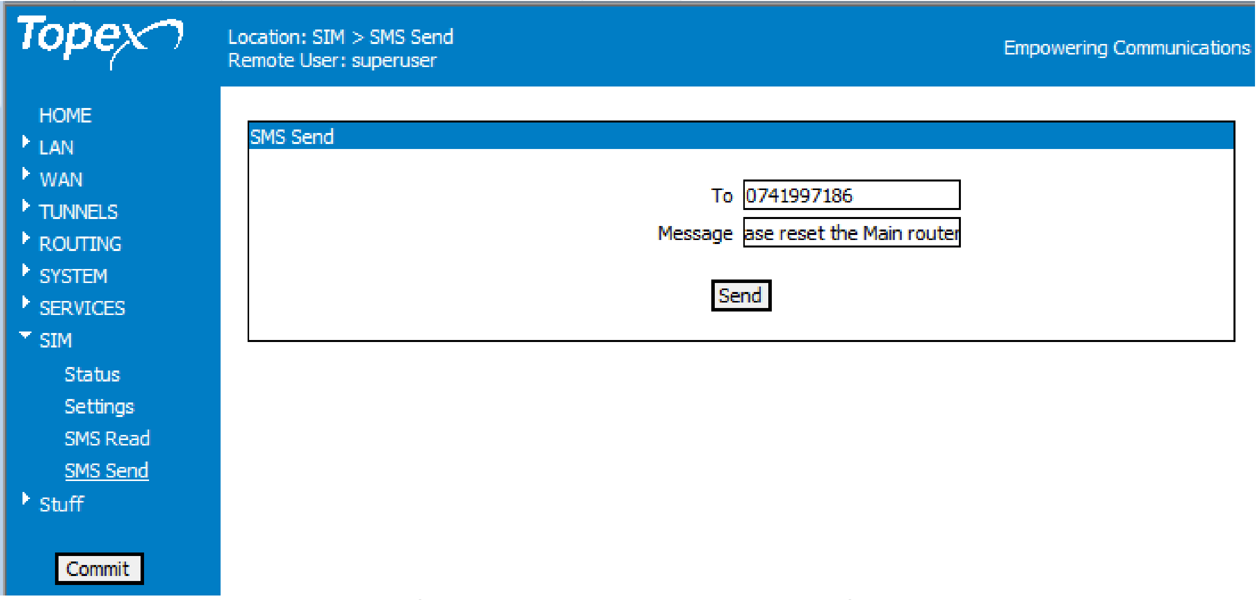
SMS Read

ID	STATUS	FROM	DATE	TEXT
1	"REC READ"	"+40732056277"	"12/06/28,10:30:50+12"	@ janet will arrive tomorrow. A 2dr?
2	"REC READ"	"+40754043064"	"12/06/28,11:11:11+12"	never forget to comply with safety instructions!
3	"REC READ"	"+40754043064"	"12/07/06,15:42:38+12"	first page will be overwritten, now!
4	"REC READ"	"+40731040784"	"12/06/28,11:30:14+12"	004A006F0073002000420061007300650073006300075
5	"REC READ"	"411"	"12/06/25,16:27:13+12"	Plata facturii dvs. a fost inregistrata in contul Orange. In co
6	"REC READ"	"+40732056277"	"12/06/28,11:30:45+12"	AT+CGSN
7	"REC READ"	"+40754043064"	"12/07/06,15:53:10+12"	nothing to configure, works in full auto mode!
8	"REC READ"	"+40754043064"	"12/06/06,13:27:48+12"	Will achieve connection using PPPOE
10	"REC READ"	"+40749068601"	"12/06/06,13:29:51+12"	I'll call you back soonest
11	"REC READ"	"+40732056277"	"12/07/05,10:41:57+12"	Ok!
12	"REC READ"	"+40753779863"	"12/07/05,17:56:11+12"	Ai 19.7193 Euro credit activ inclusiv pana la 10/08/2012 .
14	"REC READ"	"+40753779863"	"12/07/06,12:21:28+12"	Ai 19.136 Euro credit activ inclusiv pana la 10/08/2012 .
15	"REC READ"	"+40753779863"	"12/07/06,12:22:30+12"	Word
16	"REC READ"	"+40753779863"	"12/07/06,15:56:05+12"	08741*746#66328076
17	"REC READ"	"+40754043064"	"12/07/18,11:41:09+12"	AT+CREG?
18	"REC READ"	"+40754043064"	"12/07/18,18:11:52+12"	rx note is: 490380483039148901234890
19	"REC READ"	"+40753779863"	"12/07/06,12:33:43+12"	Info
20	"REC READ"	"+40754043064"	"12/07/18,18:12:09+12"	AT+CGSN
22	"REC READ"	"+40753779863"	"12/07/06,12:48:01+12"	Load
31	"REC READ"	"+40754043064"	"12/07/06,13:05:26+12"	AT+CREG?
32	"REC READ"	"+40754043064"	"12/07/06,13:05:35+12"	AT+CGSN

Figure 5-224: Updated list of sorted messages following a new “Read” command.

5.7.4 SMS Send

This option allows you to send out a SMS message through the mobile network.



To 0741997186

Message ase reset the Main router

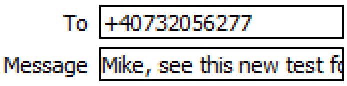
Figure 5-225: SIM pages - SMS Send.

Just type in the destination phone number in the field “To” and the text you want to transmit in the “Message” field , then click the Send button.

Wait about 40 seconds for the mobile network to perform the sending operation.
If the SMS cannot be send (network busy, congestion or other problems), an error messages will appear on top of the screen.

Note: if the phone number for the SMS destination is in the same mobile network, you may enter it in short form, as “0740999999” or “0754043064”.

But if it is in a different mobile network, you must type it in full format: country code, area code, number, for example “+40732056277”.

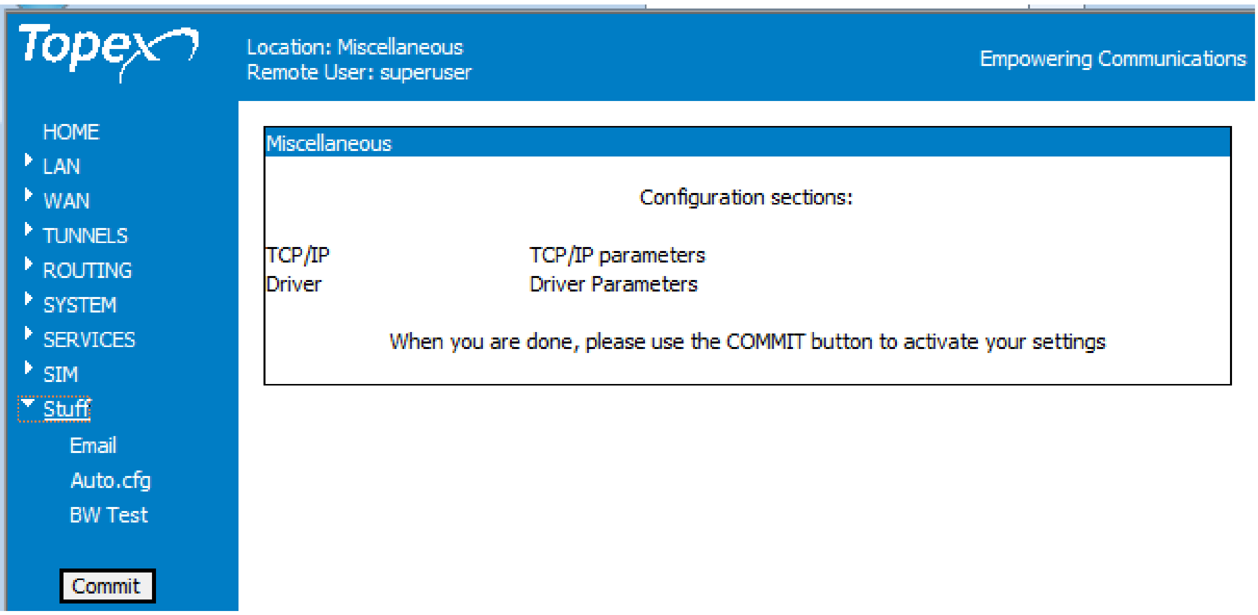


To +40732056277

Message Mike, see this new test fo

5.8 Stuff

The “Stuff” element of menu holds miscellaneous features that are reserved for advanced users. Depending upon the actual firmware revision, this configuration Web page may be available or not on your equipment, an can include more or less elements:



Miscellaneous

Configuration sections:

TCP/IP	TCP/IP parameters
Driver	Driver Parameters

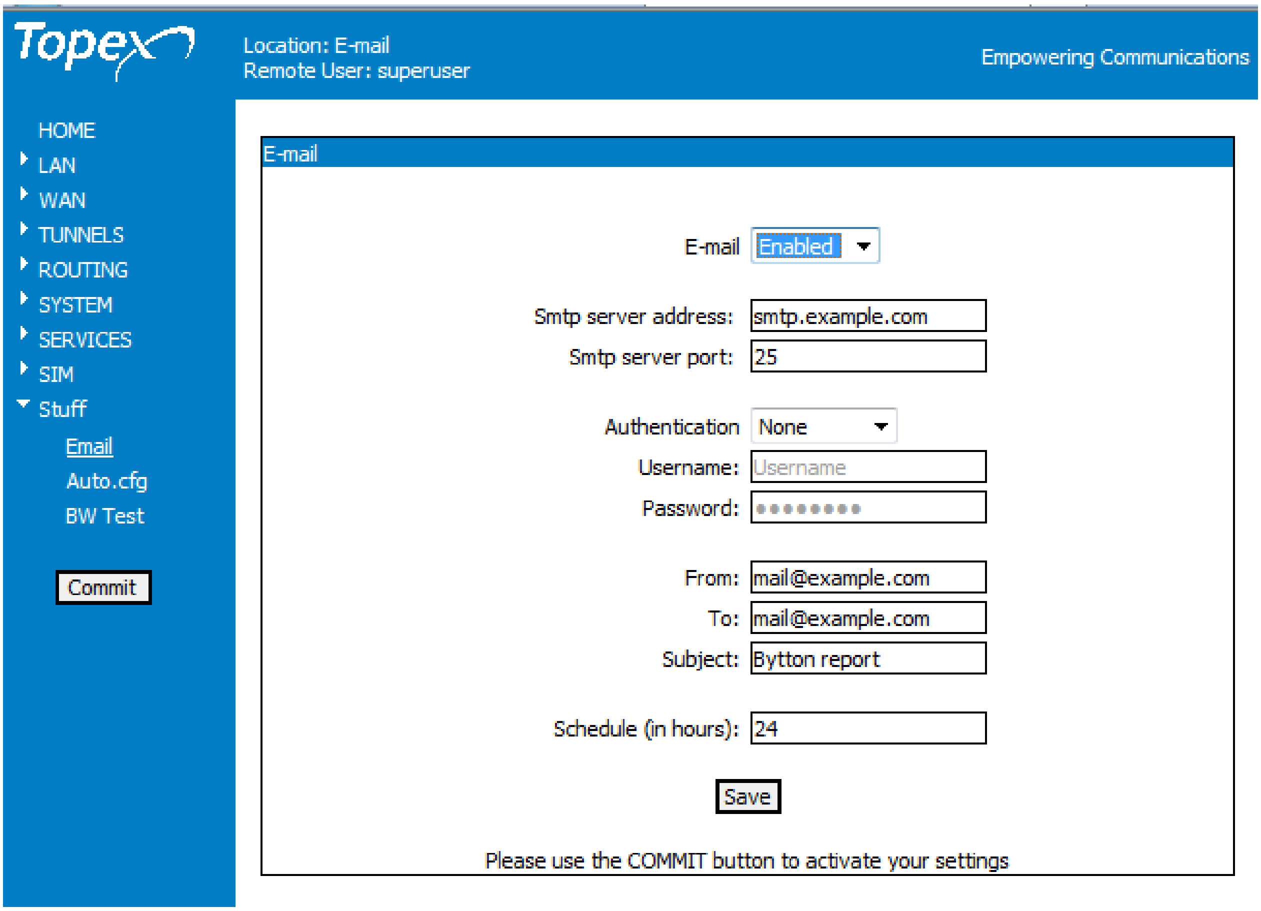
When you are done, please use the COMMIT button to activate your settings

Figure 5-226: Section “Stuff” of the configuration Web pages for Superuser.

These “miscellaneous” stuff pages may include email reporting, remote self-configuration and bandwidth testing.

5.8.1 E-mail

Here are the settings allowing Bytton ICR to send out report information via E-mail.



E-mail: Enabled

Smtp server address: smtp.example.com

Smtp server port: 25

Authentication: None

Username: Username

Password: ••••••••

From: mail@example.com

To: mail@example.com

Subject: Bytton report

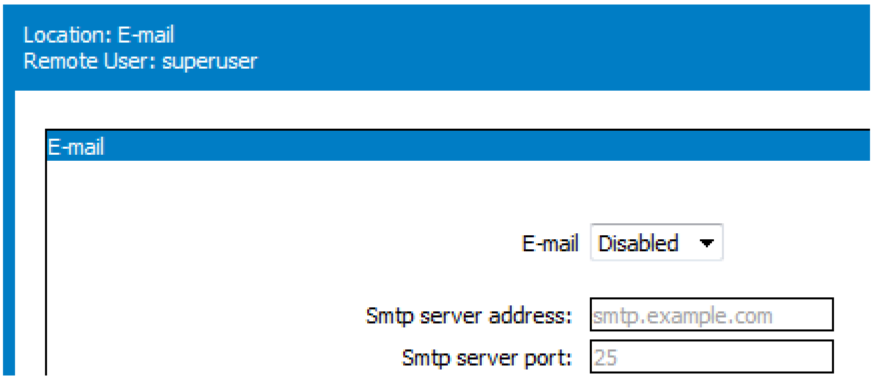
Schedule (in hours): 24

Please use the COMMIT button to activate your settings

Figure 5-227: Status reporting via E-mail

By default, this feature is **Disabled**.

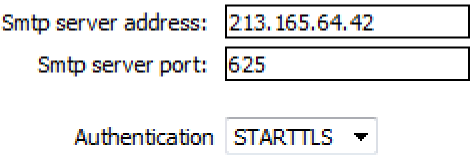
When disabled, all the fields that follow are colored in gray, indicating that they are not active (you cannot edit them)



E-mail: Disabled

Smtp server address: smtp.example.com

Smtp server port: 25



Smtp server address: 213.165.64.42

Smtp server port: 625

Authentication: STARTTLS

After setting the E-mail feature to Enabled, the fields become editable, you must configure the parameters.

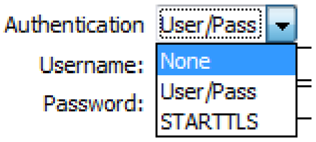
Figure 5-228: Enabling and configuring the SMTP service for reporting e-mail.

SMTP server address: the name or address of the SMTP port used for mail. Enter here the mail server that will be used to handle outgoing messages.

Simple Mail Transfer Protocol is, as its name indicates, a … simple Internet standard for electronic mail, defined first in 1982 and last updated by RFC 5321.

“**name or address**” means that you can type either the human-form name of the server, such as “Mail4.topex.eu” or “smtp.gmail.com” , or the machine-form, that is the IP address of the respective servers, such as 77.238.184.86 or 213.165.64.42

Smtp server port: By default, SMTP uses TCP port 25, or port 587 for submission, but other ports (465) may also be used.



Authentication: User/Pass

- None
- User/Pass
- STARTTLS

Username:

Password:

You can enable or disable the “ICMP redirect” feature for receiving and / or respectively sending out data packets over the local network.

Figure 5-229: Enable or disable and configure the Authentication feature.

You can leave it to None, meaning no authentication at all is required, or choose either User/Pass, when ordinary authentication is requested, by means of an Username and corresponding Password. The most secure option is STARTTLS, advanced ESMTP authentication feature (ESMTP over secure TLS/SSL connection).This is standardized in RFC3207, “SMTP Service Extension for Secure SMTP over Transport Layer Security”. It is used to increase the security of mail server transactions.

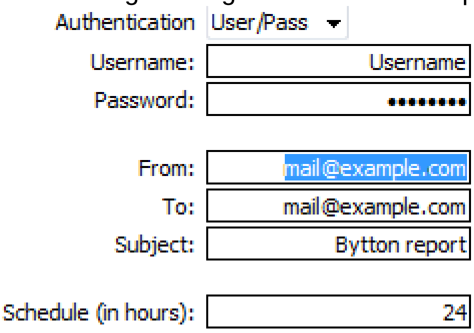
A few examples of names (IP addresses) of mail servers, and ports used by these:
 - Mail.adelphia.net or 75.180.132.91
- pop3.live.com or pop.juno.com
- the well-known Gmail service uses for POP the port number 995, and the connection must be secure (TLS/SSL required).

Yahoo uses Incoming Mail (POP3) Server: pop.mail.yahoo.com (needs SSL, port: 995) and Outgoing Mail (SMTP) Server: smtp.mail.yahoo.com (also use SSL, port: 465, need authentication)

Standard ports for mail are: POP3 - port 110, SMTP - port 25, Secure SMTP (SSMTP) - port 465, Secure POP3 (SSL-POP) - port 995.

Many ISPs do block the standard port for outgoing email, port 25, so you may have to change the smtp ports to 587 or 26!

The meaning or usage of other fields is quite obvious:



Authentication: User/Pass

Username: Username

Password: ••••••••

From: mail@example.com

To: mail@example.com

Subject: Bytton report

Schedule (in hours): 24

Figure 5-230: Configure the other parameters for E-mail reporting of Bytton.

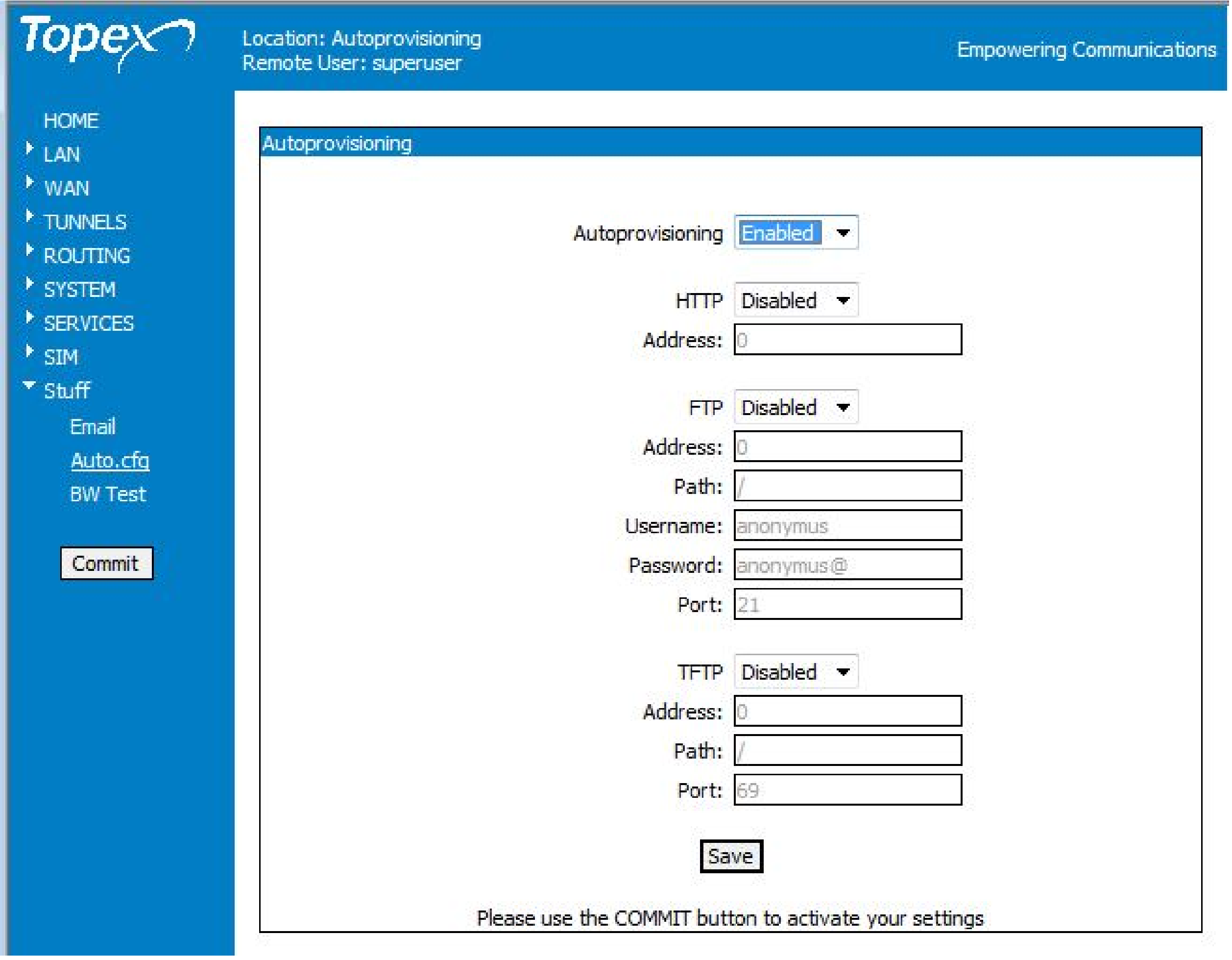
“**To**” is the real destination e-mail address, while “**From**” is a dummy field, you must complete it so the recipient does know that the message comes from Bytton LTE, but it is not a real e-mail address, it cannot be used for receiving messages!

The **Subject** field, set by default to “Bytton report”, can also be changed to the words or phrase that you want to use.

Finally, “**Schedule** (in hours)”, as its name suggests, is the time interval following which the status report will be sent out. With the default settings, the Bytton report shall be sent by e-mail every 24 hours.

5.8.2 Auto-configuration

The “Auto provisioning” section may contain settings to several means by which Bytton imports by itself the configuration file required to operate.



Location: Autoprovisioning
Remote User: superuser

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Autoprovisioning: Enabled

HTTP: Disabled
Address: 0

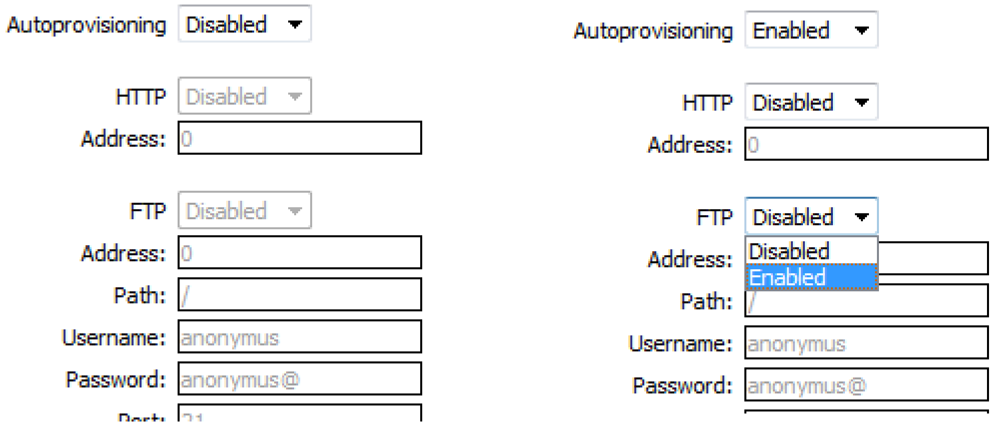
FTP: Disabled
Address: 0
Path: /
Username: anonymus
Password: anonymus@
Port: 21

TFTP: Disabled
Address: 0
Path: /
Port: 69

Please use the COMMIT button to activate your settings

Figure 5-231: Autoprovisioning – settings for automatic retrieval of configuration file.

First of all, to use it, you must Enable the Autoprovisioning feature – by default it is disabled so all fields below it are colored in gray, showing they are not editable. When you Enable the Auto-provisioning feature, the following fields “light up”:



Autoprovisioning: Disabled

HTTP: Disabled
Address: 0

FTP: Disabled
Address: 0
Path: /
Username: anonymus
Password: anonymus@
Port: 21

Autoprovisioning: Enabled

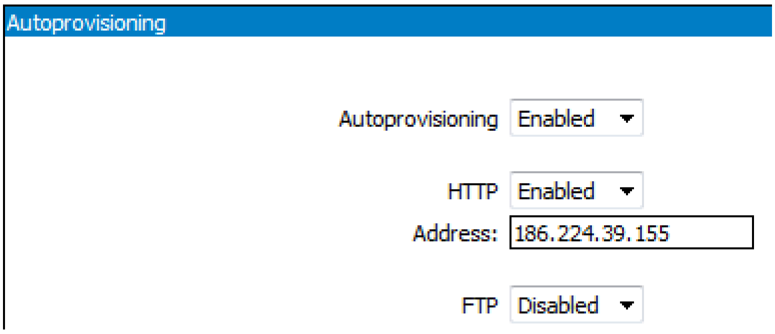
HTTP: Disabled
Address: 0

FTP: Disabled

Address:
Path: /
Username: anonymus
Password: anonymus@

Figure 5-232: Aspect of the fields of “Autoprovisioning” when the feature is Disabled and respectively Enabled.

Then you have to choose (by enabling it) one of the means of retrieving the configuration file, which is stored remotely:



Autoprovisioning

Autoprovisioning: Enabled

HTTP: Enabled

Address: 186.224.39.155

FTP: Disabled

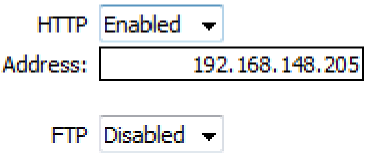
Figure 5-233: Aspect of the fields of “Autoprovisioning” when the feature is Disabled and respectively Enabled.

The **name** of the respective configuration file must be the IMEI of the Bytton equipment, acting as a unique identifier: 355060025698866, 355060025642740, 352099001761481, 355060025698866 , 4901542032375, etc..

You can choose as means of retrieval HTTP, FTP or TFTP.

HTTP:

When you choose the http method, the standard port is used, no authentication is required. You must only complete the address where the configuration file is to be found, as shown:



HTTP: Enabled

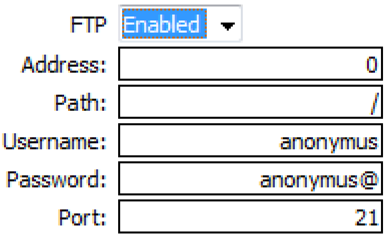
Address: 192.168.148.205

FTP: Disabled

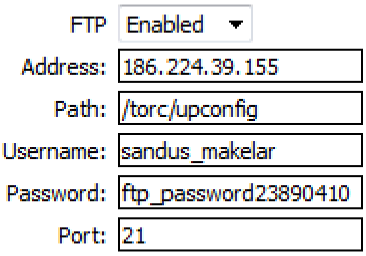
Figure 5-234: Aspect of the fields of “Autoprovisioning” when the feature is Disabled and respectively Enabled.

FTP:

The standard File Transfer Protocol, very much used, with a large array of features and options. FTP also observes the client/server model, in this case a client runs on Bytton and connects to a remote FTP server. FTP itself uses the TCP transport protocol exclusively, it never uses UDP for its transport needs. . Also, FTP uses *two* ports to accomplish its task, by default port 21 is used for control (to listen to commands) while port 20 is employed for the actual data transfers.

 FTP: Enabled Address: 0 Path: / Username: anonymus Password: anonymus@ Port: 21	An interactive FTP session uses two operating modes , respectively active and passive mode. These two modes are initiated by the FTP client, and then acted upon by the FTP server. But in this case you do not have to bother with modes! Figure 5-235: Retrieving the Auto-configuration file by using FTP.

After enabling the configuration download via FTP, you must fill-in the address of the FTP server, the path towards the location where the configuration file is stored, the user name and password for authentication (by default, it tries anonymous log-in) and the port used for commands.



FTP: Enabled

Address: 186.224.39.155

Path: /torc/upconfig

Username: sandus_makelar

Password: ftp_password23890410

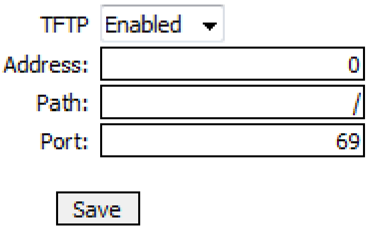
Port: 21

Figure 5-237: Fill-in the required fields for FTP transfer of the “Autoprovisioning” information..

TFTP:

As its name says, **Trivial File Transfer Protocol** is a very simple protocol for transferring files, derived from the full FTP. Generally used exactly for this kind of tasks, **automated transfer of configuration** or boot files between machines in a local environment. This is because it has no security, it does not even, provide authentication. Its advantages are simplicity of design and very low usage of memory, it has been implemented on top of the UDP using port number 69, it does not require TCP!

This makes it is ideal for simple machines such as routers with limited data storage!



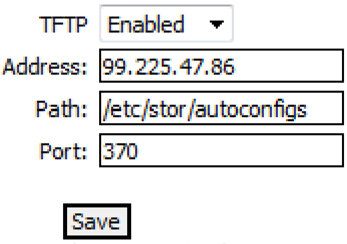
TFTP Enabled
Address: 0
Path: /
Port: 69

TFTP is currently defined by RFC 1350. It is seldom used interactively, like the FTP, by human users, instead it is excellent for machines simpler than a computer, networked devices that do not have the capabilities of “true” computers, but still need to be able to do file transfers.

Due to the lack of security, it is dangerous to use it over the Internet. Thus, TFTP is generally only used on private, local networks.

After enabling the TFTP section, you simply enter the address where the configuration file is stored, then the full path, and finally the port number to be used.

By default, the standard port for TFTP is used, number 69:

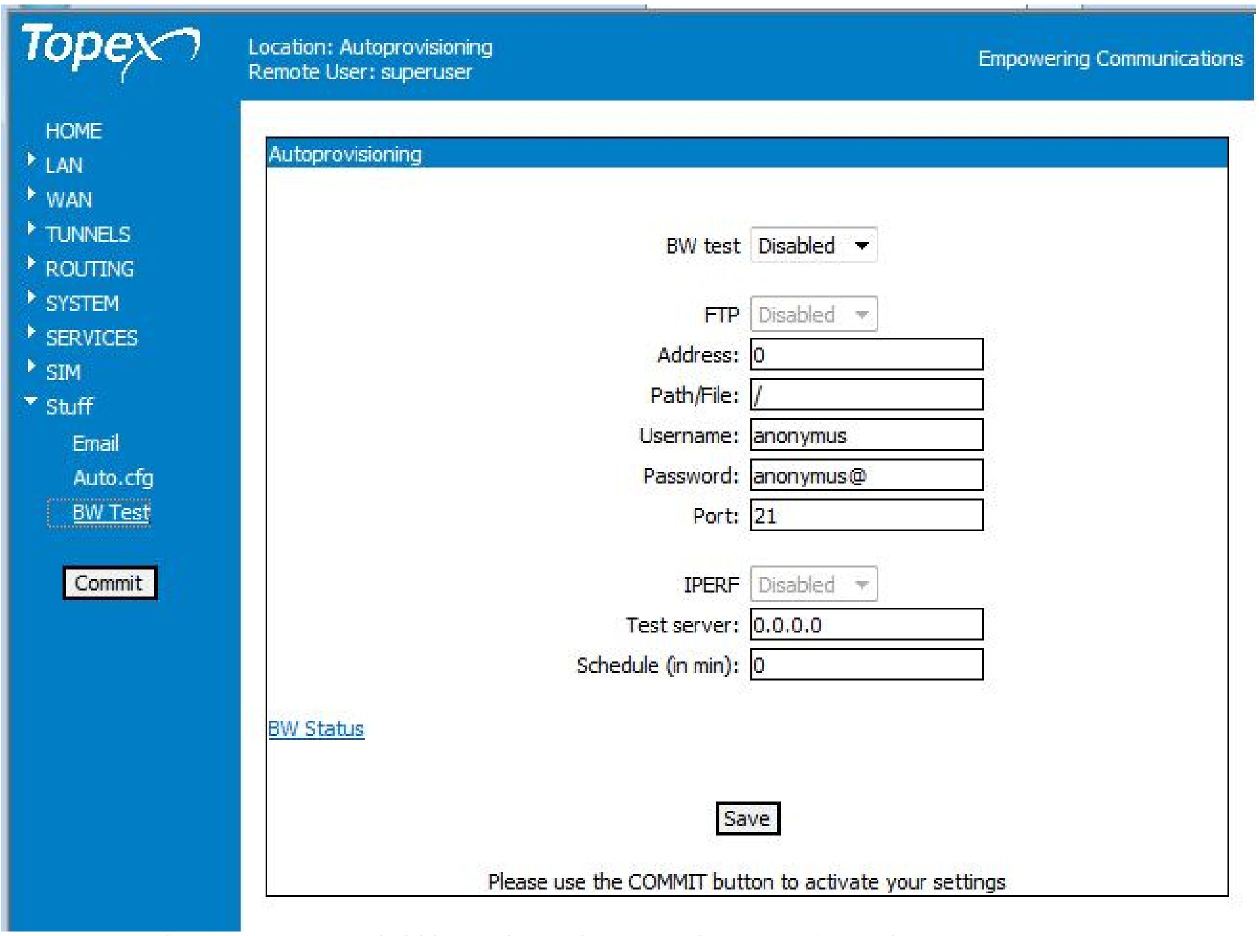


TFTP Enabled
Address: 99.225.47.86
Path: /etc/stor/autoconfigs
Port: 370

Figure 5-238: Configuring the TFTP client of Bytton to get the Auto.cfg file .

5.8.3 BW test

Performs Bandwidth tests over the Bytton equipment:



BW test: Disabled
FTP: Disabled
Address: 0
Path/File: /
Username: anonymus
Password: anonymus@
Port: 21
IPERF: Disabled
Test server: 0.0.0.0
Schedule (in min): 0

Please use the COMMIT button to activate your settings

Figure 5-239: Bandwidth Testing – data speed tests performed over Bytton LTE..

First, Enable this feature (by default it is disabled).

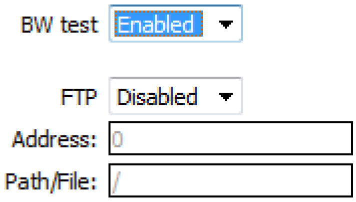

BW test: Enabled
FTP: Disabled
Address: 0
Path/File: /

Figure 5-240: Enable Bandwidth Testing.

Then, choose the method to be used: either FTP or IPERF.

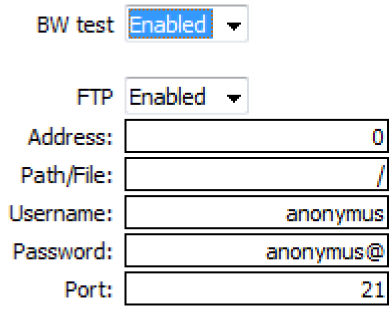
In both cases, the basic principle is simple, a large file of known length is uploaded to a destination, then downloaded, and the time necessary for the operation is measured, thus computing the bandwidth (Megabits per second).

FTP

In the BW test web page, first enable “BW test” then Enable the FTP option, as shown:

Configure the FTP settings:

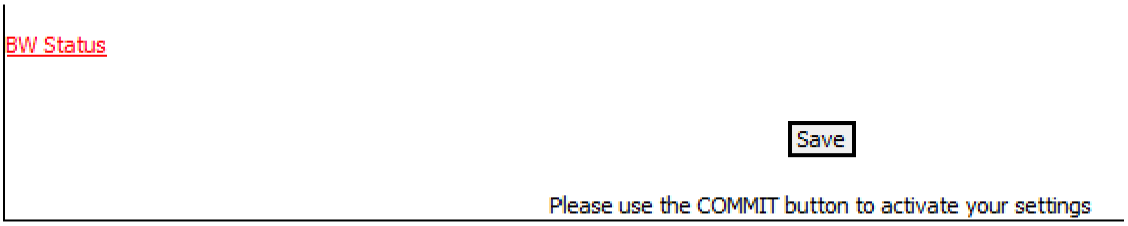
Complete the address of the FTP server to be used the path towards the file to be used for testing, and the port.
Authentication parameters (user name and password) may also be filled-in



BW test: Enabled
FTP: Enabled
Address: 0
Path/File: /
Username: anonymus
Password: anonymus@
Port: 21

Figure 5-241: Bandwidth Testing using FTP.

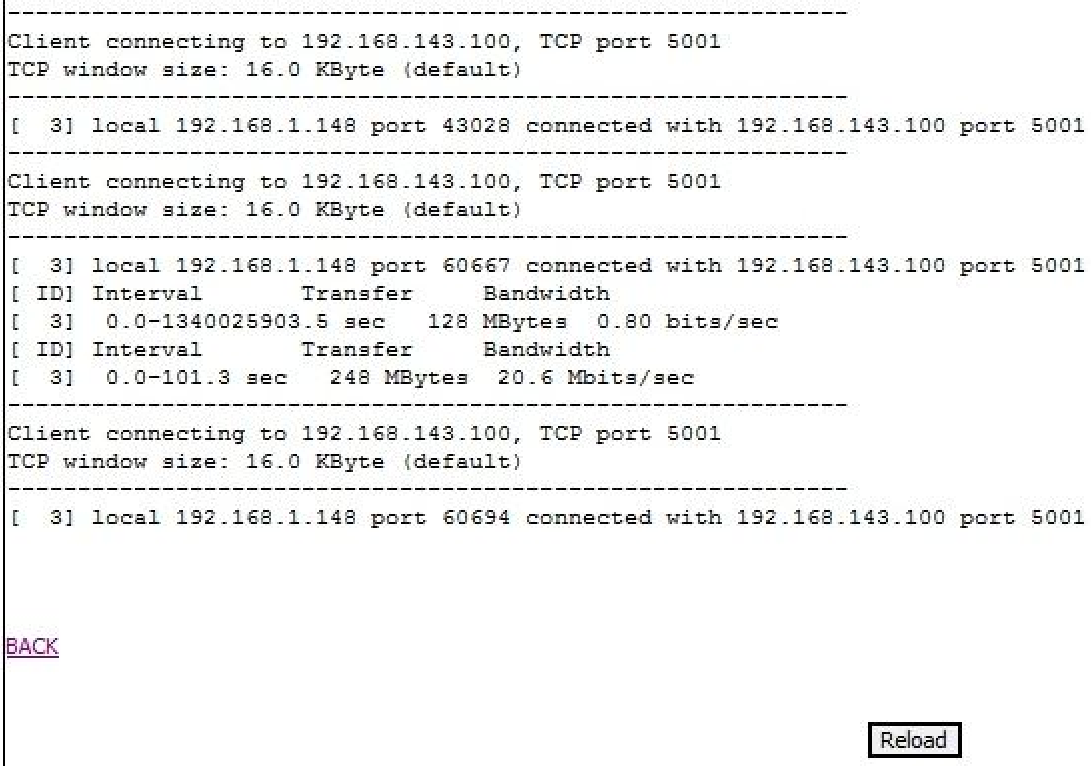
Now click the link BW Status located to the left, at the bottom of the page, to start the bandwidth measurement:



Please use the COMMIT button to activate your settings

Figure 5-242: Start the Bandwidth Test using FTP.

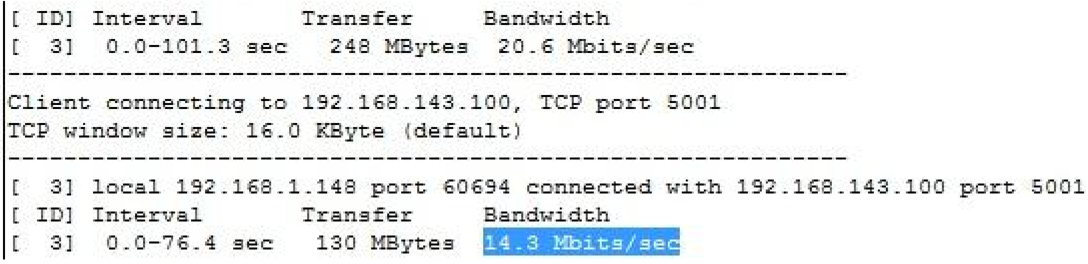
A new window pops up, showing the phases and results of the test:
“*Client connecting to server, TCP port used, time interval required for transfer, computed bandwidth:*



```
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 43028 connected with 192.168.143.100 port 5001
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 60667 connected with 192.168.143.100 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-1340025903.5 sec   128 MBytes  0.80 bits/sec
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-101.3 sec   248 MBytes  20.6 Mbits/sec
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 60694 connected with 192.168.143.100 port 5001
```

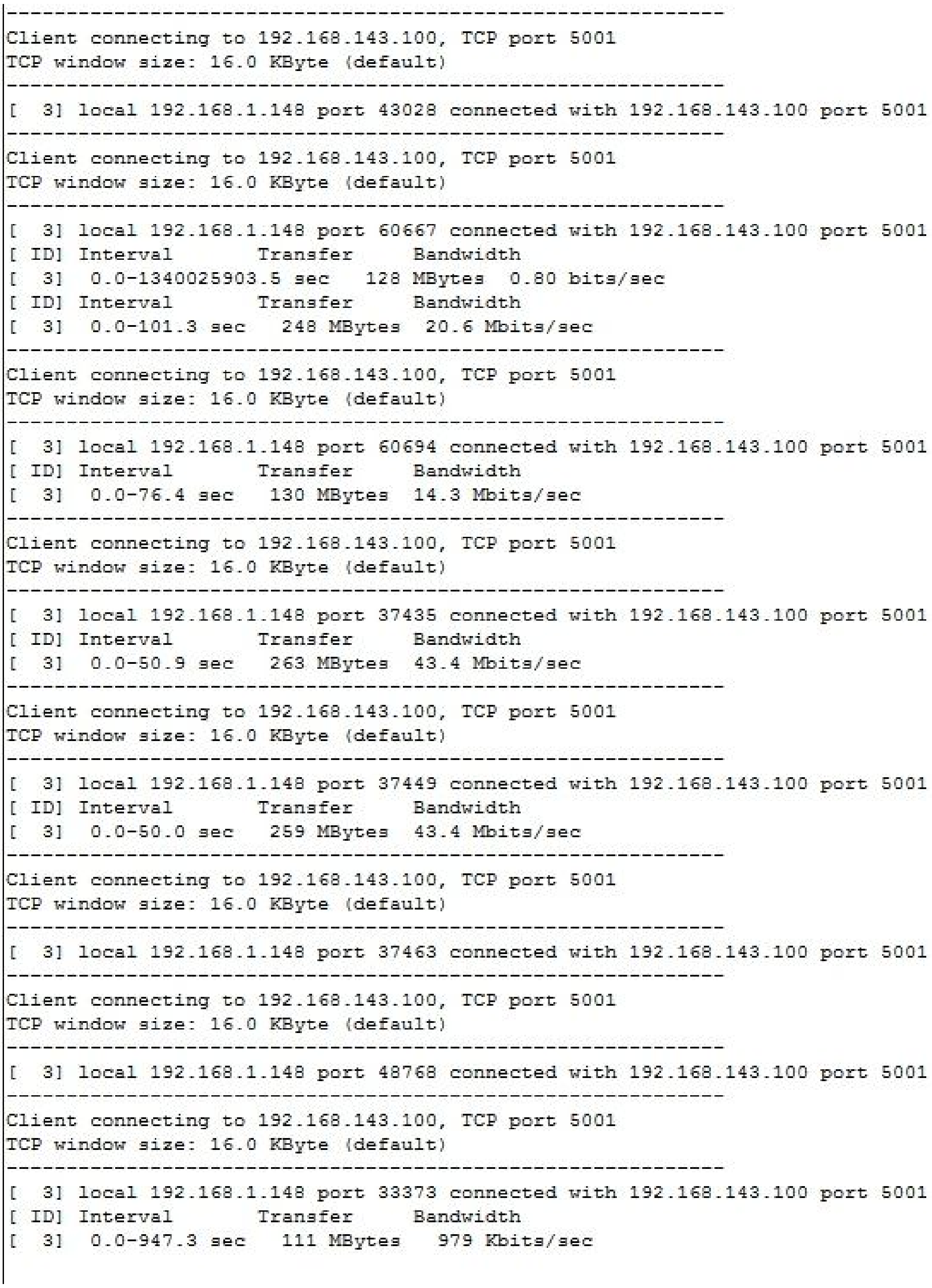
Figure 5-243: Actual result of BW Testing – transfer speed measurement using Bytton as router.

Another test, for large file sizes (130 and respectively 248 M bytes) show a measured speed that is now of 14,3 M bits per second:



```
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-101.3 sec   248 MBytes  20.6 Mbits/sec
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 60694 connected with 192.168.143.100 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-76.4 sec   130 MBytes  14.3 Mbits/sec
```

Here are several different results of BW tests:

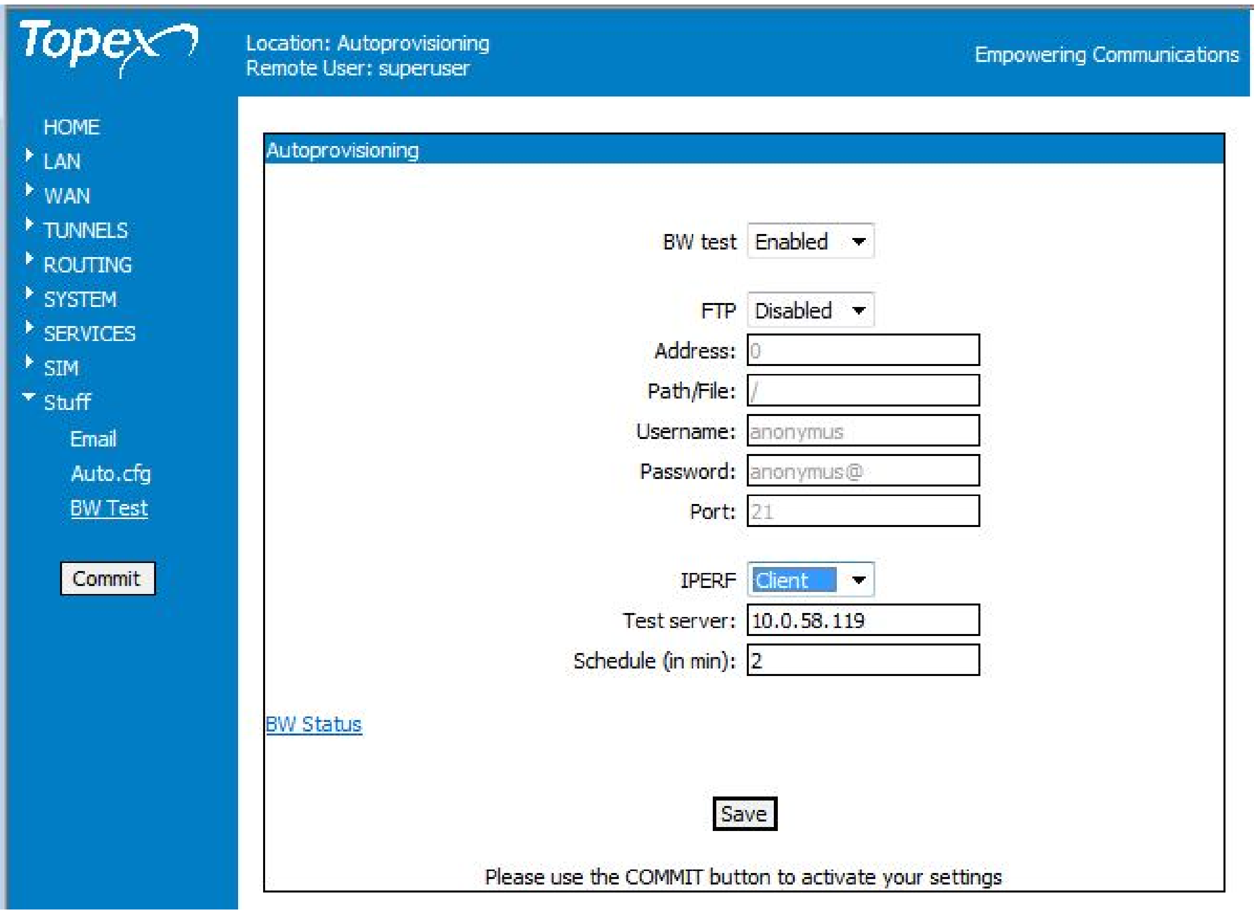


```
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 43028 connected with 192.168.143.100 port 5001
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 60667 connected with 192.168.143.100 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-1340025903.5 sec   128 MBytes  0.80 bits/sec
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-101.3 sec   248 MBytes  20.6 Mbits/sec
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 60694 connected with 192.168.143.100 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-76.4 sec   130 MBytes  14.3 Mbits/sec
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 37435 connected with 192.168.143.100 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-50.9 sec   263 MBytes  43.4 Mbits/sec
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 37449 connected with 192.168.143.100 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-50.0 sec   259 MBytes  43.4 Mbits/sec
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 37463 connected with 192.168.143.100 port 5001
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 48768 connected with 192.168.143.100 port 5001
------------------------------------------------------------
Client connecting to 192.168.143.100, TCP port 5001
TCP window size: 16.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.1.148 port 33373 connected with 192.168.143.100 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-947.3 sec   111 MBytes   979 Kbits/sec
```

Figure 5-244: Several BW Tests that were performed for Bytton using the FTP option.

IPERF

In the BW test web page, first enable BW test, then Disable the FTP option and go to IPERF to choose “Client”:



BW test: Enabled
FTP: Disabled
Address: 0
Path/File: /
Username: anonymus
Password: anonymus@
Port: 21
IPERF: Client
Test server: 10.0.58.119
Schedule (in min): 2

Please use the COMMIT button to activate your settings

Figure 5-245: Using IPERF for BW Tests of the Topex wireless router.

What it is?

Generally, “Iperf” is an industry standard tool to measure the bandwidth and the quality of a network link. The network link under test is delimited by two hosts running Iperf. This tool is accurate and provides clear metrics to understand and use the performance metrics it produces. As you notice, the Iperf feature on Bytton LTE may operate either as a Client or as a Server. For extensive BW tests over a link, one host must be set as client, the other one as server.

The quality of a link can be tested as follows:

- Latency (response time or RTT): can be measured with the PING command available in “Test Net“ link that shows up in the “Interface Status” pages.
- Jitter (latency variation): can be measured with an Iperf UDP test.
- Datagram loss: can be measured with an Iperf UDP test.

The “iperf” running on Bytton LTE is a simplified application, it just measures the bandwidth.

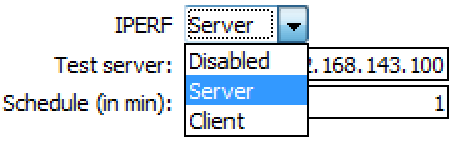
The bandwidth is measured through TCP tests.

The main difference between TCP (Transmission Control Protocol) and UDP (User Datagram Protocol) is precisely that TCP use processes to check that the packets were correctly received at the destination, while with UDP the packets are sent without any checks but with the advantage of being quicker than TCP. The “Iperf” utility uses the different capacities of TCP and UDP to provide statistics about network links.

Iperf has a both a client and server functionality, and can measure the throughput between the two ends, either unidirectionally or bi-directionally.

A typical Iperf output contains a time stamped report of the amount of data transferred and the throughput measured.

To configure IPERF on Bytton, in the field IPERF, choose Client instead of the default Disabled.
Complete the correct IP address in the filed “Test Server”.
Specify the scheduling time interval, in minutes, in the field “Schedule” – the default value is one minute.



IPERF Server

Test server: .168.143.100

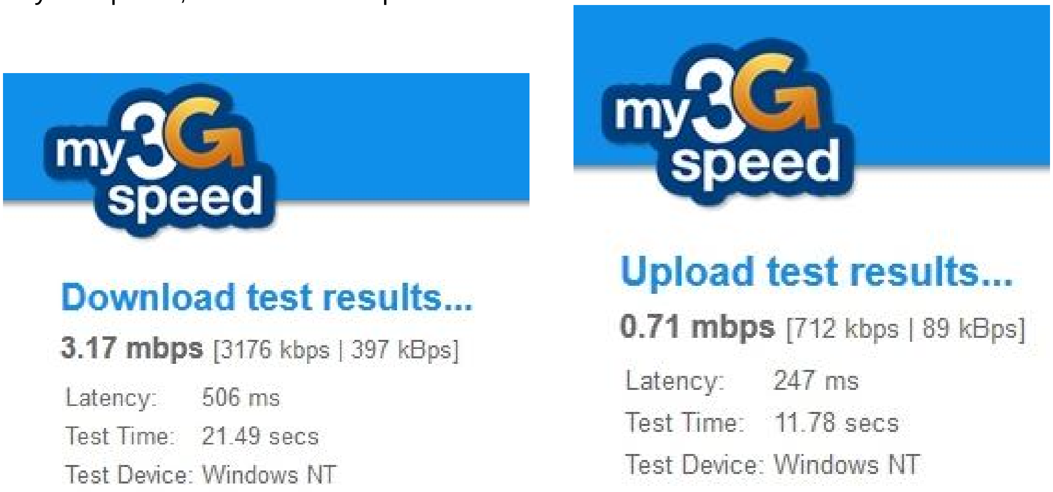
Schedule (in min): 1

Figure 5-246: Configuring IPERF for BW testing over Bytton.

5.8.4 Actual Speed Test Results

The values determined by means of the “BW Test” web page are more accurate, but you may also use different freely available “Internet Speed Test” sites.
The results from some of these sites are shown here:

“My 3G speed”, download and upload:



Download test results...

3.17 mbps [3176 kbps | 397 kBps]

Latency: 506 ms

Test Time: 21.49 secs

Test Device: Windows NT

Upload test results...

0.71 mbps [712 kbps | 89 kBps]

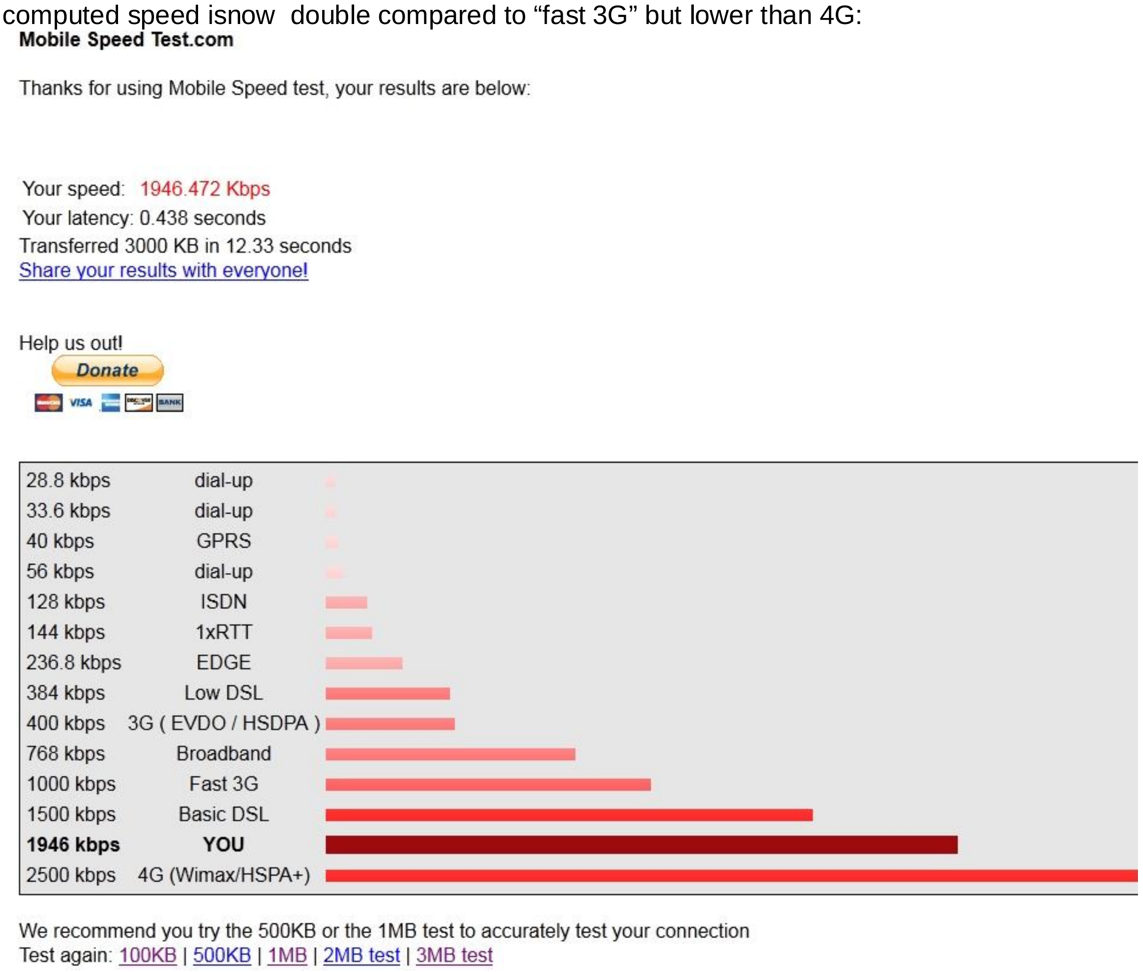
Latency: 247 ms

Test Time: 11.78 secs

Test Device: Windows NT

Figure 5-247: Download and Upload speed tests on “My 3G speed” site.

Internet speed test using a different file size, 3MB.
The computed speed isnow double compared to “fast 3G” but lower than 4G:



Mobile Speed Test.com

Thanks for using Mobile Speed test, your results are below:

Your speed: 1946.472 Kbps
Your latency: 0.438 seconds
Transferred 3000 KB in 12.33 seconds
Share your results with everyone!

Help us out!

28.8 kbps	dial-up
33.6 kbps	dial-up
40 kbps	GPRS
56 kbps	dial-up
128 kbps	ISDN
144 kbps	1xRTT
236.8 kbps	EDGE
384 kbps	Low DSL
400 kbps	3G (EVDO / HSDPA)
768 kbps	Broadband
1000 kbps	Fast 3G
1500 kbps	Basic DSL
1946 kbps	**YOU**
2500 kbps	4G (Wimax/HSPA+)

We recommend you try the 500KB or the 1MB test to accurately test your connection
Test again: 100KB | 500KB | 1MB | 2MB test | 3MB test

Figure 5-248: Speed test for large files, using Mobile Speed test.com site.

Another set of comparative Internet speed tests, for this Bytton LTE equipment:

Firmware version: topex-3.0.3-a-FA-S
Ethernet link up
PPP link online, IP=93.122.148.36
PPPOE link offline
System uptime: 12:51:12 up 37 min, load average: 0.00, 0.00, 0.00

DHCP Leases:
1342745334 d8:9e:3f:06:25:99 191.168.1.11 radus 01:d8:9e:3f:06:25:99
1342743331 00:13:02:6d:73:da 191.168.1.12 Irina-Dell 01:00:13:02:6d:73:da
1342743261 00:06:4f:02:15:82 191.168.1.13 VO000073 01:00:06:4f:02:15:82

- first, when using the Ethernet port for connection, as indicated by the routing Table and the Interface Status displays:

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
191.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

Ifaces:

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:191.168.1.1  Bcast:191.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:12652 errors:0 dropped:0 overruns:0 frame:0
          TX packets:15194 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:2761304 (2.6 MiB)  TX bytes:13951601 (13.3 MiB)

lan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:2A
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:11281 errors:4 dropped:0 overruns:0 frame:0
          TX packets:15471 errors:1 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2823991 (2.6 MiB)  TX bytes:13901997 (13.2 MiB)
          Base address:0x2200

ppp1      Link encap:Point-to-Point Protocol
          inet addr:93.122.148.36  P-t-P:10.64.64.65  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:13467 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10297 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:13045215 (12.4 MiB)  TX bytes:2485850 (2.3 MiB)

wan       Link encap:Ethernet  HWaddr 00:50:C2:F5:23:29
          inet addr:192.168.1.148  Bcast:192.168.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:111710 errors:32 dropped:0 overruns:0 frame:0
          TX packets:394 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:6938268 (6.6 MiB)  TX bytes:51456 (50.2 KiB)
          Base address:0x3000
```

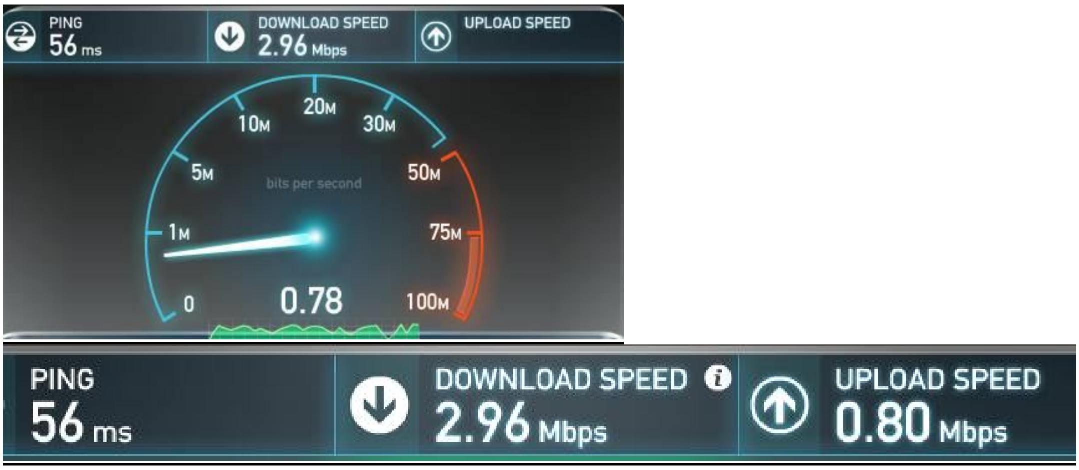


Figure 5-249: Speed test when the Ethernet port is used for WAN.

- Now, connection to Internet over the 3G wireless data link:

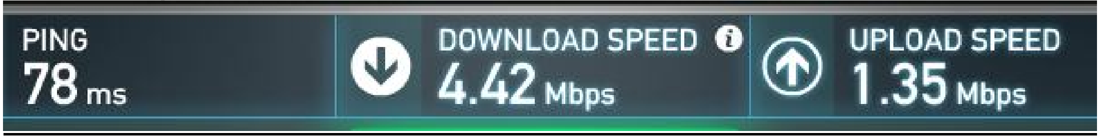
PPP link online, IP=93.122.148.36

```
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.64.64.65     0.0.0.0         255.255.255.255 UH    0      0        0 ppp1
191.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 br0
192.168.0.0     0.0.0.0         255.255.0.0     U     0      0        0 wan
0.0.0.0         10.64.64.65     0.0.0.0         UG    0      0        0 ppp1
```

```
br0       Link encap:Ethernet  HWaddr 00:19:70:49:F3:D7
          inet addr:191.168.1.1  Bcast:191.168.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:250209 errors:0 dropped:0 overruns:0 frame:0
          TX packets:412636 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:24925941 (23.7 MiB)  TX bytes:554504957 (528.8 MiB)
```

```
ppp1      Link encap:Point-to-Point Protocol
          inet addr:93.122.148.36  P-t-P:10.64.64.65  Mask:255.255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST  MTU:1500  Metric:1
          RX packets:415307 errors:0 dropped:0 overruns:0 frame:0
          TX packets:251562 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:549364190 (523.9 MiB)  TX bytes:24488482 (23.3 MiB)
```

See below actual speed test results for the wireless connection:



PING 78 ms

DOWNLOAD SPEED 4.42 Mbps

UPLOAD SPEED 1.35 Mbps

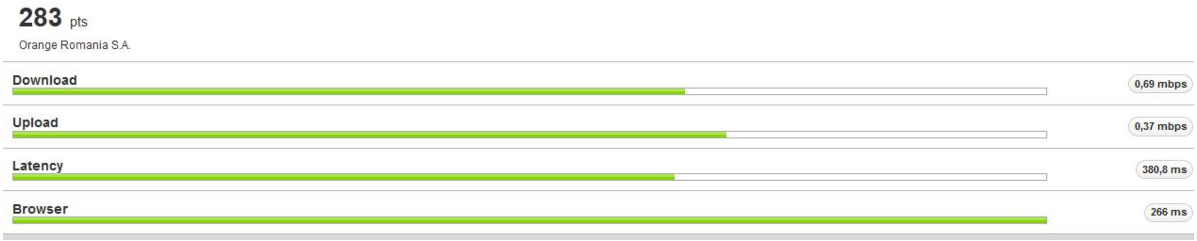
Figure 5-250: Speed test when the 3G wireless module is used for WAN.

Broadband Speed Test Results

Test run on **19/07/2012 @ 10:55 PM**

Mirror: **Internode**
Data: **3 MB**
Test Time: **28.94 secs**

Your line speed is **846 kbps** (0.85 Mbps).
Your download speed is **106 KB/s** (0.1 MB/s).



283 pts

Orange Romania S.A.

Download 0,69 mbps

Upload 0,37 mbps

Latency 380,8 ms

Browser 266 ms

Figure 5-251: Detailed speed tests for the same Bytton while PPP1 wireless link is used for WAN.

5.9 Status Page

The Bytton LTE router features a **status page**, accessible for any user without need for administrative password.

You can select it form the first connection screen of Bytton LTE:

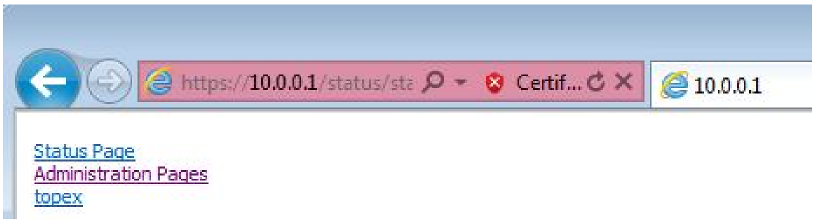
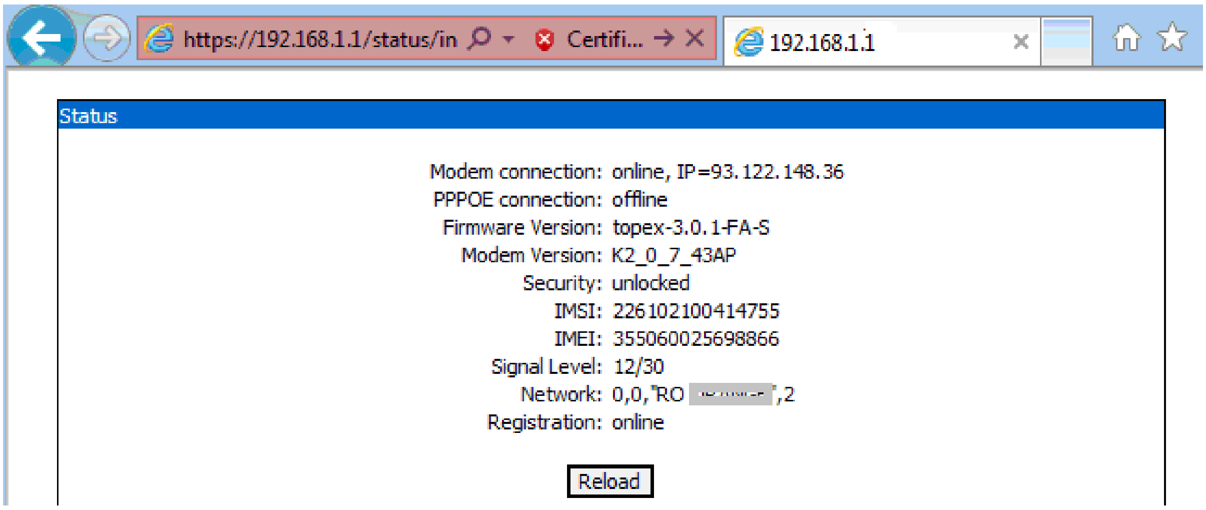


Figure 5-252: Accessing the “Status page” link.

Or you can enter in your browser directly the URL for the page: ““https://192.168.1.1/status” or https://192.168.1.1/status/index.html

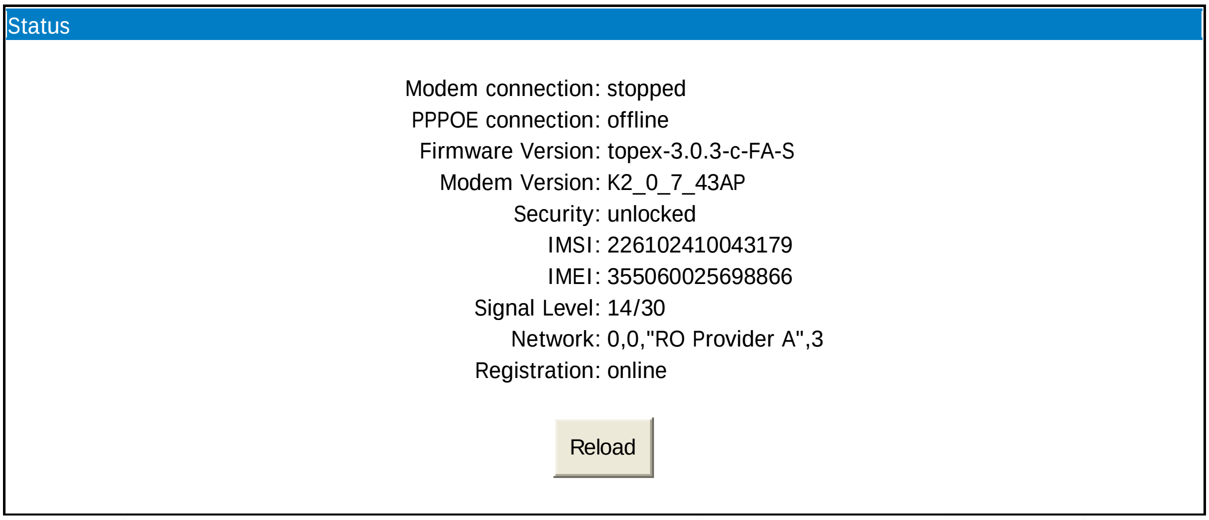


Status

Modem connection: online, IP=93.122.148.36
PPPOE connection: offline
Firmware Version: topex-3.0.1-FA-S
Modem Version: K2_0_7_43AP
Security: unlocked
IMSI: 226102100414755
IMEI: 355060025698866
Signal Level: 12/30
Network: 0,0,"RO [redacted]",2
Registration: online

Reload

Or:

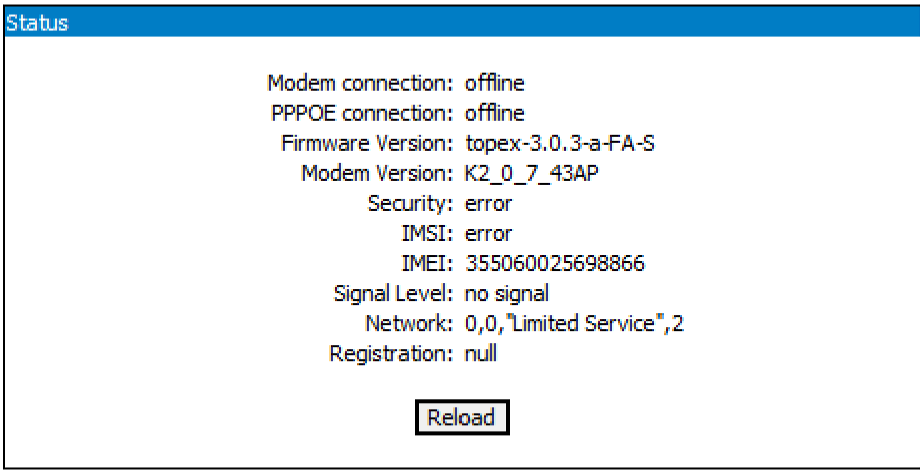


Status

Modem connection: stopped
PPPOE connection: offline
Firmware Version: topex-3.0.3-c-FA-S
Modem Version: K2_0_7_43AP
Security: unlocked
IMSI: 226102410043179
IMEI: 355060025698866
Signal Level: 14/30
Network: 0,0,"RO Provider A",3
Registration: online

Reload

Figure 5-253: Status page example – access and aspects for “connection stopped”.



Status

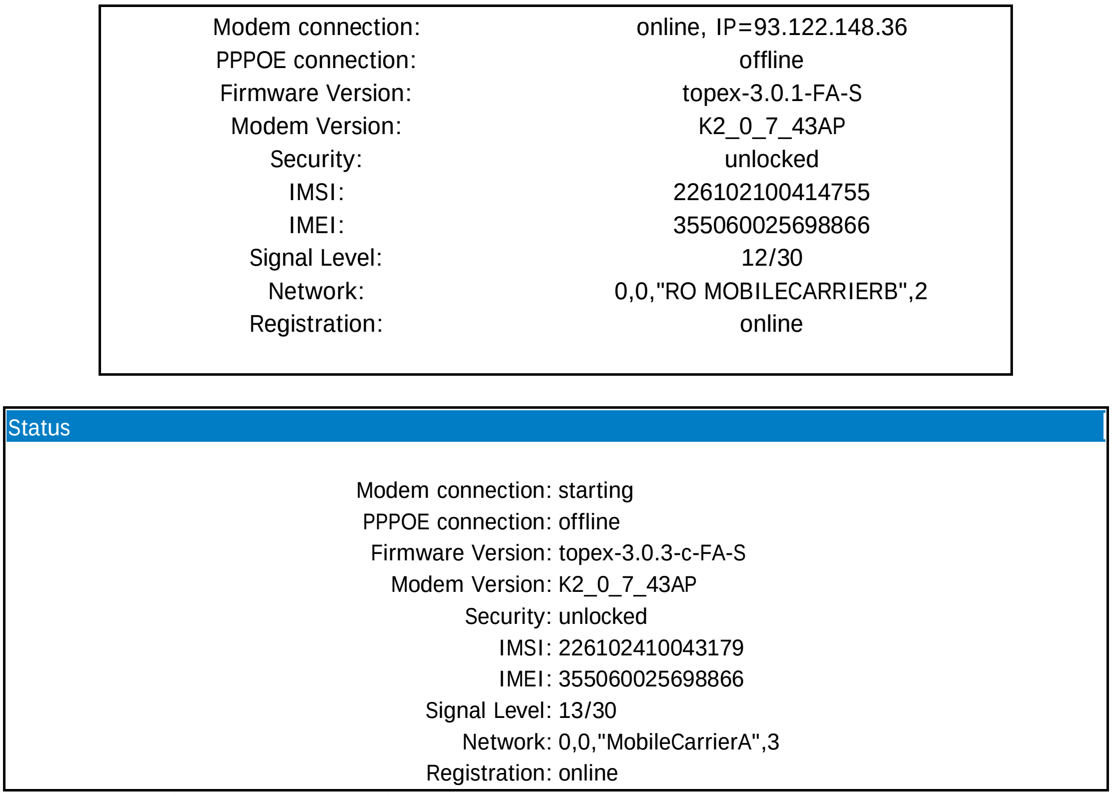
Modem connection: offline
PPPOE connection: offline
Firmware Version: topex-3.0.3-a-FA-S
Modem Version: K2_0_7_43AP
Security: error
IMSI: error
IMEI: 355060025698866
Signal Level: no signal
Network: 0,0,"Limited Service",2
Registration: null

Figure 5-254: Other status page example – no registration, error indication.

While the configuration web pages shown previously are for **configuring** the Bytton ICR equipment, and are accessible only with log-in (you have access if you enter the correct user name and password), the Status Page can be accesses by any user (it does not request a password for log-in!).

The Status Page shows you the essential parameters of the Rohde & Schwarz Topex S.A. Bytton ICR wireless router, that are available in the web page "SIM Status" and "System Status" described previously.

Modem (Data) connection: it may be offline, online or stopped.
When it is online, it also shows the current IP on the WAN side, such as "172.20.36.180" or "93.122.148.36" in these examples.
You may have, as in this example, a SIM registered online, the mobile network is available for voice calls, but the modem connection is offline, you cannot connect to Internet via HSPA modem.
You can see also info about the Ethernet link or PPP link ("PPPOE connection – offline").



Modem connection: online, IP=93.122.148.36
PPPOE connection: offline
Firmware Version: topex-3.0.1-FA-S
Modem Version: K2_0_7_43AP
Security: unlocked
IMSI: 226102100414755
IMEI: 355060025698866
Signal Level: 12/30
Network: 0,0,"RO MOBILECARRIERB",2
Registration: online

Status

Modem connection: starting
PPPOE connection: offline
Firmware Version: topex-3.0.3-c-FA-S
Modem Version: K2_0_7_43AP
Security: unlocked
IMSI: 226102410043179
IMEI: 355060025698866
Signal Level: 13/30
Network: 0,0,"MobileCarrierA",3
Registration: online

Figure 5-255: Another two examples of Status page for Bytton ICR.

PPPoE connection: information about the data link using PPP over Ethernet. In the above example, the status for the PPPoE connection is not yet available, so you see this error message.

Firmware version: version of the firmware running on BYTTON: you may see “topex-3.0.1”-FA-S” or “MobileCarrierB-3.0.0.–FA-O-b” in the above examplse, and so on.
The three digits following the name of the company show the version of the application program running, such as 2.7.2 or 3.0.1, while the final letters such as “FA-S” detail the platform, the modem type and the version (standard, dedicated for a certain carrier, with hard disk drive, etc).
Finally, the last letter may indicate the type of the case, P for plastic or M for metal in the case of the industrial router;

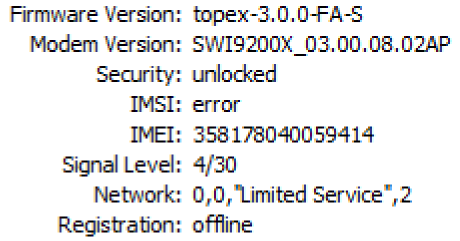
Modem Version: a code, such as “SWI9200X_03.00.08.02AP“ or “ K2_0_7_43AP”, describing the version of the embedded firmware of the mobile modem of the Bytton LTE equipment; it is very useful for debugging.

Security: the state of the SIM card. Normally it should be “unlocked”, if it is “Locked by PIN” it means you must enter the correct PIN code in order to unlock it.

- **IMSI** (International Mobile Subscriber Identity), identity of the subscriber , respectively of the SIM card used.
- **IMEI** (International Mobile Equipment Identifier). 15-digit number that uniquely identifies an individual mobile terminal wireless device such as the 3G/4G modem of Bytton LTE.

- **Signal Level**, displayed with four figures separated by a bar. The two digits indicate the level of the RF signal for the GSM/GPRS/EDGE/UMTS/HSPA network on a scale from zero to 30. The higher the value, the better signal you have, 17/30 is better than 14/30!
- **Network**: the name of the mobile network where the equipment is registered, as transmitted by the mobile carrier (may be a name, such as RO MobileCarrierA, Provider B, of just a code like “22601”.

- **Registration status**: shows if the SIM card of the equipment is registered to the mobile network (online) or not.

Of course, if the SIM is not present, not activated or the signal level is much too low, the network-related information cannot be displayed. But the information related to the equipment (firmware version, version of the GSM or HSPA modem, IMEI code) will still be shown on the screen	 Firmware Version: topex-3.0.0-FA-S Modem Version: SWI9200X_03.00.08.02AP Security: unlocked IMSI: error IMEI: 358178040059414 Signal Level: 4/30 Network: 0,0,"Limited Service",2 Registration: offline

- If the SIM is active and the signal is above zero, it will show IMSI and network information, even if not properly registered with the mobile carrier (you cannot make voice or data calls).

6 TECHNICAL SPECIFICATIONS

Title	Description
Cellular networks supported	Depending upon actual type of mobile module used It can be GSM/GPRS/EDGE and respectively UMTS/HSDPA/HSPA+ or LTE
Frequency bands	GSM/GPRS/EDGE: quad band 850/900/1800/1900 MHz HSPA+/UMTS(WCDMA): tri-band or quad-band, 850/900/1900/2100MHz: LTE: multi-band 800/900/1800/2100/2600 MHz or LTE 700
Supported protocols	TCP/IP, PPP, CHAP, PAP, ARP, UDP, FTP, TFTP, OSPF, RIP, BGP, NTP and others
Features	Full Firewall (SPI); Router Auto-negotiation, Auto-crossover, fully configurable 3+1 switch DHCP Server Remote configuration via Web page Multiple IPs over each interface, bridges, VLAN Fine tuning of each ETH port Masquerade and MTU adjustable for each interface Virtual Routing Tables QOS by means of packet marking and classifying (802.1p, 802.1 q) and various packet scheduling algorithms GRE, IPSEC, PTTTP and Open VPN for IP tunneling Quagga with RIP, BGP or OSPF for dynamic routing
Wired Network interfaces	ETH Integrated four- port Router that includes a three LAN port Switch with Management and Layer2 for Ethernet 10/100 base-T. QoS according to 802.1p, 802.1q. Supports both static and dynamic IP address One dedicated WAN port. All ports are fully configurable via Web interface (assignement, IP address and netmask, speed, mode of operation) Connector type: female RJ45.
	Serial One or Two SER port for RS-232 / RS-485 serial links, over RJ-45 connectors; Selection between RS-232 and 485 is done at the factory, by mounting different hardware, according to the customer's order. RS-232 interface is type 5-wire (RX, TX, GND, RTS, CTS) RS-485 interface is full duplex (two wire pairs, one for TX and one for RX)
	SPECIAL Optional one USB 2.0 Slot (on request) Optional one FXS telephone interface (on request)
High speed wireless modem	Depending upon the type of module selected for equipping Data service based on packet switched (PS) mode; Supporting SMS service based on GSM, GPRS, EDGE or UMTS, supporting group transmission of messages GPRS: Multi-slot Class 12 EDGE: Multislot class 12, Link Adaptation and Incremental Redundancy WCDMA 3GPP Release 5. MC7710 modules available for LTE (up to 100 Mbps download) featuring antenna diversity (MIMO support – two antennas may be used).
Packet access	One-phase and two-phase access for GPRS and EDGE
Max. transmitter power	GSM 850/900MHz: 2W DCS1800: 1W UMTS/HSPA 900/2100MHz: 0.25W
Data services	Depending upon the type of mobile module selected for equipping LTE: In MIMO configuration (antenna diversity), peak downlink speeds up to 100 Mbps and peak uplink speeds up to 50Mbps with MC7710 HSPA+: Max 42 Mbps download and 5.76 Mbps upload with Sierra Wireless MC7710 HSPA+: Max 21 Mbps download and 5.76 Mbps upload with Sierra Wireless MC8705.

	HSDPA/HSUPA: Max 7.2 Mbps download and 5.76 Mbps upload with Sierra Wireless MC8792V/8795V HSDPA : Max 3.6 Mbps download and 384 Kbps upload with Simcom 5216 EDGE – max 236.8Kbps download, max 118Kbps upload GPRS – max 85.6Kbps download, max 42.8Kbps upload CSD – GSM data rate 14.4 Kbps The choice of radio module also affects the maximum temperature range for functioning and storage!. *Note: the values specified by the manufacturer are the uppermost limits of the respective 3G+ technology under laboratory conditions, you may not reach these speeds on your premises.*
SMS	Supporting SMS based on CS domain of GSM or UMTS Supporting SMS based on PS domain of UMTS
VPN & Security	
GRE	Client; Several GRE tunnels may be defined.
PPTP	Client
OpenVPN	Client, TUN or TAP, UDP or TCP
IPSEC	Host to host, network to network or Road Warrior IPSec Termination of two or more IPSec tunnels Up to 20 IPSec tunnels
Encryption protocols	DES, 3DES, AES
Identity authentication of peers	Symmetrical PSK – Pre Share Key Non symmetrical Public RSA key
Authentication algorithms	MD5, SHA1
Security of keys	PFS – Perfect Forward Secrecy Diffie Hellman algorithm IKE mechanism
Network features	
Routing	Static Dynamic, Unix – based Quagga software RIPv1, RIPv2, OSPF , BGP.
Firewall	NAT, PAT IP Tables MAC Address Filtering for all interfaces ACL – Access Control List SPI – Stateful Packet Inspection
DHCP	DHCP server, with forwarding option
DNS	DNS Server, forwarding DNS requests Dynamic DNS
PPP	Dual SIM capability (not synchronuosly) AT Commands Authentication: PAP, CHAP Verification of data link and failover
PPPoE	Pont to Point Protocol over Ethernet
VRRP	Virtual Router Redundancy Protocol
NTP	Client for NTP, up to version 4.0

WiFi Access Point	
Supported standards	IEEE 802.11 b/g. Optionally also wireless N (802.11n) available, with support for dual antennas.
Operation Modes	Configurable as Access Point, Station or Bridge
Connection Modes	Infrastructure, Ad-Hoc
Wireless security	WEP – 64 or 128 bits WPA, WPA2 – PSK or PSK 2 crypto MAC Filtering TKIP, AES
Mobile antenna	External multi-band antenna with magnetic base and cable Two different types are shipped; one for GSM/3G and another for LTE (4G) modules in varioaus frequency. In care of 4G modules, which feature antenna diversity (MIMO), two LTE antennas may be used.
GPS antenna	For GPS-enabled modem modules, a GPS antenn is available.
WiFi antenna	Stick antenna with 90^o bending N-type has MIMO support (connectors for two wireless antennas) thus two WiFi antennas are required.
Supply voltage	12 $V_{D.C}$. (+ center wire, - external conductor)
Supply adapter	Standard - special switching mode power adapter for 230V AC mains Output : 12 V $_{D.C}$. / 2.1 A Input: from 100 to 240 V $_{A.C}$. / 0,3 A / 50 Hz Optional car kit adapter, for powering from the car battery Optional wide voltage range supply, form 9 up to 48 V $_{DC}$ input (by factory order)
Status indicators	LEDs, for POWER, DATA, WiFi and SGN (level of signal), plus two LED per each LAN or WAN port.
Temp. range	Operating: Standard 0^0 ... $+70^0$ C Optional Industrial: -25^oC … $+75^o$C (Sierra Wireless modules) Optional Industrial: -30^oC … $+80^o$C (SIMCOM modules) Storage: up to -40^0..$+85^0$ C for no more than 96 hours Humidity: 0 to 95%, non-condensing
IP Classification	**Ingress Protection Rating:** IP 20
Chassis	
Material	Ruggedized metallic case
Dimensions (L x W x H)	210 x 130 x 30 (mm) except protrusions
Installation	Horizontal mounting, on a flat surface DIN Rail mounting possible by means of a mechanical adapter
Weight	Tipically 0,400 Kg, Maximum 0.800 Kg (equipment box only) Tipically 1 Kg – whole package

7. OPERATING ENVIRONMENT

Bytton LTE was designed for indoor use only, so you should NOT operate it outdoors unles it is placed into weatherproof enclosures.

You must install the Bytton LTE equipment in closed rooms or enclosures, where the environment conditions should be:

- operating temperature range: from 0 to 75 ^{o}C in case of units with components in the commercial temperature range, and respectively from -25 up to +80 ^{o}C in case of units built using h components in the industrial temperature range
- relative humidity: from 5 to 95 %, non-condensing.

The extended temperature range version can operate form -30^{o}C up to +80^{o}C ambient temperature, but the case is not waterproof – the IP rating is just 20.
For outdoors usage, you must ensure its protection against rain, spay, or saline mist!

You should avoid dust and prolonged exposure to sun radiation. In addition, Bytton LTE must NOT be used in a flammable or explosive environment, or in locations where toxic or flammable gases may accumulate.

The equipment must be handled with care, to avoid mechanical shocks and blows.

Bytton LTE should not be used in an environment with high level of EMI (electromagnetic interferences) that is in close proximity to high power equipment such as electric motors or heaters. In addition, it should not be placed near copiers, PC monitors, TV sets or other audio-video appliances.

In order to ensure adequate working temperature, the Bytton LTE interface must not be used too near heat sources or in direct sunshine.

Also, it must not be overcrowded: you must leave free space around, below and above the Bytton LTE router. This is needed both for connecting phones / data / antennas cables, and also for ventilation (natural air cooling to dissipate the heat generated during operation).

Remember, when allowed operating temperature is exceeded this may not have an immediate, visible effect on the BYTTON unit, but it can result in unreliable operation, accelerated ageing and hence diminishing of lifetime.

When selecting the location for installing Bytton LTE and its external antennas you must remember the recommendations described in the chapter about mounting the equipment.

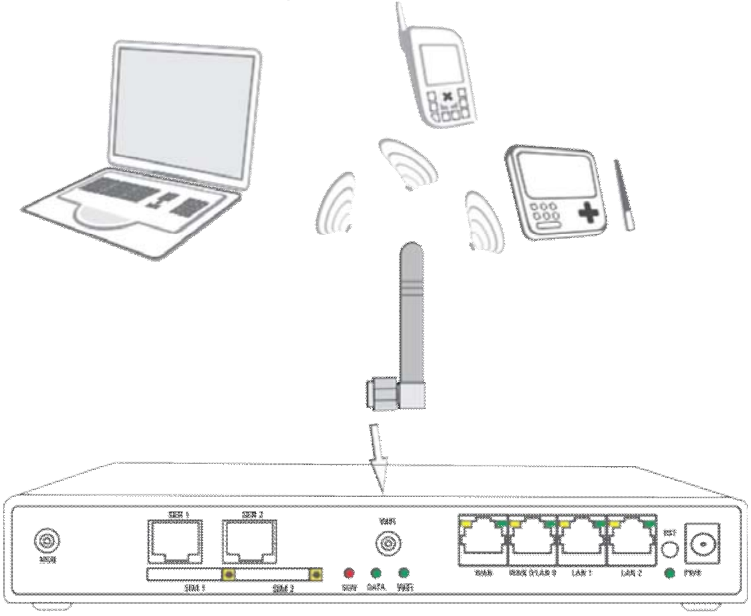
Bytton LTE equipment does not include materials or components that are harmful to the environment.

When the life cycle of this equipment is finished and it cannot be repaired or re-used anymore, you should dispose of it in accordance with laws and legal regulations that are valid in your area.

8 APPLICATIONS

8.1 Wireless gateway/firewall/router using the 3G+ networks

The Bytton family was designed primary for wireless use, where it connects several computer, one or more cabled and/on wireless local networks or peripheral devices by means of its embedded 3G+ modem. The radio modem can connect to a wide range of LTE, UMTS/HSPA or GSM/GPRS mobile voice and data networks. Bytton ICR acts as a powerful residential gateway, being a compact, all in one box (NAT, PAT, router, firewall), connected to Internet via mobile broadband HSPA+ or LTE technology.



You may connect to the Bytton ICR equipment several wireless and wired (Ethernet) clients, that is notebooks, desktop computers, tablets, Smartphones and various peripherals or measurement or commercial devices, at the same time.

Figure 8-1: Wired and wirelss local clients connected to the Bytton wireless router.

The access to data traffic does no longer require additional investments on equipment or software (router, switch , software, wiring operations). Bytton ICR broadband router allows connection to the local network (LAN) via three Fast Ethernet (10/100 Mbps) ports .

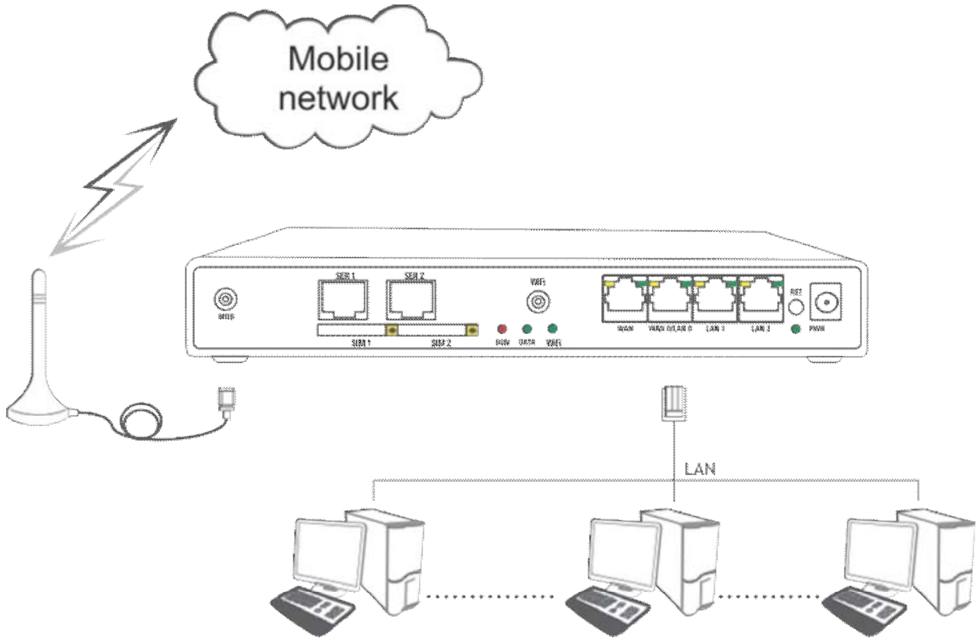


Figure 8-2: Ilustration of SOHO applications for Bytton ICR.

These kinds of applications are especially suited for both home and small or medium business network environment, where land connections are not readily available, and also for field applications, taken advanced of the industrial-grade built of Bytton LTE and its optional extended temperature range features. In addition, temporary events (festivals, sporting competitions, trade fairs and exhibitions) may benefit from the use of a wireless broadband router for data and voice. Even if the temporary event is located in the heart of the city, getting a wired broadband connection for only two-three days makes no economic sense.

8.2 M2M Field Applications

Bytton ICR is an industrial grade broadband cellular router, so its applications are not limited to home and office, as described previously. The extended temperature range version, when fitted with serial interfaces, is becomes a machine-to-machine device that provides high data transfer rates to remote equipments located out in the filed, over 3G+ mobile networks.

n addition to the advanced VPN and secured software features of the SOHO version, Bytton LTE provides industrial grade characteristics such as rugged metal case, extended temperature range for operation and storage and DIN Rail mounting for installation in an equipment rack.

This rugged, compact-size wireless router is a suitable solution for field-specific applications, such as telemetry or back-up data transfers, since it includes a wide range of communication interfaces and protocols, supervised by advanced mechanisms such as backward capability including cross 3G+ networks coverage, WAN, WiFi and USB connections. Using this features, it can “talk” to several machines or measuring instruments out in the field, not just PC’s but also POS or ATM from filling stations and shops, telemetry equipments located at remote oil wells or pumping stations, etc. All these remote machines may be connected, via VIPN tunnels, over the high speed HSPA+ networks, to remote offices and to the headquarters of a big company with distributed presence, as illustrated below:

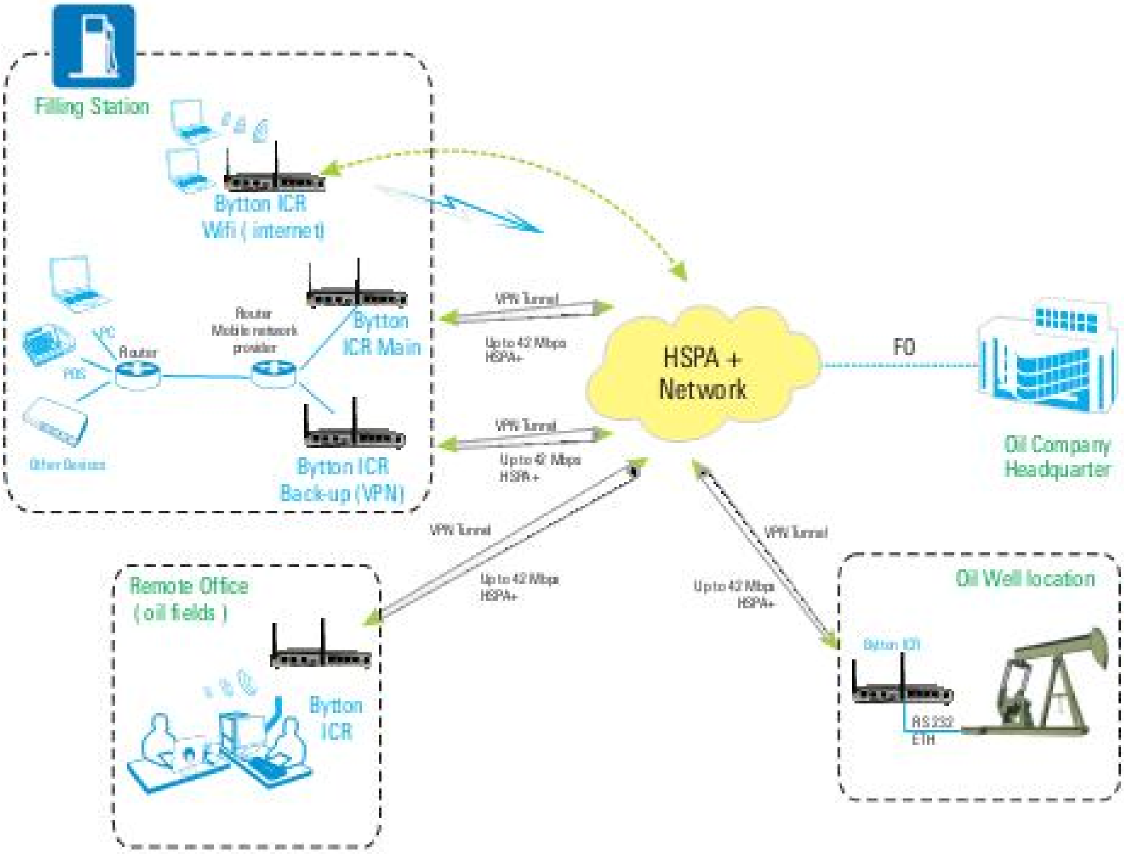


Figure 8-3: Illustration of distributed and field applications for Bytton ICR.

The availability of serial ports means that older “legacy” equipments (measurement and control units, meters, POS, card readers, ATMs), which feature only serial ports (RS-232 or RS-485), may also be connected to the Bytton ICR mobile router by means of its one or two SER ports, as shown in the illustration:

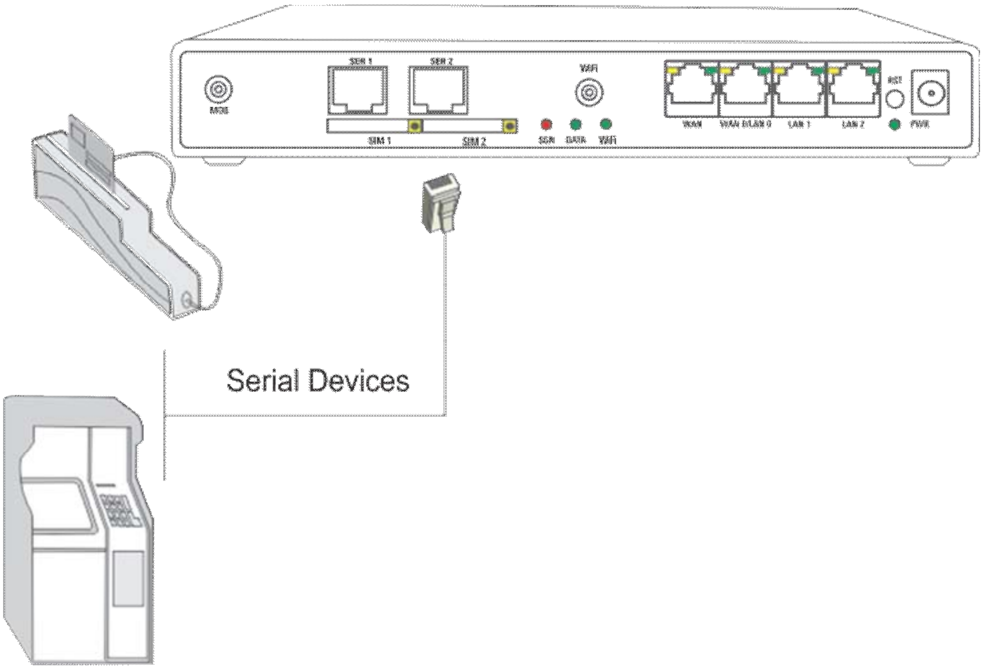


Figure 8-4: Bytton ICR used for serial connection to legacy equipments.

Domains of applications for the industrial grade cellular router may include Oil & Gas Industries, Processing Plants, Property / Estate Agencies, Logistics, Recruitment, Travel & Hospitality, Healthcare, Media & Broadcasting , Insurance & Finance.

9 Glossary

3G – “Third generation” mobile networks, specially designed for high speed data services. The classic definition of wireless networks that following the 2G systems (GSM) and they offer high speed data services in addition to the basic voice capability. These 3G mobile communications systems provide an enhanced range of multimedia services (high speed Internet access, video streaming, etc.). The high data transfer speed specific to the third generation communications network leads to an increased efficiency of information transmission, while the real time access to data and information means important savings of time and money. UMTS is the best known (but not the only one!) of the 3G networks, while HSPA+ is considered to be 3,5 G or 3G+.

4G - “Fourth-generation wireless”, the next stage of broadband mobile communications. According to the ITU,specifications es a 4G network requires a mobile device to be able to exchange data at 100 Mbit/sec. A 3G network, on the other hand, can offer data speeds as slow as 3.84 Mbit/sec. Several technolgies are used for 4G data networks, such as using Long Term Evolution (LTE) or Worldwide Interoperability for Microwave Access WiMAX. Generally OFDM is used -a type of digital modulation in which a signal is split into several narrowband channels at different frequencies. This is more efficient than TDMA employed in 2G, which divides channels into time slots and has multiple users take turns transmitting bursts or WCDMA, uesd by 3G, which simultaneously transmits multiple signals on the same channel.
4G does not mean only higher data rates, but also other enhancements - simultaneous connections to multiple high-speed networks that provide seamless handoffs throughout a geographical area, and better coverage using femtocells and picocells. As its name suggests, Bytton LTE may be equipped with a LTE mobile modules, to achieve data rates of up to 100 Mbit/sec.

Broadband - A type of data transmission in which a single medium (radio, cable or fiber optics) carries several channels of data at once. Broadband is also associated with high transfer speed (at least 300 Kbps). UMTS technology qualifies for mobile broadband connection, and HSPA+ or LTE are even better!

Device name - Also known as DHCP client ID or network name. Some ISP provide the customers with such device names, when using DHCP to assign addresses.
DHCP (Dynamic Host Configuration Protocol) **-** This protocol allows a computer (or many computers on your network) to be automatically assigned a single IP address from a DHCP server. DHCP is available on Bytton LTE both for LAN (cabled or wireless) and WAN.

DNS – Acronym for Domain Name System (or Service), an Internet service that translates domain names into IP addresses. This allows the Internet hosts to use both addresses type domain name (such as topex.ro or linux.org), and addresses type IP numbers (for instance 192.17.3.4). The domain name addresses are intended for human users and are automatically converted into IP (numeric) addresses. Because domain names are alphabetic, they are much easier to remember. The Internet however, is really based on IP addresses. Every time you use a domain name, therefore, a DNS service must translate the name into the corresponding IP address.

DNS Server – computer able to answer to the interrogations in a DNS system. The DNS server maintains a database that includes the host computers with their domain names and the corresponding IP addresses. For instance, if you ask the DNS server for the domain name apex.com, it will return the IP address of the hypothetical company called Apex. DNS servers are linked in their network, so if one DNS server doesn't know how to translate a particular domain name, it asks another one, and so on, until the correct IP address is found. When a user enters a domain name into the Internet browser, the user is sent by the DNS Server to the proper IP address. The DNS server address used by the computers on your home network is the location of the DNS.

DNS Server Address (Domain Name System) **-** DNS allows Internet host computers to have a domain name and one or more IP addresses. A DNS server keeps a database of host computers and their respective domain names and IP addresses, so that server your ISP has assigned.

Dynamic DNS - service that allows clients connecting to the Internet with a dynamic IP address to be able to use applications that require a static IP address. The Internet Service Provider changes the IP address of the users, but there are applications that work only with static (fixed) IP addresses. Dynamic DNS makes it possible for sites on the Internet to establish connections to you computer without need for tracking the IP address themselves. DDNS is useful both for wired or wireless (such as UMTS) dialup connection where at each connection a new address is assigned, and for DSL services where the address is changed occasionally by the ISP. Bytton LTE allows usage of Dynamic DNS.

Domain Name Resolution - The resolving of a domain name. Internet applications don't communicate with domain names such as google.com or topex.ro, instead they use IP addresses (for example 193.226.61.95 or 216.239.39.99). Domain Name Resolution is the process (transparent for the user) of converting domain names into corresponding IP addresses. Every operating system has routines that deal with resolution of domain names.

Encryption - This provides wireless data transmissions with a level of security. Bytton provides various degrees of encryption for data sent out via its embedded Wi-Fi access point.

Ethernet - Standard for wired computer networks. Ethernet networks are connected by cables and hubs, and move data around. For wired connections, Bytton LTE provides Ethernet 10/100 ports, three for the local LAN and one for WAN. The ports are fully configurable, from the Web interface you may join the three LAN ports in the same switch or not, assign the different Ips, set them to operate duplex or half-duplex, select data speeds of 10 or 100 Mps, enable or disable auto-negotiation, and so on.

Firewall - System designed to prevent unauthorized access to or from a private network. The firewall determines which information passes in and out of and prevents anyone outside of your network from accessing your computer without authorization and possibly damaging or viewing your files. Any company with an intranet that allows its workers access to the wider Internet must use a software or hardware firewall to prevent outsiders from accessing its own private data resources and for controlling what outside resources its own users have access to. Here the firewall is software a set of related programs (residing on the gateway server) that protect the resources of the local (internal) network.

Gateway - A network point that manages all the data traffic of your network, as well as to the Internet and connects one network to another. Bytton LTE is also gateway, since it interfaces between the local networks (wired or wireless) and the HSPA mobile network or another broadband connection.
GRE – Acronym for Generic Routing Encapsulation. GRE is used as a tunneling protocol, which can encapsulate a wide variety of protocol packet types inside IP tunnels. IP tunneling using GRE protocol allows easy creation and expansion of a Virtual Private Network using the 3G+ mobile network. The Bytton LTE router from Rohde & Schwarz Topex S.A. allows you to use several different GRE tunnels.

HSDPA (High-Speed Downlink Packet Access) is an enhanced 3G (third generation) mobile telephony communications protocol in the High-Speed Packet Access (HSPA) family, also refered as 3.5G, 3G+ or turbo 3G. HSPDA allows mobile networks based on UMTS to have higher data transfer speeds and capacity. Current HSDPA deployments support down-link speeds of up to 42 Mbit/s. Further speed increases are available with HSPA+, which provides speeds of up to 337 Mbit/s with Release 11 of the 3GPP standards.

HSPA+, also called "I-HSPA" (for Internet-HSPA) or Evolved High-Speed Packet Access, is a wireless broadband standard defined in 3GPP release 7 and above. By its name you can see that HSPA+ is an enhanced version of the previous 3G+ High Speed Packet Access system, a further increase of the speeds of the basic 3G system, and another step towards 4G (data rates up to 42Mbps currently and 100 Mbps in the LTE networks)!

IP Address – Short from Internet Protocol address. The numerical address of a network device or resource as expressed in the format specified in the Internet Protocol (IP). In the current addressing format, IP version 4, the IP address is a 32-bit (4 bytes) sequence divided into four groups of decimal numbers separated by periods ("dots"). Each number can be zero to 255. These four groups of numbers look like "127.0.0.1" or „213.154.120.170". The four numbers in an IP address are used in different ways to identify a particular network and a host on that network.

IP – Acronym for Internet Protocol. It is the protocol from TCP/IP that directs the way data is sent from one computer to another on the Internet. The messages are divided into data packets, routed from the sender network to the receiver network and there re-assembled in the right order to re-create the original message. Because a message is divided into a number of packets, each packet can, if necessary, be sent by a different route across the Internet. These data packets can arrive in a different order than the order they were sent in. The Internet Protocol just delivers them. It's up to TCP protocol (Transmission Control Protocol) to put the packets back in the right order.

IP Tunneling - a tunneling protocol encapsulates a packet of the same or lower protocol, while in a regular protocol, the lower layer protocol encapsulates the higher level protocol. In order to achieve a Virtual Private Network (corporate network) you must ensure the port forwarding (tunneling), that is the transmission of private data through a public network such as 3G. The routing nodes in the respective public network must not be aware that the transmission is part of a private network. Tunneling means the encapsulation of the data and protocol information of the private network within the transmission units of the public network. Widely used tunneling methods are the Point-to-Point Tunneling Protocol (PPTP) developed by Microsoft and generic routing encapsulation (GRE), developed by Cisco Systems.
All Bytton LTE equipments support the GRE protocol. Depending upon actual firmwarte revison sunning on it, Bytton LTE supports several types of secure IP tunnels, including GRE, IPSEC, OVPN and PPTP.

ISP (Internet Service Provider) - An ISP is a business that allows individuals or businesses to connect to the Internet. Users log on to the Internet using an account with an ISP or Internet Service Provider. ISPs can serve IP addresses dynamically, or assign static (fixed) IP addresses to individual computers. In this case, the Internet provider is the operator of the 2G/3G or LTE mobile network.

LAN - Acronym for local area network (computer network that spans a relatively small area). A group of computers, workstations and associated devices that share a common communications line or wireless link and are located in a relatively limited area, typically inside the same office building. The communications link that interconnects these computers allows any device of the network to interact with any other from the same network. The devices that compose a local network (workstations, personal computers and peripherals) are called nodes and typically share the resources of a single processor or server. This server has resources (applications, processing and data storage capabilities) that are shared in common by multiple computer users. The LAN can be connected to other local networks over any distance via phone lines, wireless links or other connections, and the system of LANs connected in this way is called a wide-area network (WAN).
The LAN may also be connected to the Internet through a gateway. The Bytton LTE equipment performs as a gateway since it interfaces between local Ethernet and/or Wi-Fi networks and the 3G, CDMA or LTE wireless data network.

LTE - Acronym for **long-term evolution**, alos calleds **4G LTE**, a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using a different radio interface together with core network improvements. The standard is developed by the 3GPP (3rd Generation Partnership Project) and is specified in its Release 8 document series, with minor enhancements described in Release 9.

MAC (Media Access Control) Address **-** A MAC address is the hardware (physical) address of a ETH device connected to a network. In the Open Systems Interconnection model of communication, the MAC layer is one of two sub-layers of the Data Link Control layer and is concerned with sharing the physical connection.
All network interface controllers must have a hard-coded and unique MAC address. The MAC address is applied at the factory and uniquely identifies network hardware, such as a Ethernet cards, modems or wireless adaptors on a LAN or WAN. The first part of the address is unique to the company that produced the device, and beyond that it is a sequence of digits unique to a single device manufactured by a company.
The IEEE 802.x protocol (for instance, 802.3 is Ethernet) specifies that the MAC sub-layer must supply a 48-bit (6 byte) address. The MAC is most frequently represented as 12 hexadecimal digits. When looking at this hex representation of the MAC address, the first six hexadecimal digits identify the vendor while the last six hex digits identify the specific network interface card. Different companies like to show MAC addresses different ways, Bytton LTE makes use of the Unix-type MAC formatting, where there are six groups of two hex figure and the separator is "**:**" instead of the "**-**" used by Microsoft. See below a few examples of MAC addresses encountered by the Bytton equipment.
MAC address filtering - Since the MAC number is a unique number, a router may be programmed to accept (or reject) only *certain* MAC addresses from the local Ethernet network or Wi-Fi access points. When an unknown MAC address tries to connect, the Bytton router will not let it. MAC filtering can be used to prevent unauthorized access into small corporate networks. Without MAC address filtering, any wireless client can join (authenticate with) a Wi-Fi network provided they know the network name (ESSID) and maybe a few other security parameters like passwords or encryption keys. When MAC address filtering is enabled, however, the router performs an additional verification over the physical address.
When this feature is enabled in Bytton LTE, when the embedded wireless access point receives a request to join with the WLAN, it compares the MAC address of that client against the Accept list. Clients on the list authenticate as normal, while clients not on the list are denied any access to the WLAN. The option

Denny acts in reverse, the clients with specified MACs will be rejected, while all others are allowed access. This is useful when you know that some computers may have viruses and want to prevent the infection from spreading!
Of course, some wireless clients allow their MAC address to be "impersonated" or "spoofed" in software. It's certainly possible for a hacker to break into your WLAN by configuring their client to spoof one of your allowed MAC addresses. Thus a determined attacker could capture details about MAC addresses from your network and pretend to be that device to connect to VLAN via Bytton. Although MAC address filtering isn't bulletproof, still it remains a helpful additional layer of defense that improves overall Wi-Fi network security against casual hackers or curious snoopers.

MIMO (Multiple-input, multiple-output) technique has been established for mobile data communications as early as 1996. In the beginning the MIMO applications were targeted towards useage with WiFi and WiMAX local networks, since it was much easier to integrate MIMO into emerging devices, than into the 3G market where the standards were already established. But in the meantime the expanding standard 3G LTE (long-term evolution) has adopted MIMO and is on the rise. This is why MIMO or dual-antenna technique can be used *both on the WLAN and WWAN sides of Bytton LTE!*

MTU - Acronym for Maximum Transmission Unit. Generally, the size of the largest datagram that can be passed by a layer of a communications protocol (that can be transmitted or received through a logical interface). All messages larger than the MTU will be divided into smaller packets before being sent. In our case MTU is the largest physical packet size, measured in bytes that a network can transmit. The size includes the IP header but does not include the size of any Link Layer headers or framing. Thus, when encapsulation and additional headers are used, you must take into account the additional length generated.
Different networks have different values for MTU, which is set by the network administrator. Most networking technologies have a default MTU size: this is 576 for many PPP connections, 1500 for Ethernet networks, 65K for HYPER channel, etc. This is why the Web interface of Bytton LTE lets you to configure specific MTU values for each interface.

NAT - Network Address Translation. NAT is an Internet standard that enables a local-area network (LAN) to use one set of IP addresses for internal traffic and another set of addresses for external traffic. On the gateway, NAT software performs all necessary translations of the IP addresses. There are several purposes for NAT usage: it provides a type of natural firewall by hiding all the internal IP addresses from the Internet. Only the single IP assigned to the router is visible from the Internet. Several computers on the local network to use one IP address, enabling access to the Internet from any computer network without the need to get more IP addresses from the ISP. Also, local computers are not directly reachable from the Internet, making them more secure. With NAT, the company can use several internal IP addresses. Since they're used only internally, there is no possibility of conflict with IP addresses used by other companies or organizations. Bytton allows you to selectively enable NAT or Masquerading for each of its interfaces!

NTP - Acronym for **N**etwork **T**ime **P**rotocol. Internet standard protocol used to update the real-time clock in a computer. It assures accurate synchronization to the millisecond of computer clock times in a network of computers. NTP is very useful in packet-switched, variable-latency data networks.
In case of Bytton LTE, when you want to measure the performances of the network, you need accurate, universal time-stamps for the data packets.
NTP runs as a continuous background client program on a computer and it sends periodic time requests to servers, obtaining server time stamps and using them to adjust the client's clock. NTP uses UDP port 123 as its transport layer. It is designed particularly to resist the effects of variable latency. There are numerous primary and secondary servers in the Internet that are synchronized to the Coordinated Universal Time (UTC) via radio, satellite or modem. For more information, visit www.ntp.org.

PPP - Acronym for Point-to-Point Protocol. Network protocol widely used to connect computers to the Internet. Works on the data link layer of the OSI model. PPP sends the TCP/IP packets of the gateway to a server that puts them onto the Internet. It is more stable than the older SLIP protocol and provides error-checking features.
PPP is the Internet standard for dial-up modem connections, no matter if they are phone line modems of high-speed UMTS wireless devices such as the embedded HSPA or LTE modem of Bytton LTE.

PPPoE - Acronym for Point-to-Point Protocol over Ethernet. A method of secure data transmission, PPPoE using Ethernet to connect to an ISP. The PPP traffic is sent over Ethernet to the Internet through a common broadband medium. The users have the appearance of "dialing" the Internet, but their computers are in fact always connected.

PPPoE supports a broad range of existing applications and services, from authentication, accounting and secure access to configuration management. Bytton LTE supports on the WAN side either PPP or PPPoE connection.

RIP - Acronym for Routing Information Protocol. RIP for IP is a distance-vector routing protocol, which is the main dynamic routing protocol used in small or medium-sized IP internetworks. For dynamic routing, Bytton LTE supports protocols RIP v2 and OSPF.

Routing -The process of determining and prescribing the path or method to be used for establishing connections and forwarding data packets. In a network, a 'routing switch' is a device that combines the functions of a switch, which forwards data by looking at a physical device address, and a router, which forwards packets by locating a next hop address. Each host with a router in the network uses the routing table information to determine the next host to route a packet to for a specified destination.
Bytton LTE performs as a router for the wired or wireless local network where it is connected. It can perform both static routing (with fixed, pre-defined routes) and dynamic routing. Dynamic routing is more complex than static routing, but it provides several benefits. It ensures scalability and adaptability. The routes are dynamic, interactive, permanently updated. Routers learn about the network topology by communicating with other routers so it may select a better route, optimized for each time period. The Bytton equipment supports static and dynamic routing, featuring different protocols for dynamic routing, such as RIP v 2 for distance vector routing and OSPF for link state routing.

S-HTTP - Acronym for SECURE HYPERTEXT TRANSFER PROTOCOL. A secure way of transferring information over the Web, by using an application-level encryption scheme. S-HTTP is an extension of the normal HTTP with security enhancements for WWW-based commerce. Web pages that use S-HTTP have a URL starting with https://. Typically HTTP data is sent over TCP/IP port 80, but HTTPS data is sent over port 443. The standard was developed for secure transactions, and uses 40-bit encryption ("weak" encryption) or 128-bit ("strong" encryption). The HTTPS standard supports certificates and allows encryption, digital signatures, authentication, or any combination of these. The S-HTTP type of transaction security is more secure than a user ID and password, thus it is mostly used by financial institutions (for example for credit-card purchases over the Web). Since Bytton LTE provides ensures S-HTTP, this means a higher degree of security for you.

SMS - Acronym for **Short Message Service**; means the transmission of short text messages to and from cellular phones. The messages must be text only (no images or graphics) and not longer than 160 alpha-numeric characters. Operators of Mobile Phone Networks use a spare data channel to send SMS messages. You may send SMS messages to another mobile subscriber, the mobile operator can send you phone settings over-the-air or commercial companies may send dedicated content to your mobile terminal. The embedded firmware allows Bytton LTE equipment to send and receive SMS (via mobile network) from the computer connected to it.

Static packet filter - One of the simplest and least expensive forms of firewall protection is known as static packet filtering. With static packet filtering, each packet entering or leaving the network is checked and either passed or rejected depending on a set of user-defined rules. Dealing with each individual packet, the firewall applies its rule set to determine which packet to allow or disallow. The static packet filtering firewall examines each packet based on the following criteria:
 * Source IP address
 * Destination IP address
 * TCP/UDP source port
 * TCP/UDP destination port
Static packet filtering is easy to implement and configure and does not use a lot of resources, but its efficiency is limited. Basic packet filtering firewalls are susceptible to IP spoofing, where an intruder tries to gain unauthorized access to computers by sending messages to a computer with an IP address indicating that the message is coming from a trusted host. Another shortcoming is that this form of firewall rarely provides sufficient logging or reporting capabilities.

SPI - Acronym for Stateful packet inspection. The embedded Bytton LTE firewall also performs stateful packet inspection. This approach examines the contents of packets rather than just filtering them. It takes into account not only the addresses of the data packets but also the contents and the state of the connection. Stateful means they take into account the state of the connections they handle so that, for example, a legitimate incoming packet can be matched with the outbound request for that packet and allowed in. In addition, an incoming packet masquerading as a response can be blocked if the firewall knows that the outbound request is in fact nonexistent. Rather than controlling the individual data packets.

SPI uses smart rules, thus enhancing the filtering process and controlling the network session. Static packet filtering cannot stop DOS attacks. But SPI closes ports until legitimate users request them opened so it prevents certain kinds of Denial of Service attacks. Since SPI firewalls compare packets to previous packets, the packets that violate the rules can be dropped.

TCP/IP – Acronym for Transmission Control Protocol / Internet Protocol. It was established by the Defense Department of the USA for communications between computers. It has been at first incorporated in Unix operating system but has become the de facto standard for data transmission via networks, including for Internet.

TCP – Acronym for Transmission Control Protocol. In TCP/IP, the TCP part is the one that takes care of keeping track of the individual units of data (packets) that a message was divided into for efficient routing through the Internet. TCP is known as a connection-oriented protocol, which means that a connection is established and maintained until the message or messages to be exchanged by the application programs at each end have been exchanged. TCP is responsible for ensuring that a message is divided into the packets that IP manages and for reassembling the packets back into the complete message at the other end.
At the destination, TCP reassembles the individual packets and waits until they have all arrived to forward them to you as a single file. It also checks the received packets. TCP acts at the transport level (level 4) of the ISO/OSI model. See also ISO/OSI model, packet, TCP/IP.

UDP – Acronym for User Datagram Protocol. It is a simpler protocol than TCP/IP that corresponds to the transport layer of the ISO/OSI model. UDP converts the messages generated by the application into data packets to be sent through IP, but does not check if the messages have been transmitted correctly or not.
UDP allows individual packets to be dropped (with no retries) and UDP packets to be received in a different order than they were sent. Consequently UDP is more efficient but less reliable than TCP and is used to different purposes - primarily for broadcasting messages over a network. With UDP, reliability is wholly in charge of the application that generates the message.
UDP is used often in applications such as videoconferencing or games where optimal performance is preferred over guaranteed message delivery.

WAN - Acronym for Wide Area Network. A system of LANs, connected together. A Wan is a network that connects computers located in separate areas, (i.e., different buildings, cities, countries). The Internet is a wide area network.
Bytton LTE features a dedicated WAN port and a configurable LAN/WAN ports, allowing versatile connection to another network or to alternate broadband service providers via Ethernet cable.

WWAN – Acronym fo wireless wide area network. Also named "broadband wireless," WWAN refers to wireless high-speed data networks covering a large geographic area. This broad category can include 2.5G, 3G, 4G, and other types of technology where each base station (tower) is designed to reach an area measured inmany kilometers. The term WWAN is used primarily to distinguish this group of diverse technologies from WLANs (Wireless Local Area Networks,) which typically cover a much smaller area, just 300 m from the base station. WLAN includes technology like Wi-Fi.

Wi-Fi type N – Besides the usual 802.11 b/g WiFi modules, Bytton LTE may be fitted with N-type Wireless Access Point using dual antennas. 802.11n is the third-generation Wi-Fi standard for wireless home networking. 802.11n equipment is backward compatible with older 802.11g or 802.11b gear, and it supports much faster wireless connections over longer distances. It uses several radio modules and antennas (MIMO) together with channel bonding techniques, which utilizes two adjacent Wi-Fi channels simultaneously to double the bandwidth of the wireless link compared to 802.11b/g. The 802.11n standard specifies 300 Mbps theoretical bandwidth is available when using channel bonding. Without it, about 50% of this bandwidth is lost (actually slightly more due to protocol overhead considerations), and 802.11n equipment will generally report connections in the 130-150 Mbps rated range in those cases.
As a drawback, channel bonding substantially increases the risk of interfering with nearby Wi-Fi networks due to the increased spectrum and power it consumes.

The manufacturer reserves the right to modify the product and manual for the purpose of technical improvement without prior notice.

The manufacturer guarantees the good functioning of the product provided that it has been correctly installed and the directives for storage and usage have been respected. The warranty implies exclusively repairing or replacing the defective unit. The warranty does not include any indirect losses or loss of profit. The manufacturer is not liable for any damage, whether direct, indirect, special, incidental, or consequential, as a result of using Rohde & Schwarz Topex S.A. “Bytton LTE” equipment.

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It is certified hereby that the Rohde & Schwarz Topex S.A. Bytton LTE unit is manufactured in concordance with the legal provisions concerning responsibility towards the quality of delivered products, fulfills the quality parameters specified in its “User’s manual” and is fit for the purpose for which it has been designed. It also warrants that the equipment will perform substantially in accordance with the accompanying documentation.

Any comments, suggestions and proposals of yours concerning our products are welcome and we are gladly waiting for your feedback:

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10 Annex 1 – Antennas for ByttonICR

Different types and numbers of Mobile antennas are supplied in the package for wireless Bytton LTE router. Mainly there are *two* standard (Omni directional) types, according to the technology and frequency bands of the mobile module: either for GSM/3G or for 4G (LTE).

Small stick antenna for 2G/3G up to 3G+ (HSPA+ networks)

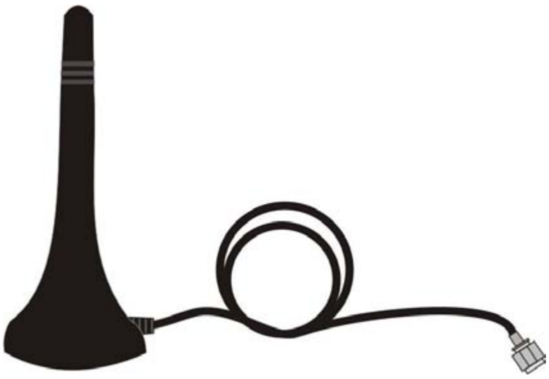
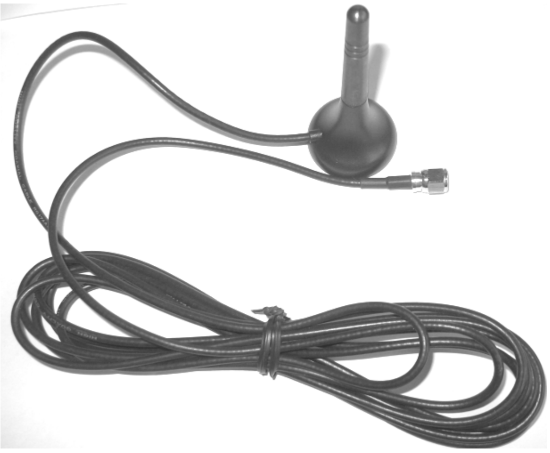


Figure 11-1: Drawing of the Mobile Antenna for 2G/3G, with magnetic base and connection cable.

The embedded multiband modem of 3G Bytton units covers almost all of the frequency bands of the world (dual band for UMTS/HSPA+ and tri-band or quad band for GSM/GPRS/EDGE). Thus, the corresponding Mobile antenna must be compatible with all these frequency rages!

The standard stick antenna for GSM/3G is small (only 7 cm height), compact, rugged, suited for indoors or outdoors usage.
It is fitted with a with magnetic base and has a 2,5m long cable.

Figure 11-2: Photo of the Mobile Antenna for 2G/3G, with magnetic base and connection cable.



The table below shows the main characteristics of the multi-band stick antenna (currently supplied with the Bytton LTE package for 3G variants).

Frequency bands	GSM 890-960 MHz PCN 1710-1880 MHz PCS 1850-1990 MHz UMTS/HSDPA 1920-2170 MHz
Gain	2 dBi
Polarization	Vertical
Height	Total 73 mm Active stick 43 mm
Base	Magnetic, bottom heavy Diameter 2,8 cm
Cable	Type RG174, length 2,5 m
End Connector	Nipple, male

Yagi GSM Antennas

In case of locations with a low level of RF, you cannot use the full potential of 3G or HSPA+ networks. For such cases, you must use Yagi antennas (high gain, directive) for the respective GSM / HSPA frequency bands, instead of the usual stick antenna.
The high gain antenna must be installed in a place with good reception (on the roof of the building).

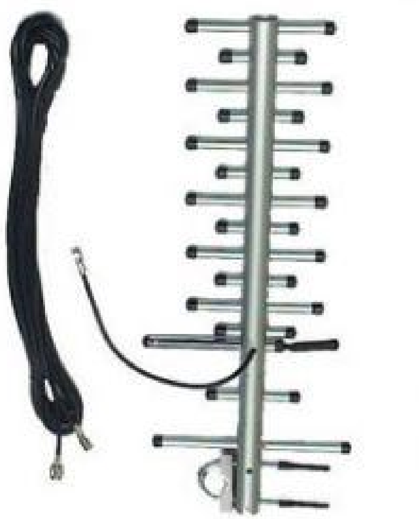


Figure 11-3: High Gain Yagi Antennas and Cables for GSM/HSPA.

Such directive antennas feature from 5 up to 14 elements, provide 10-12 dBi gain and come with a connection cable that is 10-15 m long, to allow installation of the antenna on a mast or atop the building, where it gets a better level of 3G signal.
The cable is a special one, large diameter, which assures low siggnal attenuation in spite of the additional length.
Such Yagi GSM/3G antennas are available from manufacturer upon request.

4G (LTE)

For the LTE 2600 MHz band, the " SM03" magnetic base antenna is shipped in the package. This is a thin rod, dual coil, weather proof antenna, specially designed for the 2.6GHz frequency band used for LTE in Europe.

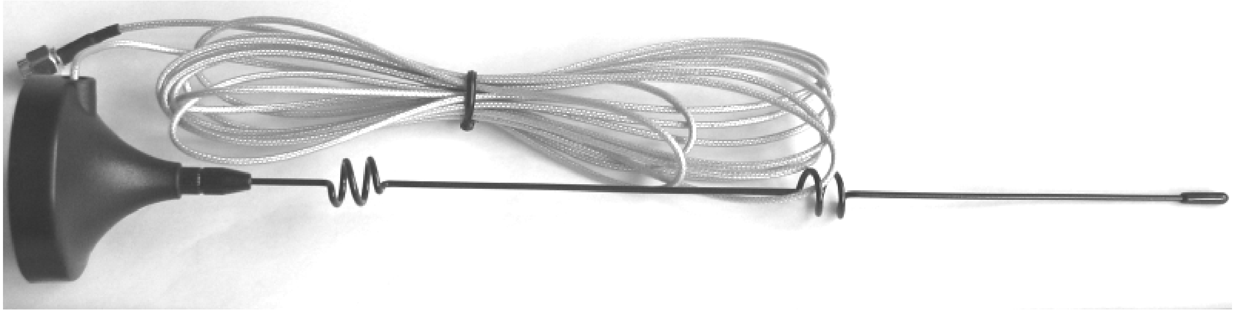


Figure 11-4: General image of the Mobile Antenna for 4G, with magnetic base and connection cable

The GSM03 antenna is for frequency ranges 890-960/1710-2150 and respectively 2600 MHz for LTE. The connection cable is thin, type RG178, and standard cable length is 3 meters, which allows more flexible placing of the antenna. Besides the SMA connector that matches the Bytton "mobile" connectors, other types are available (SMB, FME, TNC).

In the 2600MHz frequency band, gain is 5dBi for the standard model with 3 m long cable and 7dBi for the variant with shorter cable (only 1 m long), which has a smaller signal loss.

The LTE antenna is omnidirectional, rated for both outdoor and indoor usage.

The following table shows the main characteristics of the multi-band LTE antenna with magnetic base, supplied with the Bytton LTE package for 4G (LTE) variants.

Name / description	**"GSM03" multi-band LTE Antenna**
Electrical specifications	
Frequency bands	GSM 890-960 MHz PCN 1710-1880 MHz PCS 1850-1990 MHz UMTS/HSPA 1920-2150 MHz LTE 2500– 2690 MHz
Gain	5 dBi / 7 dBi (1m variant)
VSWR	<1.5
Input Impedance	50 Ohm
Directivity	Omnipolar
Polarization	Vertical
Maximum Power	60 W / 30 W
Mechanical specifications	
Height	Total 270 mm Active rod (wire+coil) 246 mm
Base	Diameter 45 mm Height 32 mm
Mounting	Magnetic Bottom heavy, stable Adhesive sticker
Cable	Type RG178, standard length 3 m
End Connector	Nipple, SMA male
Temperature range	Storage: -45^{o}C to +75^{o}C Operating -30^{o}C to +75^{o}C
IP protection	Fit for outdoors usage

In case of locations with a low level of 4G signal, Yagi (high gain, directive) antennas are also available for the LTE frequency band. They may be apparent or enclosed in a “Radome”, single ori paired (LTE technology typically employs antenna diversity, thus two antennas are used). Typicall Yagi gains range for 9dBi up to 14dBi in the 2500-2700MHz frequency bands, and the UV-stable, UL flame rated radome assures all-weather operation.

Warning! *Don’t use excessive force when threading the antennas. Make sure the antennas are securely screwed into the respective RF connectors, but do NOT use a spanner or screw key, which could damage the antenna connector! Tighten the flange lightly, by hand.*

The stick antennas has vertical polarization, they should be placed in vertical or horizontal position, depending of the local RF field condition for the respective frequencies bands.
In case of antenna diversity (MIMO) versions, the antennas shall be connected in the same way, only there are two of them:

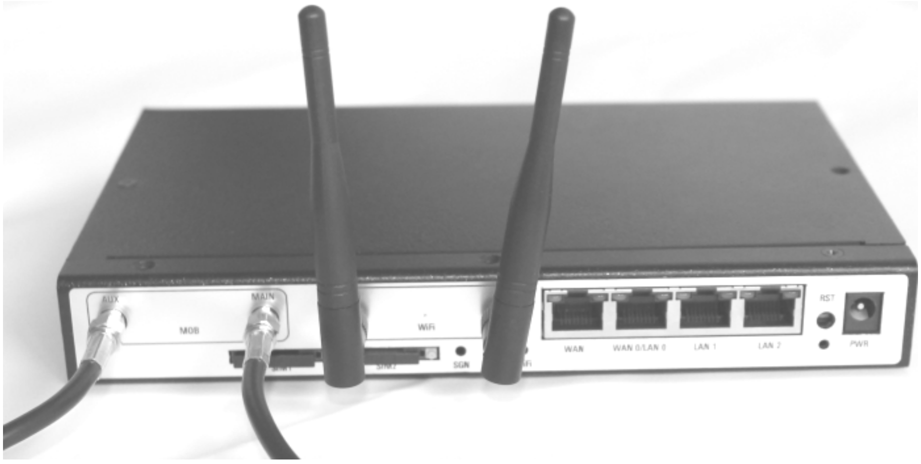


Figure 11-5: Photo of diversity-enabled Bytton, with two stick antennas for WiFI and two connectors for the 4G Mobile antennas.

Warning!
For the multiple-antenna variants of the equipment, the indications “MAIN” and “AUX” must be always observed, even when you use two identical antennas. This holds true both for the Mobile and WiFi antennas, as shown:

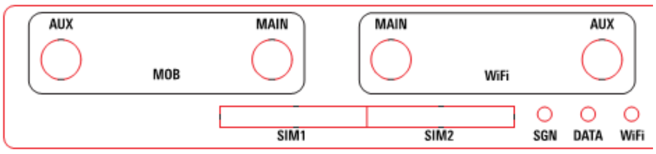


Figure 11-6: Schematic drawing of the “AUX and MAIN” markings of antenna connectors, both for Mobile (LTE network) and for Wi-Fi (type N).

This rule means that, when you connect a single antenna to a diversity-enabled equipment, always use the MAIN connector. With just one antenna, it will not be able to operate in diversity mode, still it will work correctly. But if you connect just a single antenna, to the AUX connector instead of MAIN, then it won’t be able to work properly!

Notice:

- The Bytton LTE unit and its antennas should be placed such as to be as far as possible from appliances or office equipment that is sensitive to radio interference (microwave ovens, copiers, TV sets, PC displays, and multimedia systems).
  For best results, try to find for the single or dual WiFi and HSPA or LTE antennas a place of maximum signal reception.
- In addition, the antenna must NOT be located near heavy-duty equipment that may generate electromagnetic interferences, such as electric motors or heaters.