



LigoPTP 24

Technical Description & Configuration Guide

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Overview

This document briefly describes the LigoPTP 24 series Full Outdoor Unit (FODU) covering the built-in management system, configuration functionality, hardware features, etc.

LigoPTP 24 Full Outdoor Units

LigoPTP 24 product family is the new next generation product line which is targeting growing demands for data transmission over microwave radio.

As a result the primary traffic interface for LigoPTP 24 radio is Fast Ethernet. In addition, LigoPTP 24 is capable of delivering up to 4E1 interfaces for legacy connectivity or any other use. As LigoPTP 24 is capable of providing bit rate of up to 108Mbps to all interfaces combined, it is a perfect addition to LigoWave portfolio. This product family provides perfect solution for a user looking for higher than PDH E3 capacity without need for STM-1 capacity. The excellent LigoPTP 24 radio and modem performance allows achieving perfect system capacity by employing 32-level modulation scheme by user's choice. Apart from the full system capacity of 108Mbps, it is possible to configure the radio to any of 7 MHz, 14 MHz and 28 MHz channels as well as to any of QPSK, 16APSK and 32APSK modulations, thus providing various capacities to suit particular needs.

LigoWave has employed most modern design solutions and components to create high performance compact radio with low power consumption – 19-25W per radio, thus we have a capability to feed the unit by using Power over Ethernet (802.3af) means.

LigoPTP 24 is a perfect building block for any modern future proof wireless network, including mobile service providers, fixed data service operators, enterprise customers, municipal and governmental networks among others.

LigoPTP 24 Feature Summary

Main Features

- Full Outdoor solution
- Capacity: up to **108 Mbps**
- Channel Bandwidth: **7/14/28 MHz**
- Modulations: **QPSK, 16APSK, 32APSK**
- Interfaces: **10/100Eth+4E1**
- Traffic: Ethernet only, Eth+1E1 to Eth+4E1
- Frequency bands: **13 / 15 / 18 / 23 GHz**
- **Power over Ethernet**
- Green Radio – **19-25W** of power consumption
- **ACM and ATPC** with **QoS** four priority queues
- **802.1Q VLAN** support

Mechanical Features

- Compact unit, **285x285x80mm, 3.5kg**,
- **3 handles** for user convenience
- Safe and easy to use **4 side locking** arrangement
- All connectors on the side of the unit, always at **45°** regarding vertical axis for both V and H polarization



Figure 1 – LigoPTP 24 Full Outdoor Unit

Interfaces/Management

- LigoPTP 24 FODU unit provides **4 connectors** and a grounding screw
- **User, NMS traffic** and **DC power** are fed over **Cat. 5e** or above cable and weather protected RJ-45 connector
- Ethernet traffic supports **QoS** and **4 priority queues**, essential for ACM use
- **User** and **NMS traffic** could be treated as a single data stream or separated by tagging with different **VLAN** tags
- **4 ports** of balanced **E1** interfaces are provided over weather protected **18pin connector**
- **Twin BNC connector** of the unit enables terminal access into the unit
- **BNC connector** provides AGC voltage signal to assist unit alignment
- Web, Telnet and SNMP are available as **NMS** interfaces into the unit



Figure 2 – LigoPTP 24 FODU Connectors



Figure 3 – LigoPTP 24 FODU Connectors

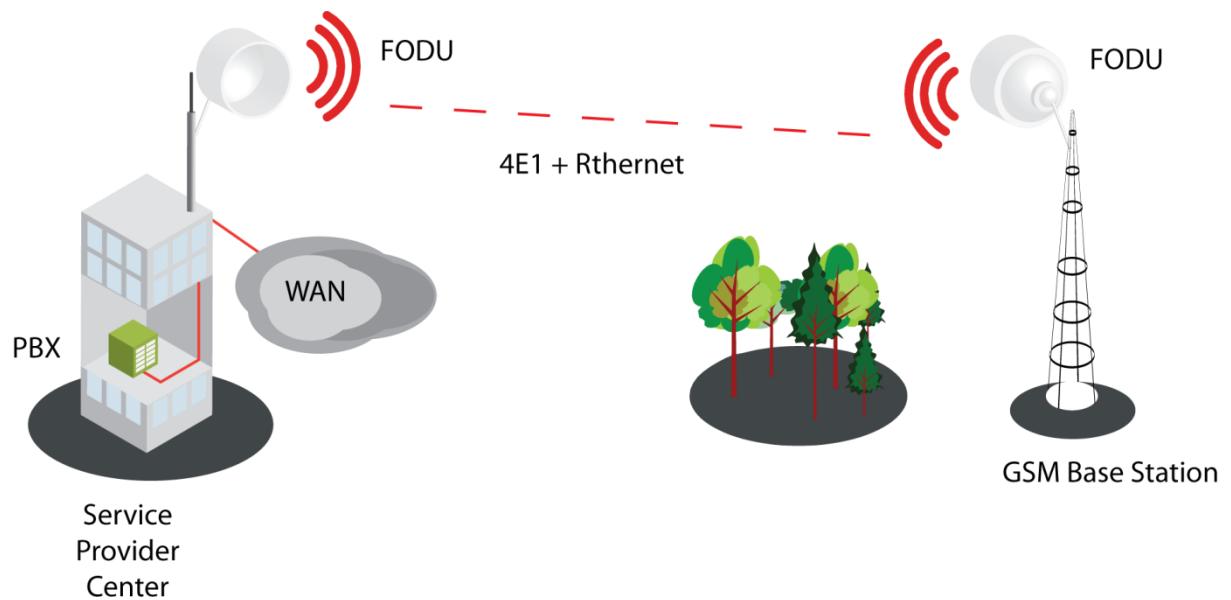
Radio Parameters

- LigoPTP 24 is a good example of latest achievements in modem and transceiver development, providing both excellent radio parameters (System Gain), due to use of **APSK modulation** and efficient yet consuming little power Tx/Rx part of the system.
- RSL Threshold at BER 10^{-6} , 28MHz, 32APSK, 100Mbps: **-77 dBm**.
- System Gain with guaranteed max Tx power and Rx sensitivity is **93 dB**.
- LigoPTP 24 provided the capability to replace typical 34Mbps PDH radio to **108Mbps** system by retaining the antenna size/distance
- **ACM** (Adaptive Coding and Modulation), hitless ACM opens whole lot of new possibilities depending on network designers strategy
- **ATCP**, Automatic Transmitter Power Control, for increased deployment density capability.
- **Very high flexibility** allows configuring the system to various channel bandwidths, modulation schemes and capacity settings

Application Examples

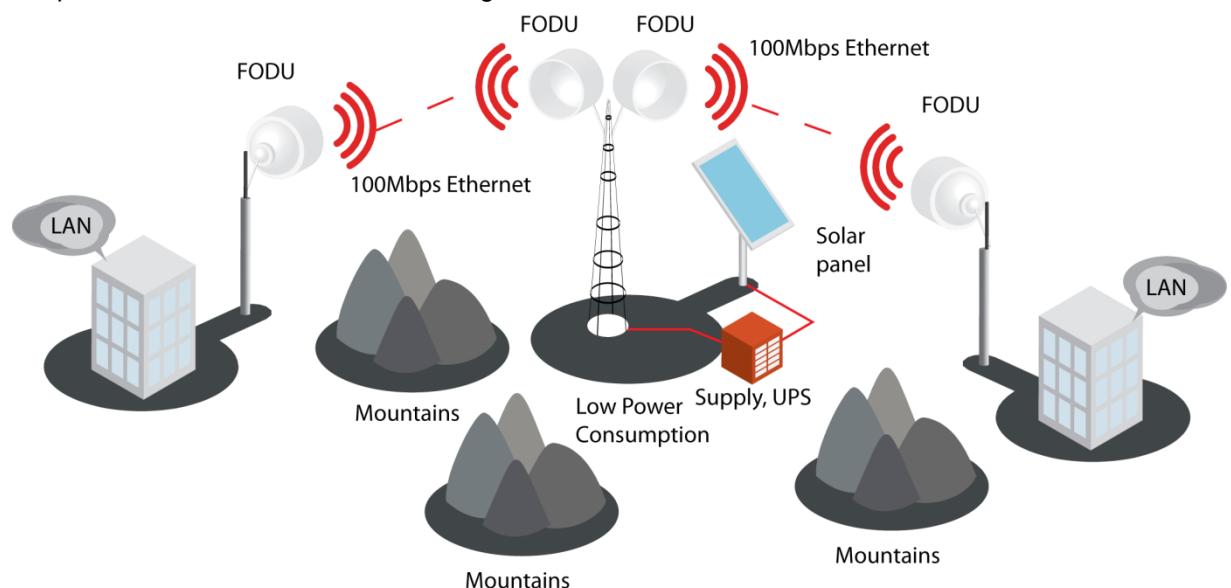
4E1 + Ethernet with LigoPTP 24 FODU

- LigoPTP 24 is a perfect tool for replacing the existing low capacity E1 radio system by preserving E1 connectivity where needed and adding high capacity Ethernet channel for future use, perfect for overlaying GSM network with 3G/WiMax and LTE (Long Term Evolution) services;
- Suitable for transition from TDM to Ethernet based networks;
- LigoPTP 24 FODU supports SNMP protocol for NMS.



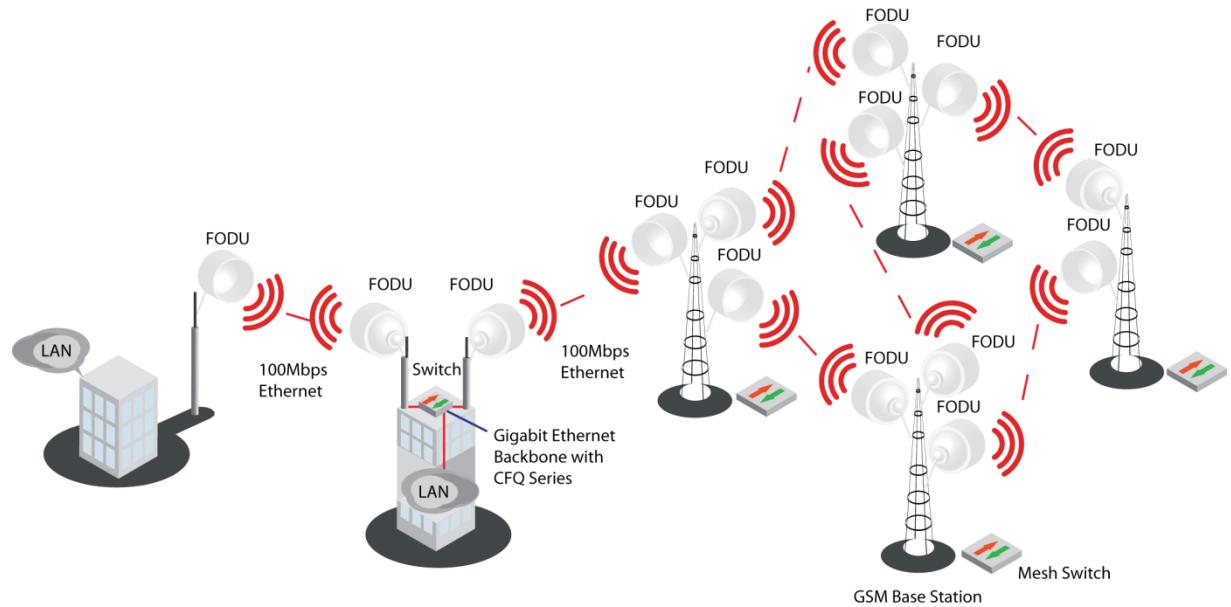
Low Power Active Repeater with LigoPTP 24 FODU

- Extends network to non line-of-sight locations;
- Ideal for crossing mountains and interconnecting Ethernet networks;
- Low power consumption allows the use of battery backed alternative power sources like solar panel and small wind turbine for off-grid remote sites.



Metro Ethernet and Mesh Networks with LigoPTP 24 FODU

- Suitable for any 100Mbps Ethernet network topology – star, ring, mesh network;
- Full Outdoor solution with Power over Ethernet Plus is efficient for All Outdoor Base station connectivity;
- Last Mile Access for demanding power user and many other applications;
- Gigabit Ethernet backhaul can be supported with LigoWave products.



Technical LigoPTP 24 Specification

| Performance | | |
|--|------------------|--|
| Channel bandwidth (MHz) | | 5 / 10 / 20 / 30 |
| Modulation | | QPSK / 16APSK / 32APSK |
| Capacity, aggregate | | 212 Mbps |
| Frequency stability (ppm) | | +/-7 |
| Guaranteed max power (dBm), adjustable | QPSK | +5 |
| | 16APSK | +5 |
| | 32APSK | +5 |
| RSL Threshold at BER 10-6, 30MHz, 32APSK, 212Mbps | | -73dBm to -75dBm |
| Adaptive Coding and Modulation (ACM) | | Hitless |
| Environmental | | |
| Stationary use | | Ref. ETSI EN 300 019-2-4, class 4.1E; non weather-protected locations |
| Operating temperature range | | -33o to +55oC |
| Mechanical Data | | |
| Dimensions: HxWxD, in / weight, lb (without antenna) | | 11.2x11.2x3.1 / 7.7 |
| Max. power consumption | | 15-20 W |
| Management Options | | |
| TCP/IP | | WEB, SNMP, Telnet - local and remote |
| ASCII Terminal | | Serial via Twin-BNC |
| Monitoring | | Via Telnet, WEB GUI |
| External Ports | | |
| Flange | | Circular 11.5mm |
| Ethernet with PoE | | RJ-45 (data traffic, management, power) |
| 4E1 | | 18-pin connector |
| Serial port for config | | Twin BNC |
| RSL port, RSSI (BNC connector) | | Output voltage vs. RSL: 0 – 1.4V vs. -90 to -20dBm |
| Antenna | | |
| PTP 24-1: | Gain | 35.0 dBi |
| | 3dB Beamwidth | 2.9° |
| | VSWR/Return Loss | 1.43:1 / 15 dB |
| | Size (Diameter) | 1 ft. |
| | Weight | 2.3 kg Operational: 112 |
| | Wind load | Operational: 112 mph Survival: 155 mph |
| PTP 24-2: | Gain | 40.3 dBi |
| | 3dB Beamwidth | 1.7° |

Performance

| | |
|------------------|--|
| VSWR/Return Loss | 1.43:1 / 15 dB |
| Size (Diameter) | 2 ft. |
| Weight | 4.4 kg |
| Wind load | Operational:112 mph Survival: 155 mph |

RSL at 10^{-6} BER (dBm) and Total Payload Capacity (Mbps, Aggregate)*

| | Channel bandwidth (MHz) * | | | |
|-------------|---------------------------|-------------------------|--------------------------|--------------------------|
| | 5 | 10 | 20 | 30 |
| QPSK | -95 dBm at 12.8 Mbps | -93 dBm at 24.2 Mbps | -90 dBm at 49.2 Mbps | -88 dBm at 73.6 Mbps |
| QPSK+wide | -94 dBm at 13.8 Mbps | -89 dBm at 30.4 Mbps | -86 dBm at 61.8 Mbps | -84 dBm at 92.6 Mbps |
| 16APSK | -89 dBm at 23.6 Mbps | -86 dBm at 48.6 Mbps | -84 dBm at 98.6 Mbps | -81 dBm at 147.4 Mbps |
| 16APSK+wide | -86 dBm at 27.8 Mbps | -81 dBm at 61.0 Mbps | -78 dBm at 123.8 Mbps | -75 dBm at 170.6 Mbps |
| 32APSK | -86 dBm at 29.4 Mbps | -83 dBm at 64.8 Mbps | -81 dBm at 123.6 Mbps | -79 dBm at 184.6 Mbps |
| 32APSK+wide | -83 dBm at 34.6 Mbps | -76 dBm at 76.2 Mbps | -74 dBm at 154.6 Mbps | -73 dBm at 212 Mbps |

*Preliminary data - actual data may vary slightly.

Cable Requirements

RS-232 Serial Connection

The ASCII console must be connected to the RS-232 serial port with Twin-BNC connector. This requires a twisted pair (TP) cable with common shield (foil and plaited shield); the cable must be suitable for Twin-BNC connector.

Using a proper cable, the operation is guaranteed for up to 10 m of cable.

4E1

The user equipment is connected to the LigoPTP 24 FODU via twisted-pair cable (at least 8 pairs, - 16 wires), refer to the chapter *Pinouts* for details. The 18-pin connector is suited for cables with the diameter from 4 to 10.5 mm.

E1 signals will be carried properly over at least 100 m of TP cable. The length of cable is restricted by the maximum allowable attenuation, which must not exceed 6 dB.

10/100Base-T

Cat. 5e UTP or better cable is required for power supply, management of device and data traffic.

LigoPTP 24 FODU can be used with any LigoWave additionally provided Power over Ethernet sourcing equipment (provided power >25 W). Used voltage is between 36–57 V DC, though the nominal voltage is 48 V, over two of the four available pairs on a Cat. 5e cable. It is possible to use passive injectors, utilizing spare leads. Refer to the chapter *Pinouts* for detailed information about pinouts.

Length of Cat. 5e cable must not exceed 100 meters.

RSSI BNC

To connect the digital multimeter to the LigoPTP 24 FODU RSSI port in order to adjust the antenna alignment, a coaxial cable with BNC connector on one end and appropriate termination on other end can be used (see example in *Figure 4 – Cable for connecting the voltmeter to the LigoPTP 24 FODU RSSI port*).



Figure 4 – Cable for connecting the voltmeter to the LigoPTP 24 FODU RSSI port

Labeling

The label can be found on the front side of the unit.

The label contains the following information (see samples in the picture below):

- Model name ("LigoPTP 24-xx").
- Product Number (I24FAE03L): product number contains information in which band side (L, H) the FODU operates. Letters A, B, C or D indicate specific subband.
- Unit Serial Number (3163901 00001); the serial number uniquely identifies the FODU.

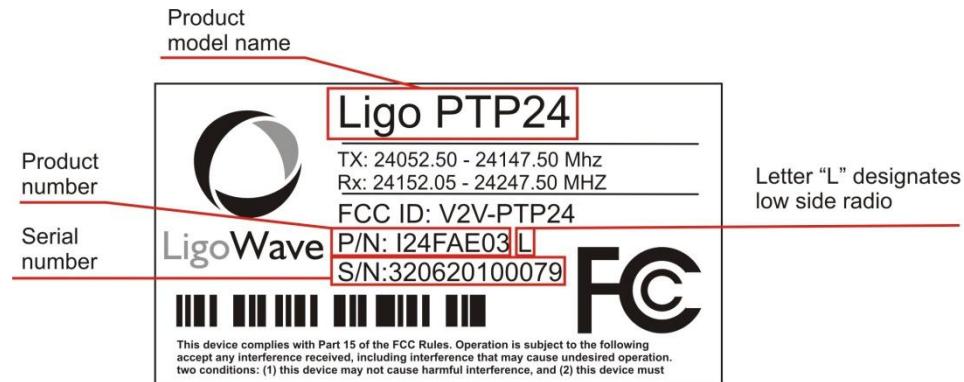


Figure 5 – Labels of the LigoPTP 24 FODU Low and High band side, operating in 24 GHz band



Note that frequency range is set from the central frequency of the first 7 MHz channel to the central frequency of the last 7 MHz channel (see below)

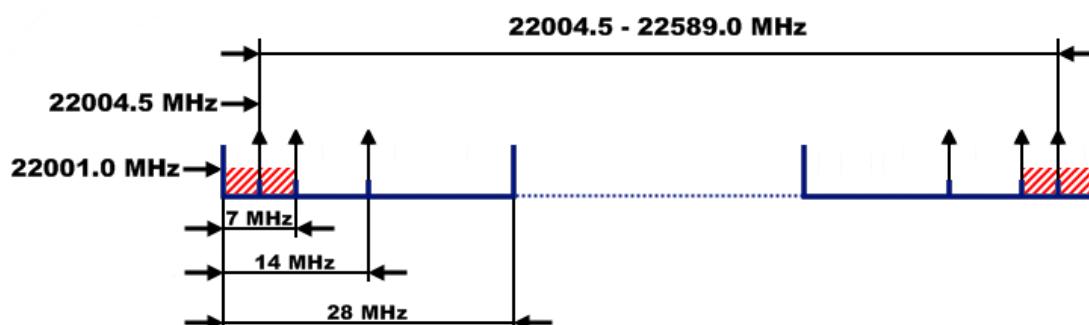


Figure 6 – Frequency range of the LigoPTP 24 FODU

The Figure explains Tx frequency range of low side LigoPTP 24 FODU radio.

Configuration and Management

There are four ways to adjust and read settings and operation parameters of the LigoPTP 24 FODU equipment:

- using **Web terminal** connected to the 10/100Base-T management port,
- using **Telnet terminal** connected to the 10/100Base-T management port,
- using **NMS or SNMP terminal**, connected to the 10/100Base-T management port, or
- using **ASCII console** connected to the serial port.

Resetting the LigoPTP 24 FODU

Depending on the method used, the user may reset the whole terminal or the management controller individually, see table below for details.

| Resetting | Description |
|---|---|
| Reset action unplugging power source. | Restarts both the multiplexer module and the management module. Resets all management counters. |
| Resetting with Restart CPU button in Web GUI 'Configuration → System configuration' window or using command prompt command " system reset " | Restarts CPU of the management controller. Resets all management counters. |
| Resetting with command prompt command " system reset cold " | Restarts modem and CPU of the management controller. Resets all management counters. |

Web Interface

This section will describe the points necessary for working with the Web interface.

10/100Base-T Port

The 10/100Base-T management port is used to connect the LigoPTP 24 to a PC or Ethernet network for Web, SNMP and Telnet management.



The 10/100Base-T port cable length must not exceed 100 meters.

Assembling the Ethernet Cable Connector



Be aware that length of RJ45 connectors may vary! This is the reason why weatherproof connector enclosure has room for longest possible RJ45 connector.

This instruction will show you how to correctly assemble weathered connector and have best possible connection of RJ45 connector with socket.



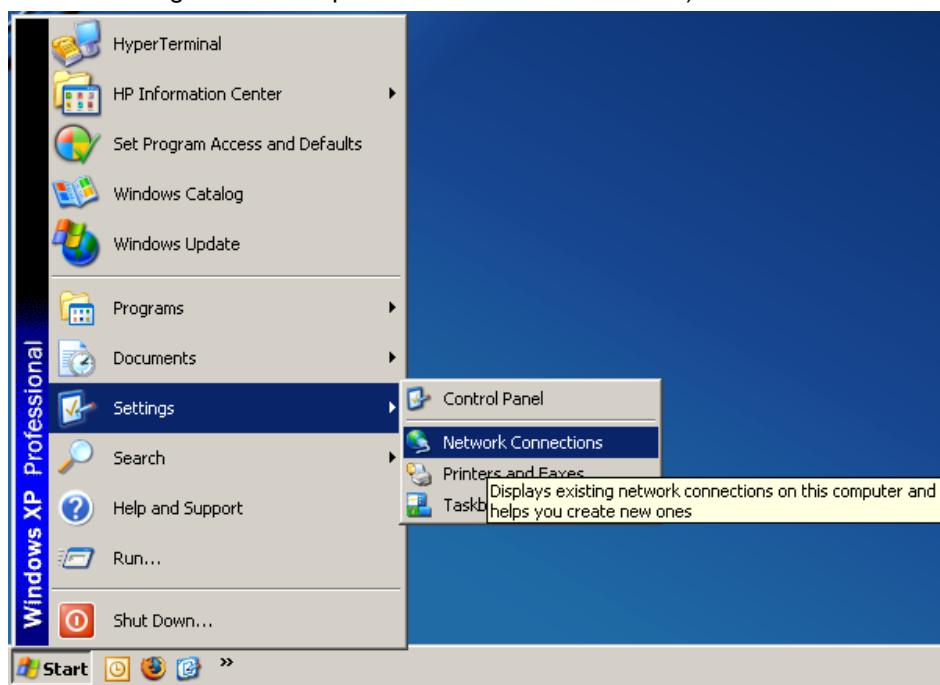
Figure 7 – Assembling Ethernet weatherproof connector

1. Prepare the cable as shown in the picture. DO NOT assemble weathered connector!
2. Plug RJ45 connector into the Ethernet socket.
3. Align weathered connector body and put it in place.
4. Fix the connector to the socket with screw. Note that cable sealing screw is still not fixed at this moment.
5. Push the RJ45 connector into the socket by pushing the cable and at the same time seal and fix the cable using cable sealing screw.
6. Assembled cable. Please fix the cable to the mast as close as possible to FODU. Do not bend it! Minimum radius shall be no less than 10cm.
7. Incorrect position of RJ45 connector, weathered connector assembled without proper RJ45 alignment. Note, that it is too deep in the connector.
8. RJ45 connector position if it is aligned during weatherproof connector assembly „in-place”.

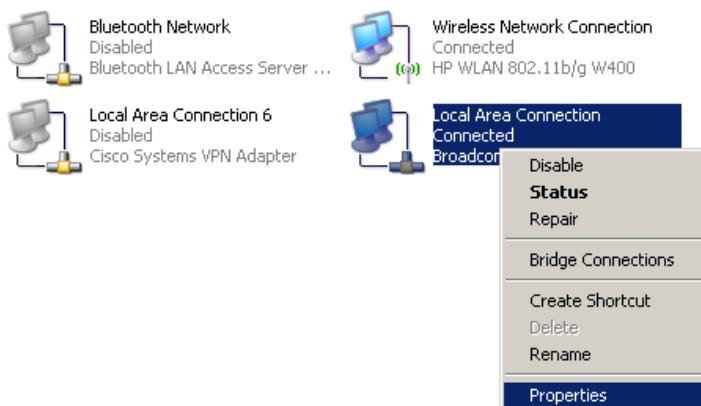
Ethernet Management Connection Configuration

Before you proceed to initial link setup with Web GUI, you must perform Ethernet connection configuration by following these steps:

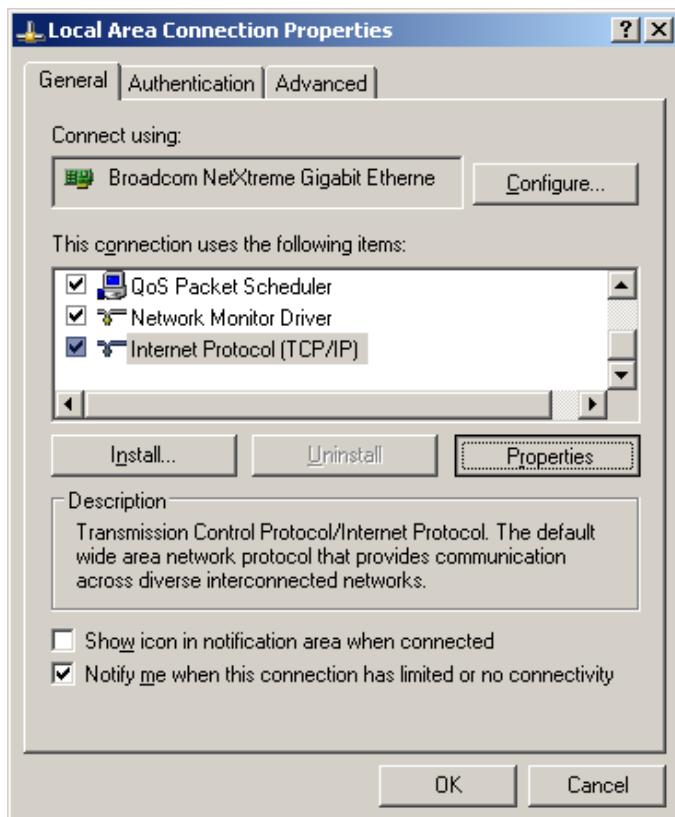
Step 1. In “MS Windows” operational system go to Start → Settings → Network connections (or Start → Settings → Control panel → Network connections)



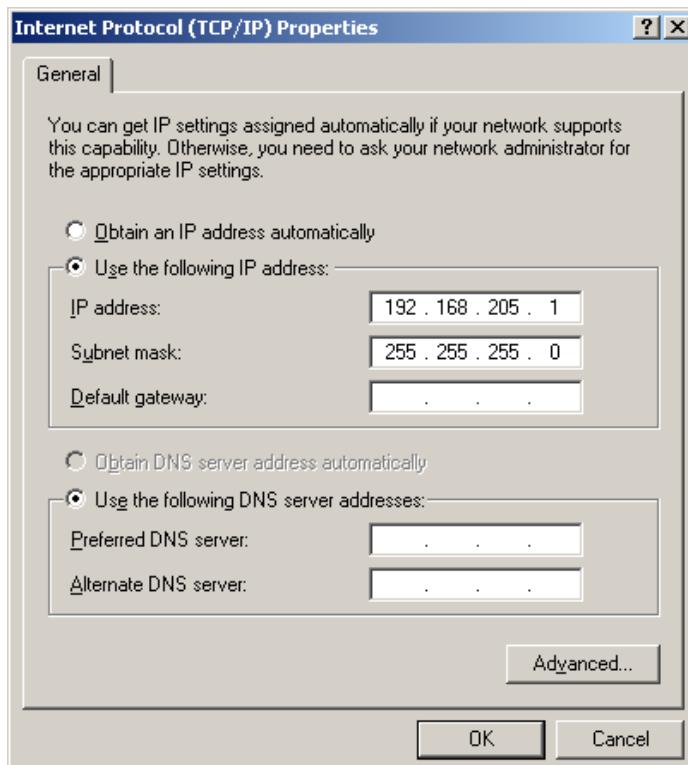
Step 2. Find ‘Local Area Connection’, click right mouse button on it and choose ‘Properties’
LAN or High-Speed Internet



Step 3. Click on ‘Internet Protocol (TCP/IP)’ from the list in the dialog box and then click on ‘Properties’



- Step 4.** In the dialog box enter the following values (so that your PC is in the same subnet as default LigoPTP 24 addresses):



Now you are ready to connect to Web GUI or establish Telnet connection.

Power over Ethernet Injection

You must have Power over Ethernet sourcing equipment (provided power>25W) to connect the laptop to the LigoPTP 24 FODU. It is possible to use passive injectors, utilizing spare leads. Refer to chapter *Pinouts* for detailed information on pinouts. Power over Ethernet injector can be purchased from LigoWave as an optional accessory. Below is an example of a passive and active Power over Ethernet injector, as well as its application scheme.



Figure 8 – Passive Power over Ethernet Injector (P/N IOATPI01)

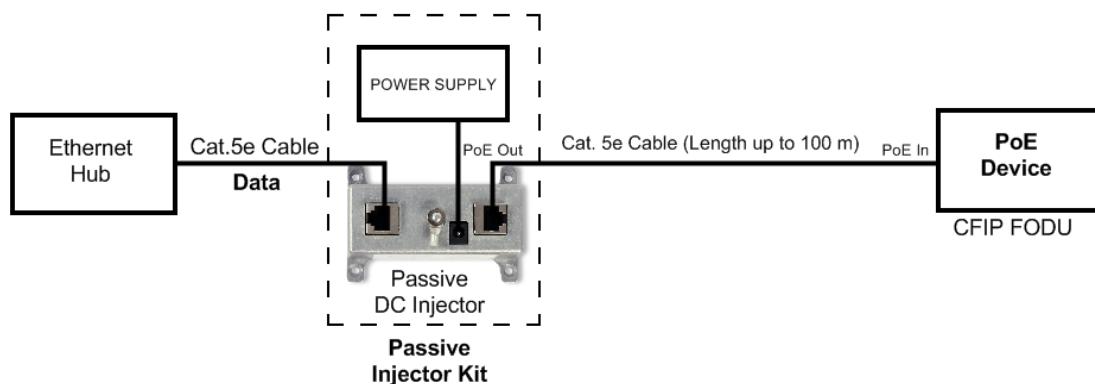


Figure 9 – Power over Ethernet Passive Injector Application

This passive injector features shielded RJ-45 jacks. This along with the metal housing helps reduce the effects of EMI. A ground lug and terminal is provided directly on the injector housing providing superior grounding. The cast aluminum housing includes integral mounting feet for easy installation.



Figure 10 –Power over Ethernet Active Injector (P/N IOATPI02) Front and Back Views

This active injector is Power over Ethernet supply with integral DC injector, so separate power supply and injector is not required. Injector is enclosed in impact resistant polycarbonate housing.

Termination Panel for 4 E1 and with Power Injector (LigoPTP-TP4)

Along with the LigoPTP 24 Full Outdoor Unit, the LigoPTP 24-TP4 panel (P/N I0GTP401) can be used for LigoPTP interface termination; the LigoPTP-TP4 panel terminates the following ports:

- **E1 ports:** the unit passes four balanced E1 signals coming from the FODU to the termination panel, providing four unbalanced 75Ω E1 ports with the BNC connector or four balanced 120Ω E1 ports with the RJ-45 socket (see **Figure 2.9.** for details).
- **WAN port:** Ethernet 10/100Base-T port for connection with the equipment at user side;
- **FODU port:** Ethernet 10/100Base-T for connection with the LigoPTP 24 FODU;
- **4E1 port:** balanced interface for 4 E1 channels to/from the LigoPTP 24 FODU;
- **Grounding screw:** for proper grounding of the termination panel.

Additionally, the termination panel provides power to the LigoPTP 24 FODU by means of the Power over Ethernet (not 802.3af) technology, which utilizes spare leads on the cable to the LigoPTP 24 FODU from the FODU port connector and provides appropriate voltage (48V) and power (>25W) (see the Figure below).

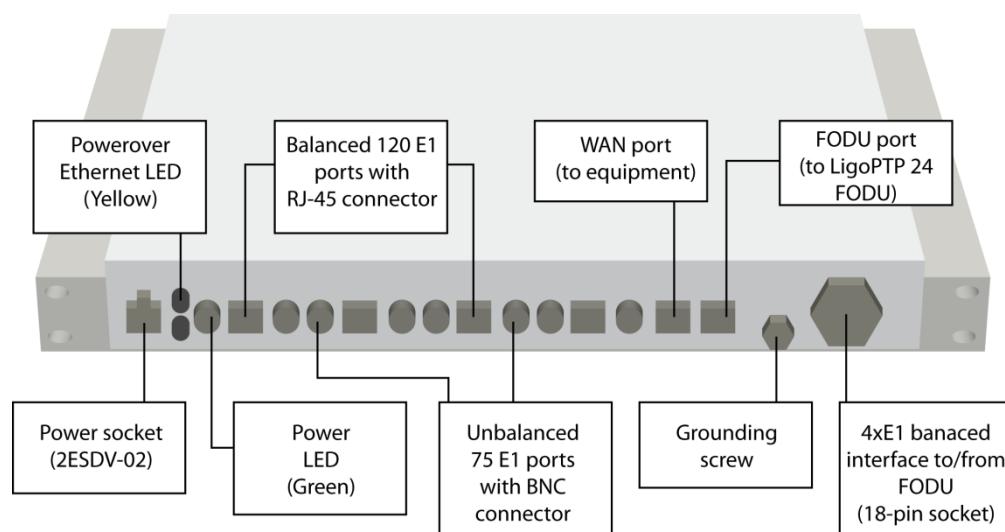


Figure 11 – Termination Panel for the LigoPTP 24 FODU; the E1 Port Numbers on the Front Panel Correspond to the LigoPTP 24 FODU Port Numbering

The termination panel also features full surge protection, meeting ITU-T K.20/K.21/K.44/K.45 recommendations and ETSI ETS 301 489 standard.



The panel does not provide serial management port (RS-232); the serial port can only be used by directly connecting to the FODU.

Power LEDs on the termination panel show if the power is being fed to the termination panel (Green LED), and if the LigoPTP 24 FODU is powered on (Yellow).

The LigoPTP-TP4 unit is optional and can be used with any of the LigoPTP 24 Full Outdoor Units. It is frequency and capacity independent.

LigoPTP-TP4 panel mechanical data:

- Dimensions (HxWxD): 44 x 482.6 x 54 mm;
- Weight: 0.6 kg.

Connection with Web Interface

It is recommended to use the following web-browsers (and all later versions):

- IE v. 6.0
- Mozilla Firefox v. 2.0.0.11
- Safari v. 3.0

- Opera v. 9.50

After web browsers selection, open it and enter address of the FODU (**Figure 2.10**).



It is important to know the Side parameter of the FODU to which you want to connect; whether the factory settings are loaded in FODU.

If Low Side -> IP: 192.168.205.10

If High Side -> IP: 192.168.205.11

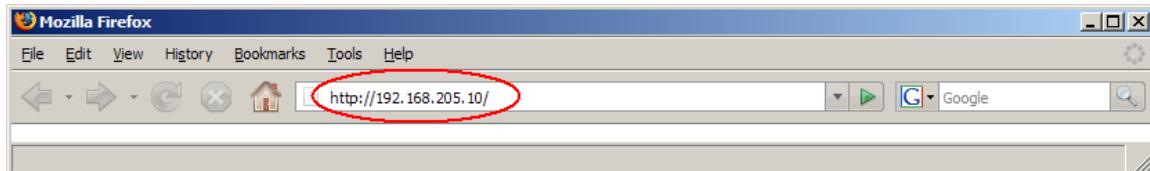


Figure 12 – LigoPTP 24 FODU IP Address



The default username and password for Web access are:

username: admin

password: changeme

If the IP address is correct, and your browser is recommended (with a suitable version), you can see the text confirming that your browser is accepted. After that you will be redirected to the “real” page. If the IP address is not valid, you will not get configuration interface, but if your browser is not accepted (not recommended or there are problems with the version), you will see the text informing that there are problems with the browser. You can push the button **Continue Anyway** to be redirected to the “real” page.

If everything is correct, you will see the main window of the WEB Interface. If in the field displaying Local and/or Remote system values there are problems (configured values are not the same for Local and Remote, or there is a problem with parameter value), the appropriate cell will be highlighted in red colour.



If the WEB page is not shown correctly, try purging browser cookies, cache and offline data and restarting the browser.



All the commands, which will be executed from the WEB GUI, will be translated to CLI commands and will be executed as in CLI.

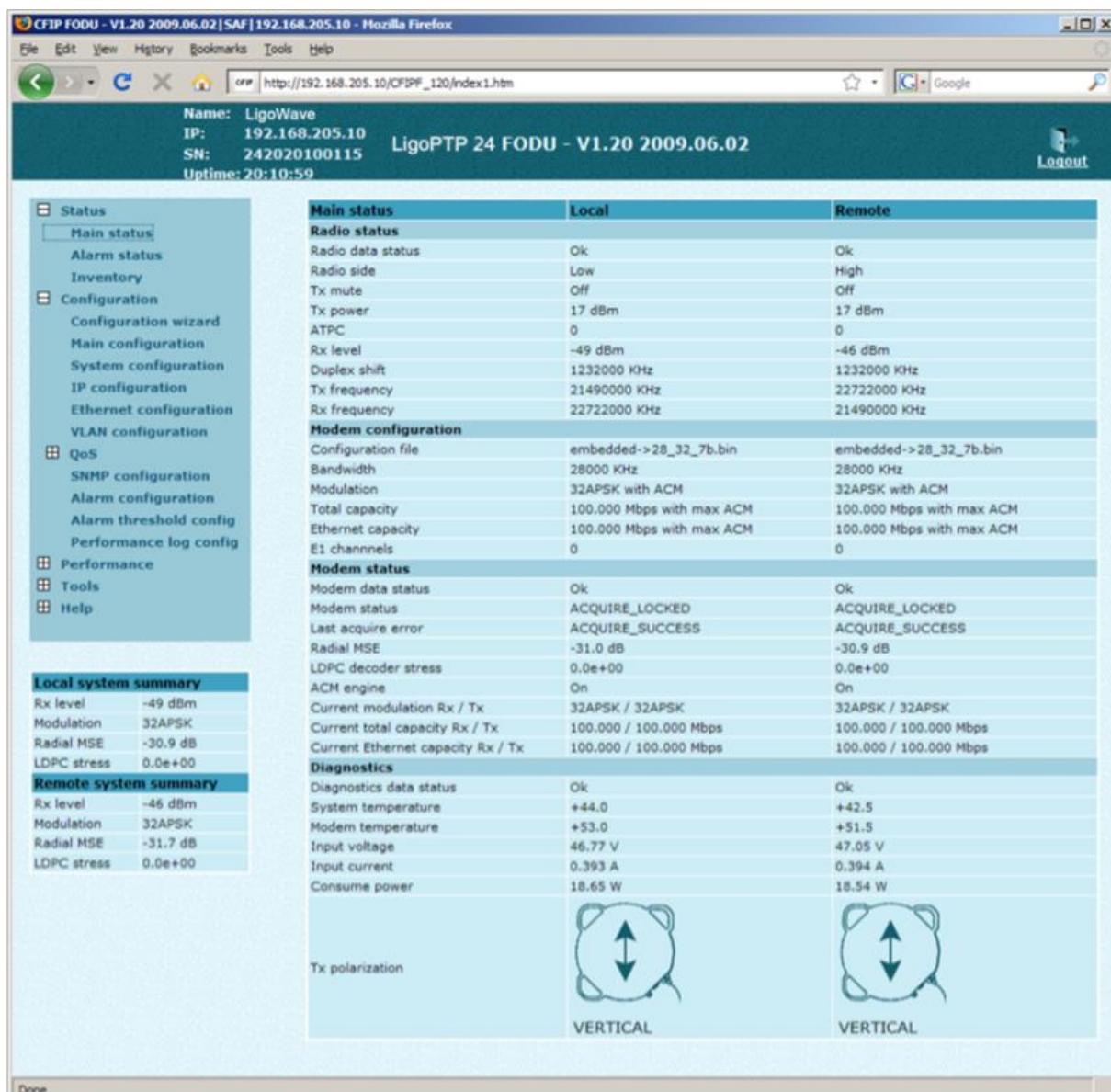


Figure 13 – Web Interface - Main Window

Interface Description

WEB interface consists of four parts, they are:

- **Top panel**, that allows to log out and gives information about device type, software version, device name, IP, serial number and uptime;
- **Menu panel** that is used to open links to other pages;
- **Status summary** for local and remote devices: this section is available while browsing other pages.
- **The main panel** where the new pages selected from the menu panel are loaded for display;

Also, special marks are used:

- Entries highlighted in red indicate that specific parameters do not comply with the norms of normal operation. For example: value is out of range; local value is not equal to the remote value and vice versa (only in some places); no value data (N/D).
- If the entry is highlighted in yellow, this means warning condition.
- If the value place reads 'N/D', this means 'No Data'.
- If the value place reads 'N/A', this means 'Not Available'.

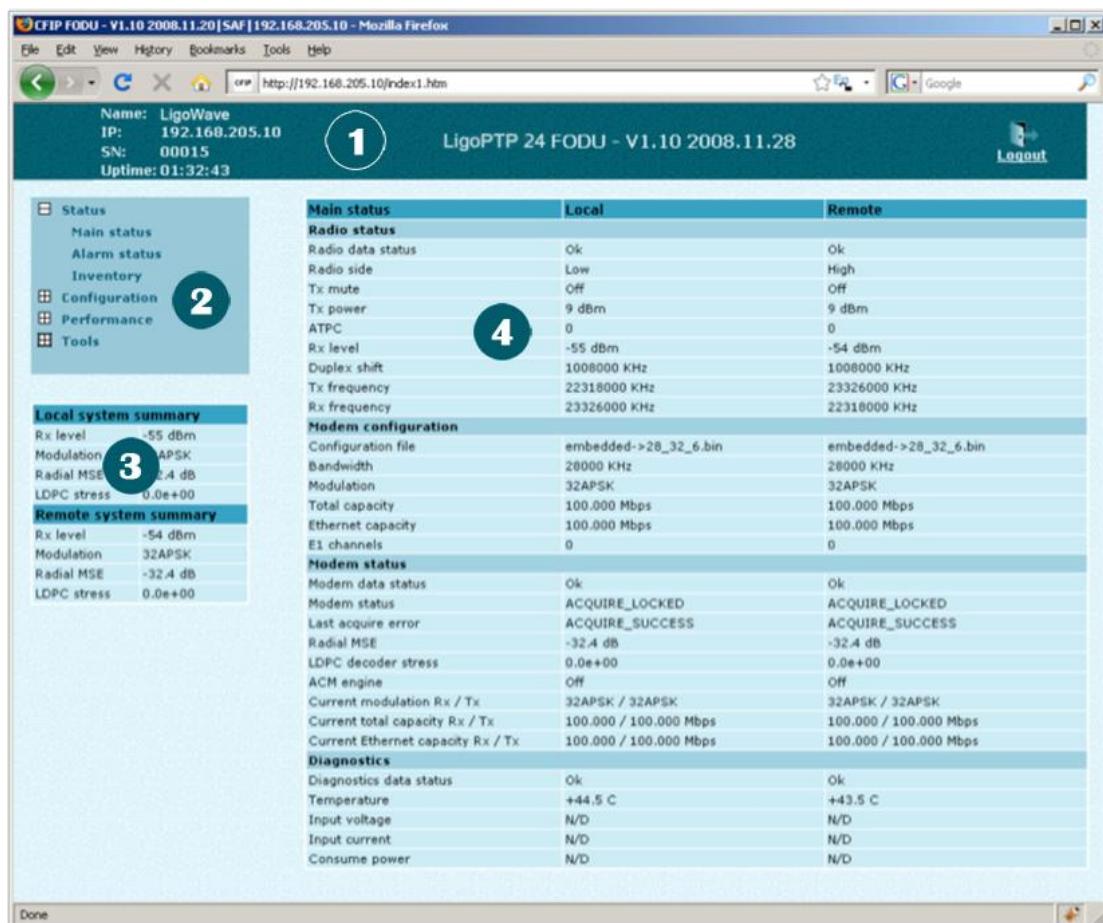


Figure 14 – Web Interface - Main Window with Section Numbering

Command Execution

There is a “Main configuration” page shown in *Figure 15 – Web Interface - IP Configuration Page with Numbering*. The entire page is divided into smaller fragments:

1. The header of page;
2. Sub-header of single type configuration parameters;
3. Execution controls related to a single type configuration parameters.
4. **Execute configuration** button executes configuration changes only on the local side LigoPTP 24 FODU, but **Execute for both** executes configuration changes on both remote and local side LigoPTP 24 FODUs. Enabling rollback feature allows going back to previous configuration in case of management connectivity loss.
5. **Write to config file** button, which generates “**cfg write**” CLI command, which saves changed configuration;
6. Configuration parameter name;
7. Configuration parameter **current** value;
8. Comments (not on every page).

Execute for both is available in **Main configuration** section, configuring simultaneously the local and remote side radio, modem or ATPC parameters only. Connection between both management CPUs must be established in order to complete successfully configuration execution for both sides.

Rollback on feature is intended to maintain connectivity of the LigoPTP 24 link by cancelling last erroneous configuration changes and reverting to previous successful configuration used. Rollback will activate only if you lose connection to WEB interface of LigoPTP 24 FODU after configuration changes applied, and reverting process will take approx. 3 minutes.

After parameter value editing, when the focus from this object is removed, this parameter value edit box may be highlighted in red, meaning that entered value is not valid.

If **Execute configuration** or **Execute for both** buttons are pressed, and one or several configuration values edit boxes is/are highlighted in red, the user will see error message with the explanation text.

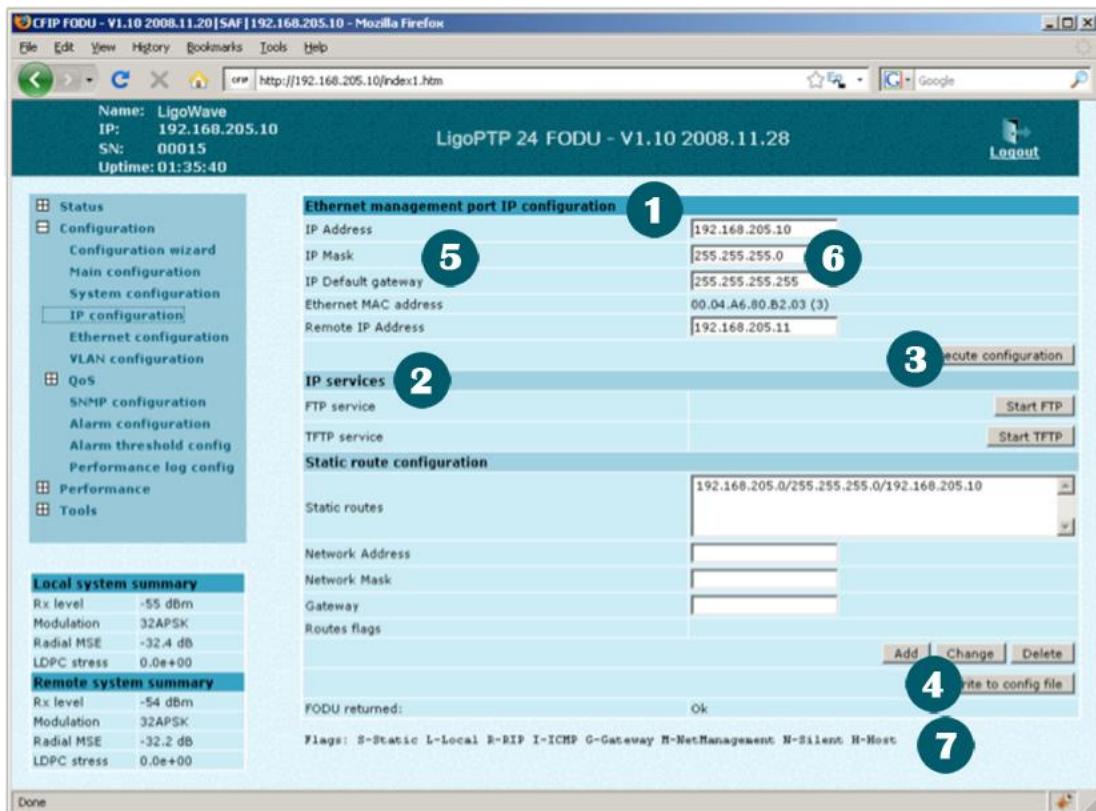


Figure 15 – Web Interface - IP Configuration Page with Numbering

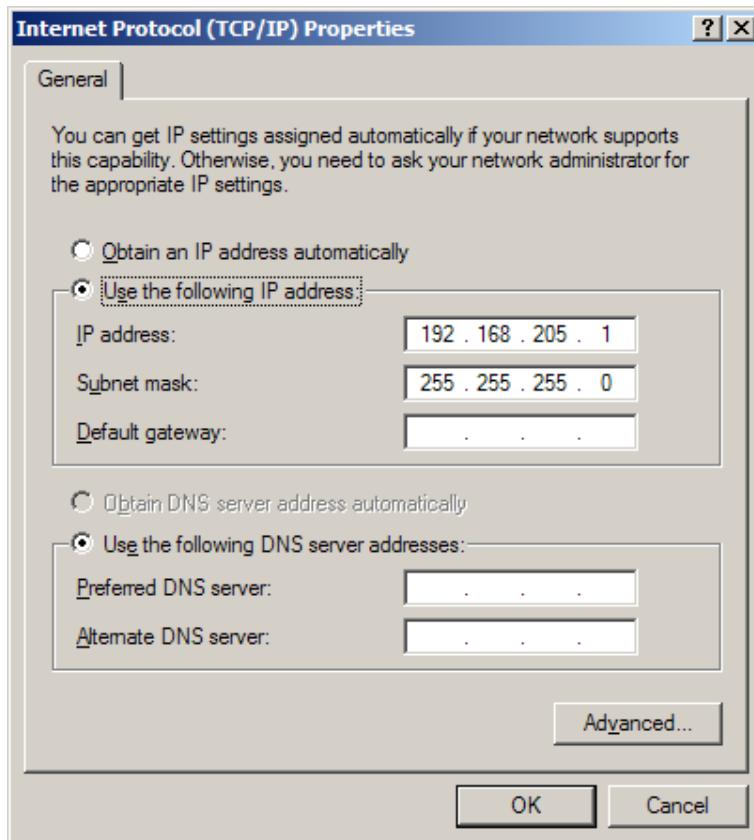
Initial Configuration with Web GUI

Your connected laptop should be in the same subnet with manageable LigoPTP 24, so you can see them. That is why, the laptop Ethernet port settings should be set as follows: (in ‘Microsoft Windows’ go to Control panel → Network Connections → Local Area Connection → Properties → Internet Protocol (TCP/IP) → Properties):

- IP address 192.168.205.1;
- netmask 255.255.255.0;
- everything else is blank.



LigoPTP 24 FODU must be powered up using dedicated Power over Ethernet injector with load power at least 25W. See Chapter 2.2.4 for details.



The next step is to connect to LigoPTP 24 FODU by entering IP in the browser address line – which is by default 192.168.205.10 for the low side and 192.168.205.11 for the high side. In case you are not sure which side you are managing at the moment, you can try both default IP addresses.

Currently supported browsers you can use are ‘Internet Explorer’, ‘Mozilla Firefox’, ‘Opera’, and ‘Safari’.



Figure 16 – Supported Browsers

When you are connected to the LigoPTP 24 FODU, you will see the window similar to the one shown in *Figure 13 – Web Interface - Main Window*.

To start simple configuration process, you must proceed with the configuration wizard which will set up the main parameters of the link to make it work. So, the first step is to go to ‘Configuration → Configuration wizard’ as shown below in the *Figure 17 – Starting Configuration Wizard*.

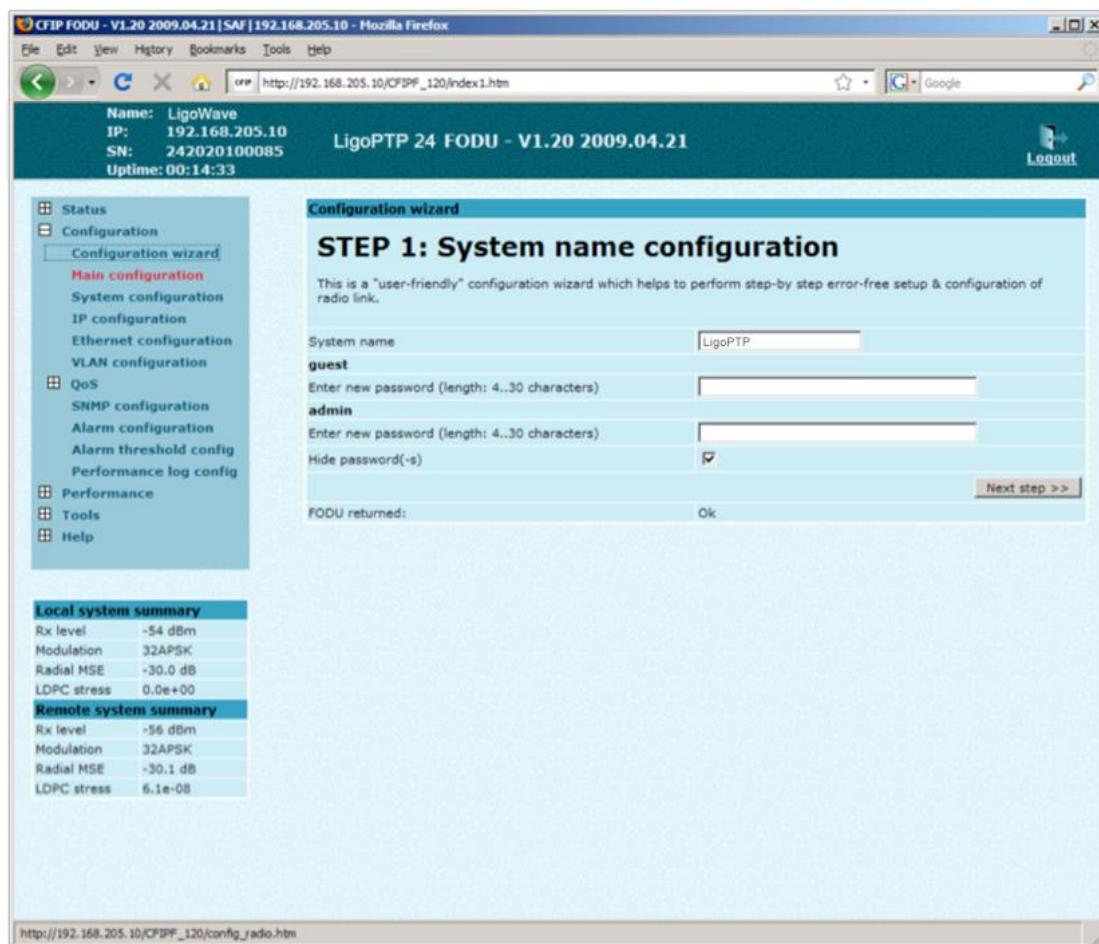


Figure 17 – Starting Configuration Wizard

Initially, you can specify preferable system name, passwords for guest and admin accounts.



Default password for “admin” account is *changeme*.
“guest” account is disabled by default!

The next time you will try to access the Web GUI management, you will be asked to enter the user name (guest or admin) and user password.



It is highly recommended to name the system after its geographical location.

By default, system name is ‘LigoPTP’.

Configuration wizard

STEP 1: System name configuration

This is a “user-friendly” configuration wizard which helps to perform step-by step error-free setup & configuration of radio link.

| | |
|---|---|
| System name | LigoPTP |
| guest | Enter new password (length: 4..30 characters) |
| admin | Enter new password (length: 4..30 characters) |
| <input checked="" type="checkbox"/> Hide password(-s) | |
| <input type="button" value="Next step >>"/> | |
| FODU returned: | Ok |

Figure 18 – STEP 1. Defining System Name and Passwords for “guest” and “admin” Accounts

After accepting and pressing **Next step >>** button, you will be redirected to the second configuration wizard screen, where you will be asked to define the network IP settings by entering IP address, IP mask, default gateway and remote link side IP address.

| Please enter FODU IP address and network mask | |
|---|-----------------|
| IP address | 192.168.205.10 |
| IP mask | 255.255.255.0 |
| IP default gateway | 255.255.255.255 |
| Remote IP address | 192.168.205.11 |

Back step << **Next step >>**

Figure 19 – STEP 2. Defining IP address, mask, default gateway and remote IP address

The third screen of the wizard is devoted to the modem configuration and requires specifying utilized bandwidth (7, 14 or 28 MHz), modulation type (QPSK, 16APSK or 32APSK) and the number of E1 channels (from 0 to 4 possible channels); besides, the modem data status is being shown.

These configuration parameters will determine overall link capacity.

| Please enter FODU modem part parameters | |
|---|--------|
| Modem data status | Ok |
| Bandwidth | 28 MHz |
| Modulation | 32APSK |
| Number of E1 channels (0..4) | 0 |

Back step << **Next step >>**

Figure 20 – Defining modem bandwidth, modulation and the number of E1 channels

The next step is radio configuration. It primarily shows the radio data status and allows specifying the main radio parameters – Tx power (the minimum value is -2, -1 or 0 dBm and the maximum – 17, 18 or 19 dBm, which depends on the modulation chosen) and Tx frequency which should be certainly already known to you regarding the channel plan and the frequency regulation issues.

| Please enter FODU radio part parameters | |
|---|--------------|
| Radio data status | Ok |
| Tx power (-2 .. 17 dBm) | 17 dBm |
| Tx frequency (22014000 .. 22582000 KHz) | 22318000 KHz |

Back step << **Next step >>**

Figure 21 – STEP 4. Defining radio Tx power and frequency

The final screen allows checking the selected settings and applying them. The optional settings are as follows:

- Clear cfg file before the new settings will take place – resetting or keeping all the other parameters, not mentioned here, after configuration execution
- Set local machine time – uses the time of your laptop
- Write this configuration into cfg file – configuration is automatically written in configuration file

Configuration wizard

STEP 5: Check parameters

Please verify the parameters set.

| | |
|--|--------------------------|
| guest | |
| Password | |
| admin | |
| Password | ***** |
| System name | LigoPTP |
| IP address | 192.168.205.10 |
| IP mask | 255.255.255.0 |
| IP default gateway | 255.255.255.255 |
| Remote IP address | 192.168.205.11 |
| Bandwidth | 28 |
| Modulation | 32APSK |
| Number of E1 channels | 0 |
| Tx power | 17 |
| Tx frequency | 22318000 |
| Clear cfg file before the new settings will take place | <input type="checkbox"/> |
| Set local machine time | <input type="checkbox"/> |
| Write this configuration into cfg file | <input type="checkbox"/> |

Back step << **Execute configuration**

Figure 22 – STEP 5. Checking settings and executing configuration

To verify the settings, we can go to **Status** or the main screen, which is the first option in the navigation panel. If there are no ‘red fields’, everything is set correctly and the link is up.

Command Prompt Interface

The LigoPTP 24 equipment can be monitored and configured by using command interface described in this chapter.

This process is performed by connecting to the Telnet terminal via the Ethernet management port; the Telnet management supports only one client.

The command line management interface offers the widest configuration and monitoring functionality. The available commands for Telnet management are found in detailed explanation of Web GUI windows, as well as in tables of additional commands.



- To end Telnet session press Ctrl+D. Opening the session again, the prompt will appear to enter username and password.
- For default (factory) usernames and passwords please refer to chapter *Configuration File*.



Syntactic notes for command prompt commands

- Commands are in **bold** font.
- All arguments (variables) are in *italic* font.
- Subcommands and keywords are in regular font.
- Arguments in square brackets ([]) are optional but required arguments are in angle brackets (<>).
- Alternative keywords are grouped in braces ({}) and separated by vertical bars (|).
- The usage of each command is displayed if the command followed by the “?” (or any unrecognizable string) is entered, e.g., *radio* ?

The management system is automatically restarted if it freezes. This is performed by the watchdog timer. Restarting of the management system does not affect (interrupt) the E1/Ethernet traffic.

RS-232 Serial Management Port

The RS-232 serial management port provides terminal management via a connected PC or another terminal device or modem.

The terminal connected to the serial management port provides the same management functionality as Telnet interfaces (refer to chapter *Telnet Connection*). In order to interconnect the LigoPTP 24 FODU and the management terminal directly through serial ports, a “straight through” modem cable is required.

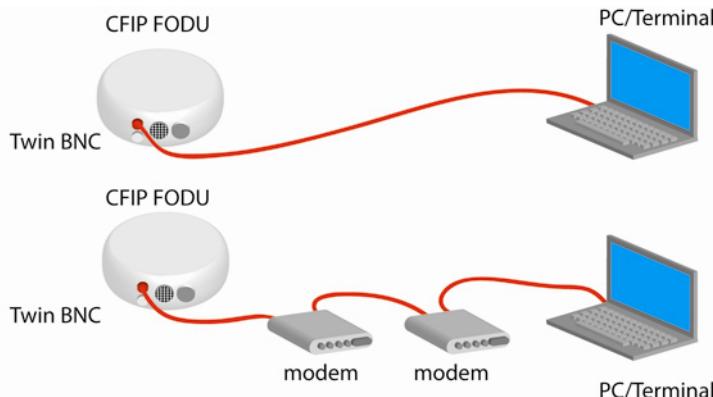


Figure 23 – Serial connection options to LigoPTP 24 FODU

When using modems, the management terminal is connected with the LigoPTP 24 FODU remotely through a telephone line. In this case, the modem connected with the LigoPTP 24 FODU should be set to Auto Answer mode.

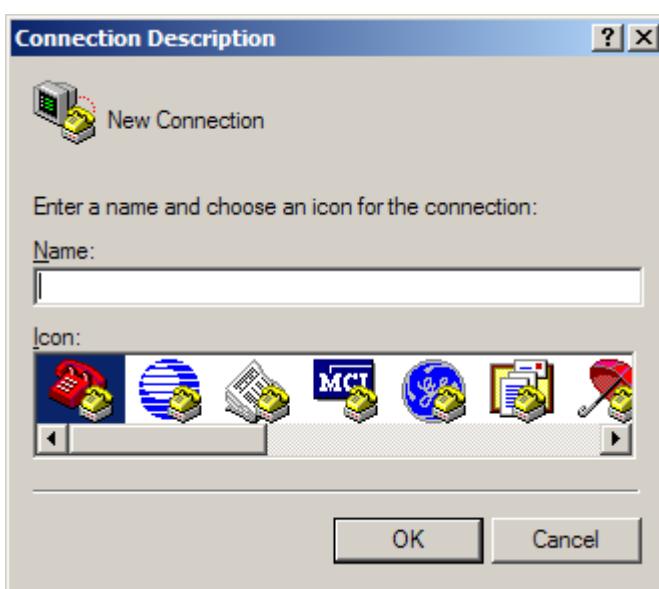
In order to connect the console to the Radio via RS-232 interface, the serial port of the management console should be configured as 19200 8-N-1, no data flow control.

To connect the PC to the RS232 management port using Hyper Terminal program (program is included in any Windows version), proceed as described below.

Step 1. Connect the PC to the RS232 serial port by means of “straight through” or modem serial cable (null-cable).

Step 2. Run “Hyper Terminal” program.

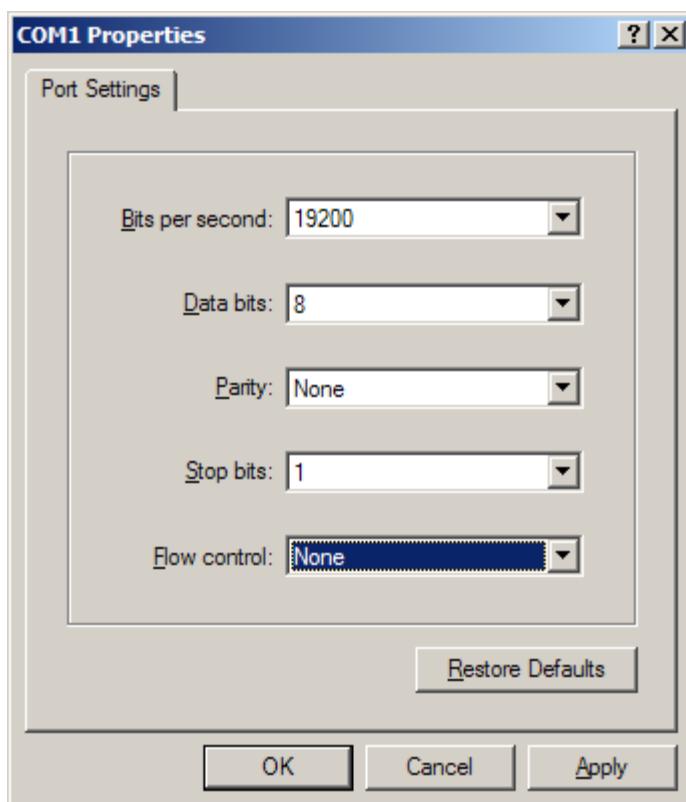
Step 3. Make a New connection and enter connection name.



Step 4. Choose port (COM1 or COM2).



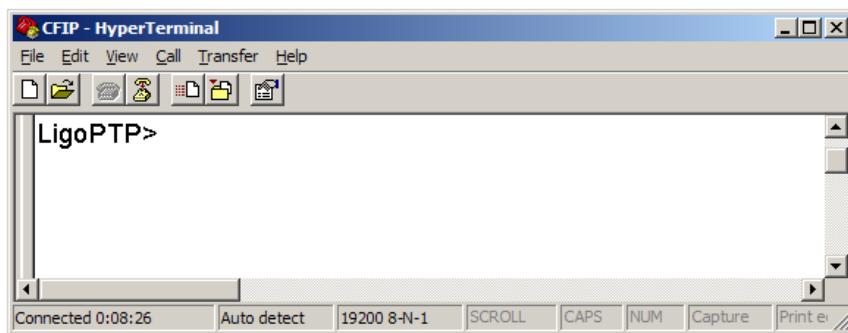
Step 5. Set port settings (bits per second: 19200, data bits: 8, parity: none, stop bits: 1, data flow control: none).



Step 6. Press OK

Step 7. Press Enter. Password is disabled by default.

If successfully connected, the prompt should appear as in the picture below.

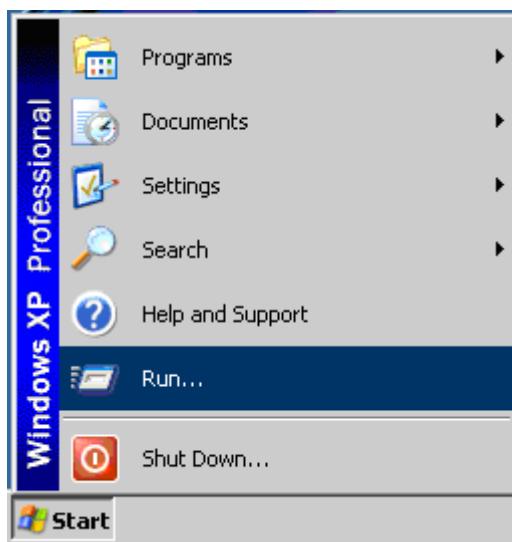


Telnet Connection

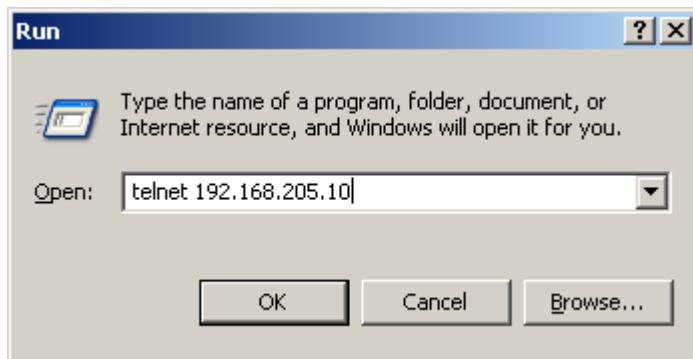
The Telnet connection to the LigoPTP 24 FODU is carried out using the Ethernet management connection. Please refer to chapter *Assembling the Ethernet Cable Connector* for Ethernet management port connection details.

When you are ready to connect to Telnet interface, please follow these steps:

Step 1 Go to Start → Run...

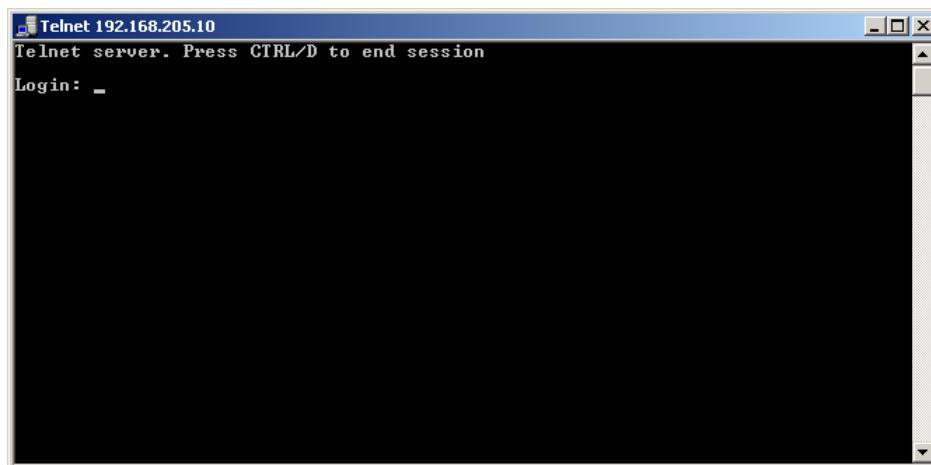


Step 2 Type in **telnet <ip_addr>**, where <ip_addr> is IP address of the LigoPTP 24 FODU you want to connect to (refer to the LigoPTP 24 FODU label explanation in chapter *Labeling*)



Step 3 If the Ethernet management connection is configured properly, you will see a window similar to the one shown below, where you will be asked to enter login and password. Default login is identical to WEB login name:

- user name – **admin**
- password – **changeme**



After you have correctly entered the login and password, you are ready to work with all the available command prompt commands.

Initial Configuration with Command Prompt

Configuration steps using command prompt are as follows:

Step 1. Check the system settings with command **status**

Step 2. Configuration required parameters:

- Tx power with the command **radio txpower [<power dBm>]**;
- Tx frequency with the command **radio freq [<freq KHz>]**;
- Channel bandwidth with the command '**modem bandwidth <7|14|28>**', where you can choose among 7, 14 or 28 MHz values;



Before you set above mentioned parameters, you must know what frequency and bandwidth you may use and at what power you may transmit.

- Modulation with the command **modem modulation <QPSK|16APSK|32APSK> [wide] [ACM]**;
- Number of E1 channels with the command **e1 set <Number of E1 channels>**;
- Name of LigoPTP 24 FODU with the command **system name <name>**. Default name is 'LigoPTP';
- IP address with the command **net ip addr <addr>**, if it is necessary;
- IP mask with the command **net ip mask <mask>** , if it is necessary;
- IP default gateway with the command **net ip gw <gw>** , if it is necessary;
- Remote IP address with the command **net ip remaddr <remaddr>**, if it is necessary;

Step 3. Save settings with the command **cfg write**; restarting with the command **system reset**;

Step 4. Check the settings made, modem and radio status with the commands **status**, **modem status** and **radio status** respectively.

Status Window

The main window in the Web GUI is the status window, which shows all the main system parameters, and, in case of failure or any other problem, it tints a specific parameter in red.

To better understand what is exactly shown in the status window, we will go through every field of the status window.

| | Main status | Local | Remote |
|-----------------------------------|---------------------------|---------------------------|--------|
| Radio status | | | |
| Radio data status | Ok | Ok | |
| Radio side | Low | High | |
| Tx mute | Off | Off | |
| Tx power | 17 dBm | 17 dBm | |
| ATPC | 0 | 0 | |
| Rx level | -49 dBm | -46 dBm | |
| Duplex shift | 1232000 KHz | 1232000 KHz | |
| Tx frequency | 21490000 KHz | 22722000 KHz | |
| Rx frequency | 22722000 KHz | 21490000 KHz | |
| Modem configuration | | | |
| Configuration file | embedded->28_32_7b.bin | embedded->28_32_7b.bin | |
| Bandwidth | 28000 KHz | 28000 KHz | |
| Modulation | 32APSK with ACM | 32APSK with ACM | |
| Total capacity | 100.000 Mbps with max ACM | 100.000 Mbps with max ACM | |
| Ethernet capacity | 100.000 Mbps with max ACM | 100.000 Mbps with max ACM | |
| E1 channels | 0 | 0 | |
| Modem status | | | |
| Modem data status | Ok | Ok | |
| Modem status | ACQUIRE_LOCKED | ACQUIRE_LOCKED | |
| Last acquire error | ACQUIRE_SUCCESS | ACQUIRE_SUCCESS | |
| Radial MSE | -31.0 dB | -30.9 dB | |
| LDPC decoder stress | 0.0e+00 | 0.0e+00 | |
| ACM engine | On | On | |
| Current modulation Rx / Tx | 32APSK / 32APSK | 32APSK / 32APSK | |
| Current total capacity Rx / Tx | 100.000 / 100.000 Mbps | 100.000 / 100.000 Mbps | |
| Current Ethernet capacity Rx / Tx | 100.000 / 100.000 Mbps | 100.000 / 100.000 Mbps | |
| Diagnostics | | | |
| Diagnostics data status | Ok | Ok | |
| System temperature | +44.0 | +42.5 | |
| Modem temperature | +53.0 | +51.5 | |
| Input voltage | 46.77 V | 47.05 V | |
| Input current | 0.393 A | 0.394 A | |
| Consume power | 18.65 W | 18.54 W | |
| Tx polarization | | | |
| | VERTICAL | VERTICAL | |

1. Shows the name of this LigoPTP 24 FODU, its IP address, serial number and uptime since the last restart. If uptime is displayed in red, the connection to LigoPTP 24 management port was lost;
2. Shows the firmware version this LigoPTP 24 FODU is currently using;
3. **Logout** button allows ending the current Web GUI management session and logging in as a different user if necessary. After pressing the button, you are automatically redirected to the login page;
4. The tree of Web GUI sections;
5. Shows short summary of the main operational parameters of local and remote system.
 - Rx level (or RSL) at both ends must not differ significantly from the previously calculated value.
 - Modulation indicates which modulation mode is used. For better operation the same modulation must be set at both ends.
 - Radial MSE is explained below in the chapter *Radial MSE*.

- LDPC is explained below in the chapter *LDPC*.

Radio data status – shows if management CPU was able to read data from radio;

Radio side – shows the radio side of local and remote LigoPTP 24 (command line – **radio side**);

Tx mute – shows if transmitter is currently muted;

Tx power – shows current transmitter power in dBm (command line - **radio status** or **status**);

ATPC – shows the amount of current ATPC correction in dBm (command line – **atpc status**);

Rx level – shows current level of received signal. It must not differ significantly from the previously calculated value (command line - **radio status** or **status**);

Duplex shift – shows the margin between the transmitting and receiving frequencies (command line - **radio status**);

Tx frequency – shows the transmitting frequency (command line - **radio status**);

Rx frequency – shows the receiving frequency (command line - **radio status**);

Configuration file – shows which configuration the modem is currently using (command line – **modem configuration**);

Bandwidth – shows width of currently utilized bandwidth in MHz (command line – **modem status** or **status**);

Modulation – shows modulation mode set (command line – **modem status** or **status**);

Total capacity – shows total capacity set (command line – **modem status**);

Ethernet capacity – shows Ethernet capacity set (command line – **modem status** or **status**);

E1 channels – shows the number of E1 channels set. The number must be equal at both ends (command line – **modem status** or **status**);

Modem data status – shows if management CPU was able to read data from modem;

Modem status – indicates the acquire status of the modem. ‘ACQUIRE_IN_PROGRESS’ will appear during start-up, when modem acquires required parameters, but in normal operation mode ‘ACQUIRE_LOCKED’ will be seen. Any other options designate failure (command line – **modem status** or **status**);

Last acquire error – indicates the reason of the modem acquisition error. In normal operation mode ‘ACQUIRE_SUCCESS’ will be seen, any other option designates the reason of acquisition error (command line - **modem status** or **status**);

Radial MSE – shows radial mean square error value. Refer to the chapter *Radial MSE* for detailed description (command line - **modem status** or **status**);

LDPC decoder stress – shows the load of LDPC (low-density parity-check code) decoder. Refer to chapter *LDPC* for detailed description (command line – **modem status** or **status**);

ACM engine – shows if ACM (Adaptive Coding and Modulation) engine is running (command line – **modem status** or **status**);

Current modulation Rx/Tx – shows the modulation modes currently utilized (command line – **modem status**);

Current total capacity Rx/Tx – shows the current capacities in both directions (command line – **modem status**);

Current ethernet capacity Rx/Tx – shows the current Ethernet capacities in both directions (command line – **modem status**);

Diagnostics data status – shows if system parameters are in acceptable margins (command line - **diagnostics**);

System temperature – shows the device internal temperature in degrees by Celsius (command line - **diagnostics** or **status**);

Modem temperature – shows the temperature on modem in degrees by Celsius (command line - **diagnostics** or **status**);

Input voltage – shows the input voltage of PSU in volts (command line - **diagnostics**);

Current – shows the current of PSU in amperes (command line - **diagnostics**);

Consume power – shows the amount of power consumed by PSU in watts (command line - **diagnostics**).

Tx polarization – shows transmission polarization and position of connectors and wires at the local side (command line - **diagnostics**).

Radial MSE

Radial MSE is a method for estimating the signal to noise ratio. ACM engine uses normalized MSE, which is the inverse of SNR. It is calculated by dividing the estimated MSE level with the energy of the received constellation. Radial MSE peak value threshold is dependent on modulation used and LDPC code rate.

If the Radial MSE value trespasses following thresholds, BER at the output of LDPC decoder will reach the value of $1.0 \cdot 10^{-6}$:

| | QPSK | 16APSK | 32APSK |
|----------|----------|--------|----------|
| Standard | -8 dB | -13 dB | -15.5 dB |
| Wide | -10.5 dB | -18 dB | -21.5 dB |

LDPC

The **LDPC** is monitored for the number of errors being corrected on the input of LDPC decoder (see figure below).



Figure 24 – LDPC decoder structure

LDPC stress value thresholds @ BER $1.0 \cdot 10^{-6}$:

- for standard settings $\sim 4.0 \cdot 10^{-2}$;
- for "wide" option $\sim 1.0 \cdot 10^{-3}$

As long as LDPC stress value is under the specified thresholds, the amount of errors (and BER itself) on the output of LDPC remains at zero level.

Detailed Configuration in Web

Configuration section in Web interface allows customizing your system to suit your specific needs.

Main Configuration

The main configuration window provides the configuration of most vital system parameters, including the ones in configuration wizard as well as some other important parameters. Below is a short explanation of provided customization fields.

Radio Configuration

| Radio configuration | |
|--|---|
| Radio data status | Ok |
| Radio side | Low |
| Tx power (-1 .. 18 dBm) | <input type="text" value="18"/> dBm |
| Tx frequency (22014000 .. 22582000 KHz) | <input type="text" value="22274000"/> KHz |
| Rx frequency | 23282000 KHz |
| Duplex shift | 1008000 KHz |
| Tx mute | <input type="button" value="off"/> |
| <input type="button" value="Execute configuration"/> | |

Radio data status – shows if management CPU was able to read data from radio;

Radio side – shows if radio side you are currently viewing is low or high (command line – radio side);

Tx power – allows you to define transmitter power. If the RSL is too high (much higher than normal - 50dBm), you might want to lower transmitter power. Too high Rx level (>20 dBm) may even result in synchronization loss. The minimum and maximal values you can choose are dependent on modulation type and LigoPTP 24 model. Maximal and minimal Tx power values are shown in the brackets. (command line - radio txpower [<power dBm>]);

Tx frequency (22014000..22582000 KHz) – allows you to enter preferable transmitter frequency, hence defining utilized channel (command line - radio txfreq [<freq KHz>]);

Rx frequency – shows the current receiver utilized frequency (command line - radio freq);

Duplex shift – shows the duplex shift between the transmitter frequency and receiver frequency (command line - radio duplexshift);

Tx mute – allows turning transmitter power off. It may be effective when diagnosing on interference existence – when transmitter power of one side is off, you should not experience significant RSL on the other side (command line - radio txmute [on|off]);

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If “**Rollback on**” is selected, configuration will be reverted in case of erroneous configuration changes applied.

Pressing **Execute for both** applies changes made to the corresponding section both for local and remote side LigoPTP 24 FODUs.

ATPC Configuration

To configure ATPC, it is necessary to set Rx (remote) “min” and “max” values and enable the ATPC feature.

ATPC update period and ATPC delta are recommended to be left unchanged. It is also possible to change the limit of Tx power correction.



Note, that ATPC is mechanism for reducing Tx power, that's why to make proper use of ATPC, transmitter power (Tx power) must be set to the maximum value.

| ATPC configuration | |
|---|---|
| ATPC function | <input checked="" type="radio"/> Enabled <input type="radio"/> Disabled |
| ATPC update period (1..5) | 1 sec |
| ATPC delta (1 .. 5 dB) | 1 dB |
| Tx power correction | 0 dB |
| Tx power correction limit (-19..-1 dB) | -15 dB |
| Remote device status | Ok |
| Rx (remote) level maximum (-60..-20 dBm) | -50 dBm |
| Rx (remote) level minimum (-90..-50 dBm) | -60 dBm |
| Rx level max/min boundaries depend on each other | |
| Rx (remote) level | -58 dBm |
| <input type="checkbox"/> Rollback on <input type="button" value="Execute configuration"/> | |
| <input type="button" value="Execute for both"/> | |

ATPC function – allows enabling or disabling ATPC (Automatic Transmit Power Control). By default this feature is disabled (command line – atpc [enable|disable]);

ATPC update period (1..5) – allows defining the period in seconds in which ATPC parameters are being updated. By default the update period is 1 second (command line – atpc delay <power change delay time 1..5 sec>);

ATPC delta (1 .. 5 dB) – allows defining ATPC delta - an increment or decrement in which Tx power is being changed. It is highly unadvisable to change this parameter (command line – atpc delta <tx power correction step 1..5 dBm>);

Tx power correction – displays the amount of transmitter power in decibels ATPC has currently corrected (command line – atpc status);

Tx power correction limit (-19..-1 dB) – allows defining the amount of dB ATPC will be able to correct regarding initial Tx power value (command line – atpc limit <tx power correction limit -19..-1 dB>);

Remote device status – shows if management CPU was able to read data from remote management CPU;

Rx (remote) level maximum (-60..-20 dBm) – allows defining the maximum Rx level. ATPC Tx power correction will be performed only in case of exceeding this defined maximum Rx level (command line – atpc rxmax <rx level max -60..-20 dBm>);

Rx (remote) level minimum (-90..-50 dBm) – allows defining the minimum Rx level. ATPC Tx power correction will be performed only in case of exceeding this defined maximum Rx level (command line – atpc rxmin <rx level min -90..-50 dBm>);

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

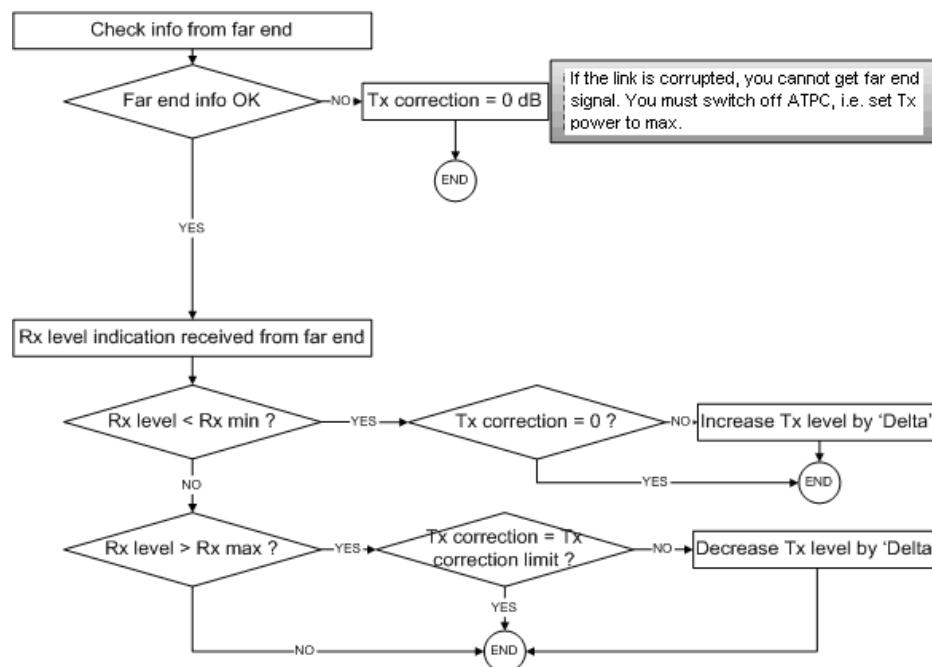
Pressing **Execute for both** applies changes made to the corresponding section both for local and remote side LigoPTP 24 FODUs.

ATPC Algorithm

ACM can be implemented together with **automatic transmit power control (ATPC)**, complimentary features that enhance overall system performance. ATPC reduces the average transmitted power as well as CCI and adjacent-channel interference (ACI), which is caused by extraneous power from a signal in an adjacent channel. It also enables a more efficient and cost-effective network frequency plan and deployment, as well as eliminating some of the receivers' "upfade" problems by changing the transmitted power according to the link momentary conditions. The lower average Tx power also extends the equipment's mean time between failures.

ATPC can be used together with ACM to control the transmitted power in any given ACM profile. Different algorithms can be implemented to achieve maximal spectral efficiency or minimal transmitted power using both features in combination. One implementation could target maximal spectral efficacy by trying to reach the highest ACM profile, while the other is willing to compromise on some of the spectral efficiency enabling CCI and ACI reduction. In any chosen algorithm, ATPC reduces the average transmitted power, benefiting each ACM profile and any link condition.

The local LigoPTP 24 FODU receives information (each second) about Rx level from the far-end LigoPTP 24 FODU through the service channel; depending on the received Rx level parameter, the local LigoPTP 24 FODU adjusts the transmitter power in accordance with the algorithm shown below.



Rx level - the Rx level figure received from the far-end

Rx max - maximum permissible Rx level at the far-end

Rx min - minimum permissible Rx level at the far-end

Tx correction

Tx correction limit

Delta - the value by which the Tx power is increased or decreased

according to far-end Rx level indication (1 dBm by default)

Figure 25 – ATPC algorithm

Modem Configuration

| Modem configuration | |
|--|--------|
| Modem data status | Ok |
| Bandwidth | 28 MHz |
| Modulation | 16APSK |
| Number of E1 channels (0..4) | 0 |
| Configuration file | none |
| <input type="button" value="Execute configuration"/> | |

Modem data status – shows if management CPU was able to read data from modem;

Bandwidth – allows choosing between 7, 14 and 28 MHz bandwidths available. The default value is 7 MHz. This option is dependent on what bandwidth you have purchased. The wider bandwidth you have, the higher will be the overall link bitrate. The maximum bitrate of 108 Mbps is possible when using 28 MHz bandwidth (command line – modem bandwidth 7|14|28);

Modulation – allows choosing between QPSK, 16APSK and 32APSK modulation. The default value is QPSK. The higher modulation order is, the higher the overall link bitrate, but worse RSL. The maximum bitrate of 108 Mbps is possible when using 32APSK modulation (command line – modem modulation QPSK|16APSK|32APSK [wide] [ACM]). See below the explanation for Adaptive Coding and Modulation and wide options;

Number of E1 channels (0..4) – allows choosing preferable number of E1 channels to be used. When the total capacity is over 100Mbps, number of E1 channels does not influence the total Ethernet capacity (100Mbps), otherwise Ethernet capacity is $\langle\text{total capacity}\rangle - \langle\text{number of E1 channels}\rangle * 2,048$ [Mbps]. By default E1 channels are turned off (command line – e1 set <Number of E1 channels>);

Configuration file – allows you to choose optional modem configuration file. This option is for specific requirements that are not included in default set of configuration options (command line – modem configuration show|<file>|embedded);

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

Pressing **Execute for both** applies changes made to the corresponding section both for local and remote side LigoPTP 24 FODUs.

Adaptive code and modulation (ACM) technology allows operators to achieve high-capacity data transmission over microwave links and improve the link utilization. This reduces both operational and capital expenditures for maintaining high-capacity links. ACM can maintain the highest link spectral efficiency possible at any given time in any link condition.

In traditional voice-dominated wireless backhaul transmission networks, service availability levels of 99.995% are the norm.

However, newer services such as Internet browsing, video streaming and video conferencing can operate at more relaxed availability levels. With use of QoS prioritizing ACM can allocate the required availability based on the priority. As a result, high-priority services such as voice enjoy 99.995% availability, while low-priority services like video streaming are allocated lower priorities.

Use of QoS prioritizing defines which services should be transmitted under any link condition and which services should be adapted whenever the link condition is degraded and the link payload is decreased.

For example, when bad weather has decreased the channel capacity of a link, ACM maintains high-priority services – such as E1 channels – with full bandwidth capacity while adapting the bandwidth capacity of low- and mid-priority services such as Internet browsing (see figure below).

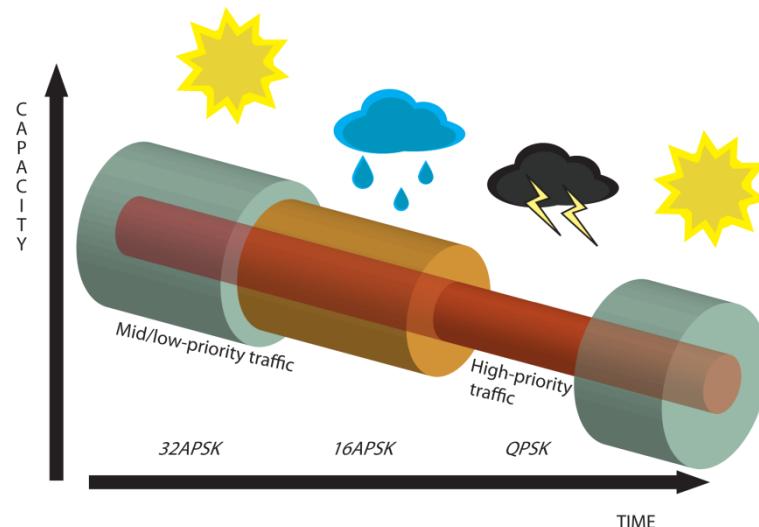


Figure 26 – ACM bandwidth capacity adaptation

Traffic can be mapped into different priorities, which define the level of service for each application. *Figure 26 – ACM bandwidth capacity adaptation* illustrates how different services – such as rich voice and video – are mapped into different classes of availability (CoA) such as 99.995% or 99.985%.

The implementation of multiple priorities increases the available capacity up to 10 times that of standard links. When conditions are clear, the wireless link operates at maximum capacity and provides all services with the full data rate. When link conditions are poor – during harsh rain, for example – predefined high-availability services such as voice are not affected. However, the capacity of low-priority services is adapted dynamically to the changing link conditions. This is done by provisioning bandwidth according to the link conditions and traffic priority.

An ACM profile defines the link parameters (modulation) for a given range of the Radial MSE. The Radial MSE range of each profile defines the threshold for switching from one ACM profile to another. Each ACM profile has a different spectral efficiency, derived from its modulation.

The receiver continuously monitors the link condition based on Radial MSE value.

Once the estimators at the receiver side show that the link performance is not suitable for the current ACM profile, an ACM switching process will be initiated. In case of degradation in the link performance, the new ACM profile will include lower modulation, decreasing the link bitrate. The ACM switching rate is measured in dB/s and is a key feature of ACM systems.

In general, the higher the switching rate, the better the system's immunity to rapid Radial MSE changes. When the switching is being executed, the payload rate is being modified to fit the aggregated data rate to the new available link data rate.

Alternatively, ACM can also be used to increase the link distance, resulting in added link spectral efficiency. The same concept is implemented as previously, with the margins that were kept for 99.995-percent bandwidth availability now used to increase the link distance. Whenever the link conditions are degraded, the system will switch to an ACM profile with lower spectral efficiency to enable maintaining the link.

The following real-world example illustrates the benefits of ACM. Consider a LigoPTP 24 link operating at 23 GHz with 28 MHz channel spacing and 45.9 dB (120 cm) antenna gain. The link is operating in a moderate rain region similar to central Europe with a distance of 30 kilometers.

The system operation is set to a minimal payload of four E1 connections plus 34 Mbps Ethernet for 99.995% availability.

Using the new ACM technology, the system was able to operate most of the time at 108 Mbps, depending on the link conditions.

Most of the time the system would support a 100Mbps Ethernet connection instead of a 34 Mbps connection. The system automatically monitored the link conditions and changed the capacity without interrupting the data transmission (hitless changes), as shown in figure below.

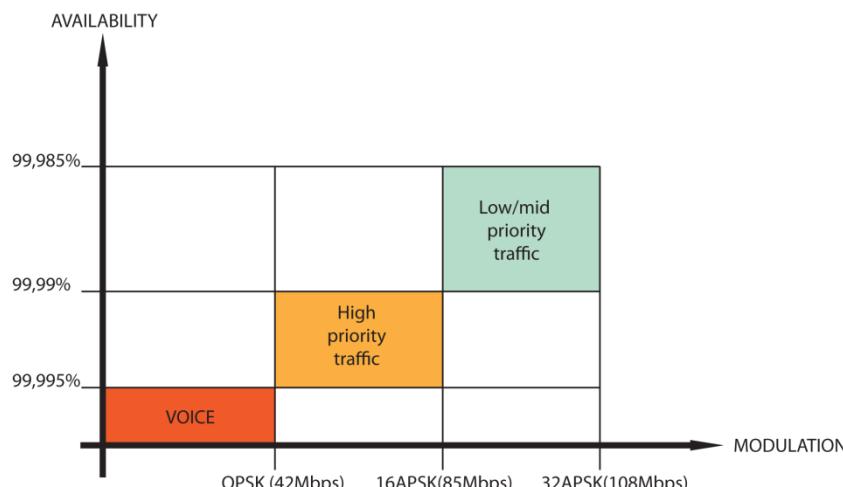


Figure 27 – Link availability and classes of services

In comparison similar system using 32QAM and providing similar capacity would provide only 99,981% of availability. Besides, lack of ACM would not provide higher availability. You would have to decrease the distance, decrease modulation or increase antenna sizes to achieve 99,995% availability for the given link.

This example demonstrates how the new technology, based on an ACM mechanism, can play a key role in the development of cost-effective next-generation wireless access networks, by taking advantage of traffic evolution from synchronous TDM traffic to packet IP-based traffic.

The **wide** option allows increasing overall capacity of the link in terms of deteriorating RSL sensitivity threshold. Note, that using 32APSK with total capacity of 100Mbps, LigoPTP 24 automatically uses "better sensitivity" mode, but incrementally enabling E1 channels, LigoPTP 24 adapts its forward error correction, till the maximum 108Mbps capacity (100Mbps Ethernet + 4E1) is enabled and LigoPTP 24 operates in "wide" mode. For more details refer to table in chapter *Cable Requirements*.

Loopback Configuration

Loopback tests are accessible using local or remote management methods.

For safety purposes all loopbacks (local and remote) can be set on a fixed time interval only. If no time interval is specified, the default value is 60 seconds (1 minute).

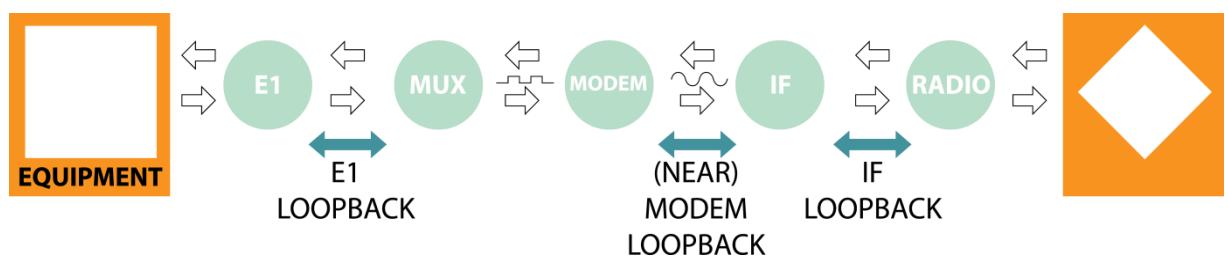
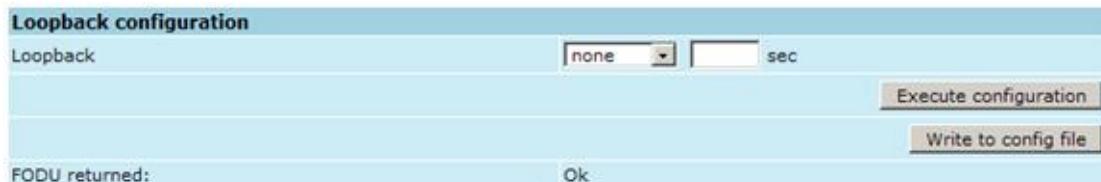


Figure 28 – Loopback Modes

- **E1** loopback mode loops signal back to local end in bounds of E1 interface. E1 loopback mode must be set on the particular channel you are wishing to test. If no E1 channels are selected, E1 loopback mode is not available;
- **NEAR** loopback mode loops signal back to local end after the modem;
- **IF** loopback mode loops signal back to local end by linking intermediate frequencies.



Loopback – allows choosing loopback mode and its activity time in seconds (command line – loopback) {status | none | if | modem | e1{1|2|3|4}} [<time>];

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

Write to config file – writes to configuration file all the changes made on the whole page (command line – cfg write);

FODU returned - in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

Additional radio and modem configuration commands in Telnet/serial interface is provided in the table below:

| Command | Description |
|---|--|
| modem status | Shows all the modem parameters. |
| modem configuration show | Displays current configuration file. |
| modem configuration <file> | Uses separate configuration file. |
| modem configuration embedded | Switches back to the embedded configuration last used. |
| modem configuration embedded | Switches back to the embedded configuration last used. |
| modem factory | Resets modem settings to factory defaults. |
| modem ipremote [on off] | Allows enabling manual remote IP specifying. By default remote IP is being obtained automatically. |
| radio factory [max] | Resets radio settings to factory defaults. By default Tx power will be turned off. 'max' option will switch Tx power to the maximum value after restart. |

Additional loopback commands in Telnet/serial interface is provided in the table below:

| Command | Description |
|---|-----------------------------------|
| Loopback status | Displays status of loopback mode. |
| Loopback {status none if modem e1{1 2 3 4}}[<time>] | Sets the specified loopback mode. |

System Configuration

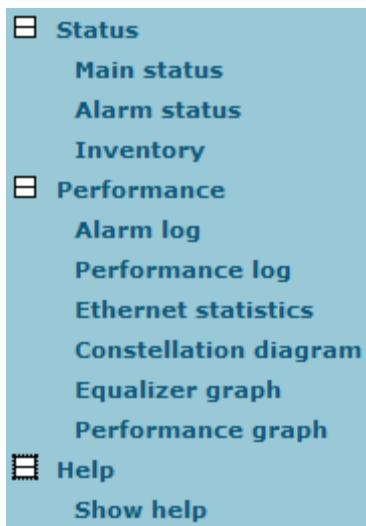
The system configuration window provides the configuration of web access, telnet and FTP interfaces; allows changing system name, web data refresh time and system time.

Explanation of customization fields:

User Configuration

| | |
|---|-------------------------------------|
| User configuration * | |
| guest | |
| Enter new password (length: 4..30 characters) | <input type="text"/> |
| admin | |
| Enter new password (length: 4..30 characters) | <input type="text"/> |
| Hide password(-s) | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> Rollback on <input type="button" value="Execute configuration"/> | |

guest – Enter new password (length: 4..30 characters) – allows entering preferable 'guest' account password and enabling the account. By default guest account is disabled. Maximal length of the password cannot exceed 30 symbols. Guest account has only monitoring privileges. The following Web GUI sections are available:



admin – Enter new password (length: 4..30 characters) – allows entering preferable ‘admin’ account password. Maximal length of the user name cannot exceed 30 symbols. By default password for ‘admin’ account is ‘changeme’. Admin account has full control of the LigoPTP 24 configuration process.

Hide password(-s) – Hides typed in password. Unchecking this option will display typed in password in plaintext.

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

More detailed status controls are available in command prompt, which include additional user management commands in Telnet/serial interface:

| Command | Description |
|--|--|
| access login <name> <password> | Logs on as a user specified by <name> and <password>. |
| access logout | Logs current user out. |
| access set <guest admin> <password> [plaintext] | Allows specifying a new password for a specific account (admin or guest). ‘plaintext’ option will save the password in plaintext in configuration script without encrypting it (by default saved passwords in configuration file are encrypted). |
| access show | Shows user name and password of a user currently logged on. |
| access list | Shows the list of usernames and passwords the current account is able to manage (if logged on as admin, ‘guest’ and ‘admin’ account passwords will be seen). |

Names Configuration

| | |
|---|---------|
| Name configuration | |
| FODU name (Max length: 16 characters) | LigoPTP |
| <input type="checkbox"/> Rollback on <input type="checkbox"/> Execute configuration | |

FODU name (Max length: 17 characters) – allows entering preferable system name. It is recommended to name the system after its geographic location. Maximum length of the user name cannot exceed 17 symbols. Default name is ‘LigoPTP (command line – system name <name>)’;

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

Other Configuration

| Other configuration | |
|---------------------------------|---|
| Web refresh (2 .. 60 sec) | <input type="text" value="5"/> |
| Time (Usage: YY-MM-DD HH:mm:ss) | <input type="text" value="09-04-17 16:17:24"/> |
| | <input type="button" value="Set local machine time"/> |
| | <input checked="" type="checkbox"/> Rollback on |
| | <input type="button" value="Execute configuration"/> |
| | <input type="button" value="Write to config file"/> |
| Immediate CPU restart | <input type="button" value="Restart CPU"/> |

Web refresh (2 .. 600 sec) – allows specifying time interval of Web data refreshing. The default value is 5 seconds. You can choose between 2 and 600 seconds (10 minutes) (command line – web refresh <web refresh time>);

Time (Usage: YY-MM-DD HH:mm:ss) – allows changing system date and time manually by entering date and time in specific syntax. **Set local machine time** button forces system to use the time set on your PC or laptop, from which you are connected to the Web interface (command line – system time [yyyy-mm-dd hh:mm:ss]);

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

Write to config file – writes to configuration file all the changes made on the whole page (command line – cfg write);

Immediate CPU restart – restarts LigoPTP 24 FODU you are connected to ((command line – system reset));



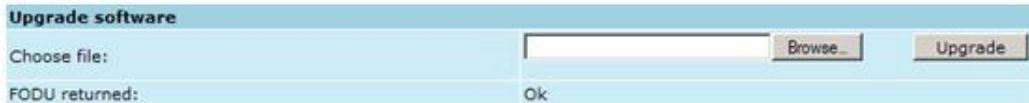
Note that after restarting the LigoPTP 24 will use only those settings, which are written to the configuration script. Other settings will be set to default values

Additional system commands of the Telnet/serial interface is provided in the table below:

| Command | Description |
|--|--|
| System status | Displays the name of the device and its uptime. |
| System inventory [sho] | Displays the LigoPTP 24 FODU product code, serial number and additional information. |
| System aliases [list all basic off add remove clear] | list – shows the alias list and whether the aliases are going to be used. The user can choose whether to see all the aliases (adding the argument “all”), built-in aliases (“built-in”), or optional aliases (“optional”) , or user aliases (“user”); all – all the aliases will be used; basic – only basic (built-in, hidden and user) aliases will be used; off – no aliases will be used; add – if two arguments are given, creates an alias of the second argument, named as the first argument. If one argument given, alias command tries and loads the aliases from a file specified by the argument; remove – removes the alias specified by the argument; clear – removes all the user aliases. |
| System commands [show help] | show – displays all available commands; help – displays available help messages for all commands. |

| Command | Description |
|----------------------------|---|
| System reset [cold] | Restarts CPU of the management controller. Resets all management counters. cold – Restarts modem as well. |
| Ver | Displays hardware and software version of FODU, as well as built date. |

Upgrade Software



Choose file – allows choosing location of software upgrade file stored on your hard disk. Software upgrade file must have *.elf.ezip extension;

FODU returned – in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

IP Configuration Window

The IP configuration window provides configuration of the Ethernet management port addressing, IP services and routes. Settings listed here are essential for building a network or other specific traffic purposes.

Explanation of customization fields:

Ethernet Management Port IP Configuration

| Ethernet management port IP configuration | |
|---|-----------------------|
| IP Address | 192.168.205.10 |
| IP Mask | 255.255.255.0 |
| IP Default gateway | 255.255.255.255 |
| Ethernet MAC address | 00.04.A6.80.B2.08 (8) |
| Remote IP Address | 192.168.205.11 |
| Execute configuration | |

IP Address – allows specifying IP address of LigoPTP 24 FODU you are currently logged in. Default IP address is 192.168.205.10 or 192.168.205.11 – depending on which side the specific LigoPTP 24 FODU is – low side has 192.168.205.10 IP address and high side – 192.168.205.11 (command line – net ip addr <addr>);



Note that LigoPTP 24 IP addresses need to be in the same subnet.

IP Mask – allows specifying IP mask of LigoPTP 24 FODU you are currently logged in. Default IP mask is 255.255.255.0, and it should not be changed unless you are owning network with huge amount of hops (command line – net ip mask <mask>);

IP Default gateway – allows specifying gateway of LigoPTP 24 FODU you are currently logged in. Default gateway is 255.255.255.255 which means that there is no gateway specified (command line – net ip gw <gw>);

Ethernet MAC address – shows the MAC address of LigoPTP 24 FODU you are currently logged in (command line – net mac);

Remote IP Address – shows IP address of remote (far-end) LigoPTP 24 FODU to ensure communication between link sides (command line – net ip remaddr <remaddr>);

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

IP Services

| IP services | |
|--------------|---|
| FTP service | <input type="button" value="Start FTP"/> |
| TFTP service | <input type="button" value="Start TFTP"/> |

FTP service – starts FTP service for file access and software update of your LigoPTP 24 FODU. By default FTP service is not running (command line – **net start ftp**);

TFTP service – starts TFTP service for file transfer between both LigoPTP 24 FODU link sides. By default TFTP service is not running (command line – **net start tftp**).

Static Route Configuration



Do not make any changes to default route; otherwise, management connection to LigoPTP 24 will be lost.

| Static route configuration | |
|---|---|
| Static routes | <input type="text" value="192.168.205.0/255.255.255.0/192.168.205.10"/> |
| Network Address | <input type="text" value="192.168.205.0"/> |
| Network Mask | <input type="text" value="255.255.255.0"/> |
| Gateway | <input type="text" value="192.168.205.10"/> |
| Routes flags | SL..... |
| <input type="checkbox"/> Rollback on <input type="button" value="Add"/> <input type="button" value="Change"/> <input type="button" value="Delete"/> | |
| <input type="button" value="Write to config file"/> | |
| FODU returned: | Ok |

Static routes – shows the list of existing static routes, as well as allows you to choose specific route you are willing to change or delete. By default there is one route which depends on earlier entered IP settings (command line – **net route**);

Network address – allows specifying network address for the route changing/adding (command line – **net route add|delete <dest addr> [MASK <mask>] <gateway>**);

Network mask - allows specifying network mask for changing/adding the route (command line – **net route add|delete <dest addr> [MASK <mask>] <gateway>**);

Gateway - allows specifying gateway for the route changing/adding (command line – **net route add|delete <dest addr> [MASK <mask>] <gateway>**);

After entering addresses or selecting a specific route, buttons **Add**, **Change** and **Delete** allow you to modify LigoPTP 24 FODU routes. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

Write to config file – writes to configuration file all the changes made on the whole page (command line – **cfg write**);

FODU returned - in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

Additional network configuration commands in Telnet/serial interface:

| Command | Description |
|----------------------------|---|
| Net ping <ip> | This command is for troubleshooting purposes to verify the service channel connectivity, - it sends a special packet to the specified address and then waits for a reply. |

| Command | Description |
|---|--|
| Net telnet <host> [<port>] | Opens Telnet session with the FODU, <i>host</i> – IP address of the FODU management Ethernet port. |
| Net tftp <host> {get put} <source> [<destination>] | Uploads or downloads (put/get) file (<source>) to or from the host FODU (<host>). |
| Web trace {show on off} | Web trace allows you to see commands being executed through Web interface when you're using serial or telnet connection. <i>Show</i> – shows web trace status (on or off), <i>on</i> – turns web trace on, <i>off</i> – turns web trace off. |
| Web timeout <time in minutes> | Allows setting the time, after which the Web GUI presumes no connectivity state. By default the value is set to 15 minutes. |

Below is the explanation of the procedure of network IP configuration in case of network IP Class area change.

For the purpose of illustration, we use B class IP network address 10.0.10.11 for the remote side LigoPTP 24 and 10.0.10.10 for the local side LigoPTP 24, while the IP address of our management PC LAN adapter will be 10.0.0.1.

The steps of the configuration procedure are as follows:

Step 1. Enter the remote side (far-end) Web GUI first (in the following case it is 192.168.205.10) and go to **IP configuration**. The configuration in this particular example will look in the following way:

| Ethernet management port IP configuration | |
|---|-----------------------|
| IP Address | 10.0.10.10 |
| IP Mask | 255.255.0.0 |
| IP Default gateway | 255.255.255.255 |
| Ethernet MAC address | 00.04.A6.80.B2.08 (8) |
| Remote IP Address | 192.168.205.11 |
| <input type="checkbox"/> Rollback on <input type="button" value="Execute configuration"/> | |



Rollback on should not be selected.

Press “Execute configuration”.

Step 2. Enter the local side (close-end) Web GUI and go to **IP configuration**. The configuration will look in the following way:

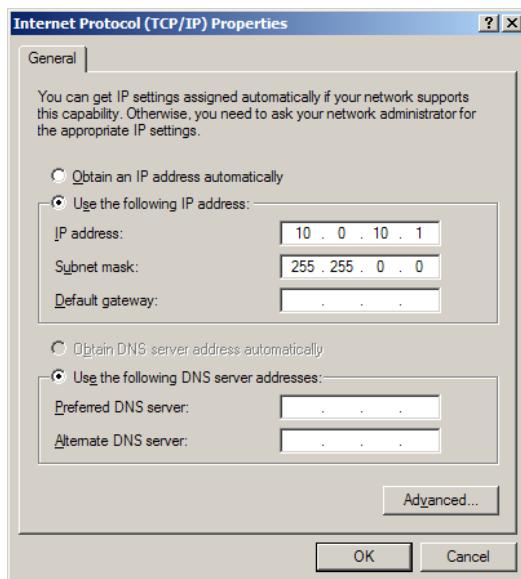
| Ethernet management port IP configuration | |
|---|-----------------------|
| IP Address | 10.0.10.11 |
| IP Mask | 255.255.0.0 |
| IP Default gateway | 255.255.255.255 |
| Ethernet MAC address | 00.04.A6.80.B2.07 (7) |
| Remote IP Address | 10.0.10.10 |
| <input type="checkbox"/> Rollback on <input type="button" value="Execute configuration"/> | |



Rollback on should not be selected.

Press **Execute configuration**.

Step 3. In “MS Windows” go to “Control panel → Network Connections”. In LAN “Properties” find “Internet Protocol TCP/IP” and click on its “Properties” (detailed description is in **Chapter Ethernet Management Connection Configuration**). Configuration of LAN Ethernet port must be as follows:



Step 4. Go to the remote side Web GUI, choose “Tools → Configuration file” and press “Cfg write”.

Step 5. Repeat Step 4 for the local side Web GUI.

Ethernet Configuration

The Ethernet configuration window provides the configuration of the Ethernet LAN, WAN and management ports as well as shows the current status of all three ports (command line – **ethernet stat**).

Explanation of customization fields:

Ethernet Status

| Ethernet status | | | | | | |
|-----------------|--------------|----------|--------------|----------|--------------|-----------|
| | Port 1 (LAN) | | Port 2 (WAN) | | Port 3 (Mng) | |
| Link | On | | On | | | |
| Speed | 100 Mb | | 100 Mb | | 100 Mb | |
| Duplex | Full | | Full | | Full | |
| Flow control | Rx On | Tx On | Rx On | Tx On | Rx Off | Tx Off |
| Rx | | | | | Enabled | |
| Tx | | | | | Enabled | |
| Bandwidth limit | | | | | Full | |

Represents all three ports of the LigoPTP 24 FODU switch – Local Area Network (LAN) port, Wide Area Network (WAN) port and Management (Mng) port;

Link – shows operation status of each port;

Speed – shows operation speed of each port;

Duplex – shows if port is operating in full or half duplex mode;

Flow control – shows if ‘flow control’ is enabled or disabled for each port;

Rx – shows if regress activity is allowed on Mng port;

Tx – shows if egress activity is allowed on Mng port;

Bandwidth limit – shows if Mng port is using bandwidth limiting. If not - 'Full' is being shown.

Ethernet Configuration

The screenshot shows the 'Ethernet configuration' section. It includes fields for LAN connection (set to 'auto'), LAN flow control (radio button selected for 'Enabled'), and Mng bandwidth (set to 'Full'). Below these are buttons for 'Rollback on' (unchecked), 'Execute configuration', and 'Write to config file'. At the bottom left is the message 'FODU returned:' and at the bottom right is the word 'Ok'.

LAN connection – allows choosing LAN speed and duplex. You are able to choose between 10 Mbps Half Duplex (10hdx), 10 Mbps Full Duplex (10fdx), 100 Mbps Half Duplex (100hdx), 100 Mbps Full Duplex (100fdx) and auto mode. By default ‘auto’ mode is on (command line – ethernet set lan connection [auto|10hdx|10fdx|100hdx|100fdx]);

LAN flow control – allows enabling or disabling LAN flow control (command line – ethernet set lan flowcntrl enable|disable);

Mng bandwidth – allows limiting bandwidth for the Management port. Possible choices are 128 Kbps, 256 Kbps, 512 Kbps, 1 Mbps, 2 Mbps, 4 Mbps and Full (command line – ethernet set mng bandwidth [128 | 256 | 512Kbps | 1 | 2 | 4Mbps | Full]);

Pressing **Execute configuration** applies changes made to the corresponding section only fr the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied;

Pressing **Execute configuration** applies changes made to the corresponding section;

Write to config file – writes to configuration file all the changes made on the whole page (command line – cfg write);

FODU returned - in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

VLAN Configuration

The VLAN configuration window provides configuration of port-based Ethernet Virtual Local Area Networks (VLANs), allowing using up to 16 different VLAN IDs. It is possible to assign 3 different modes to your VLANs – Trunk (LAN port is interconnected with WAN port and Management port is not accessible – useful for configuring customer VLANs), Management (all ports are interconnected) and Access (all VLAN tagged packets are being untagged at LAN egress port and tagged at LAN ingress port).



Note, that Trunk and Access type VLANs cannot be configured together.

The screenshot shows the 'VLAN configuration' section. It includes fields for 802.1Q VLAN (radio button selected for 'Enabled'), Management VLAN ID (set to 13), and LAN port mode (set to 'Trunk'). Below these are sections for LAN Trunk VLANs (Trunk VLAN port ID 1, Trunk VLAN number 67), LAN Access VLANs (Trunk VLAN number 51), and LAN Management VLANs (Reset VLAN). At the bottom are buttons for 'Clear', 'Add', 'Reset VLAN', and 'Write to config file'. At the bottom left is the message 'FODU returned:' and at the bottom right is the word 'Ok'.

802.1Q VLAN – enables support of 802.1Q VLAN (command line – ethernet vlan [enable | disable]);

Management VLAN ID – allows specifying Management VLAN ID. When already configured, shows current Management VLAN ID (command line – ethernet vlan <VLAN ID> management);

LAN port mode – specifies LAN port operation mode for user traffic VLANs – with tagging/untagging packets (Access) or passing through already tagged packets (Trunk) (command line – ethernet vlan <VLAN ID> [Trunk | Access]);

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied;

Trunk VLAN number – allows to specify and add Trunk VLAN ID. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied (command line – ethernet vlan <VLAN ID> [Trunk | Access]);

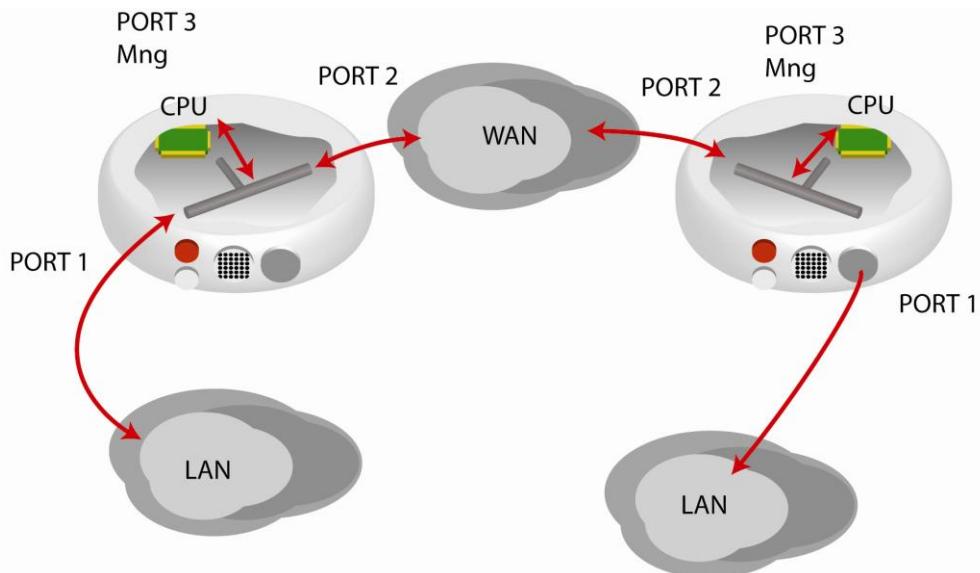
Reset VLAN – resets the whole VLAN configuration (command line – ethernet vlan reset);

Write to config file – writes to configuration file all the changes made on the whole page (command line – cfg write);

FODU returned – in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

To ensure correct operation of VLANs, both individual VLAN IDs and general 802.1Q VLAN should be enabled.

Ethernet Switch Port Status and Settings



Switch port 1 (LAN) is connected to LAN interface.

Switch port 2 (WAN) is connected to WAN interface, modem and radio part.

Switch port 3 (Mng) is connected to LAN Management CPU.

Ethernet Switch Block (Functional) Diagram

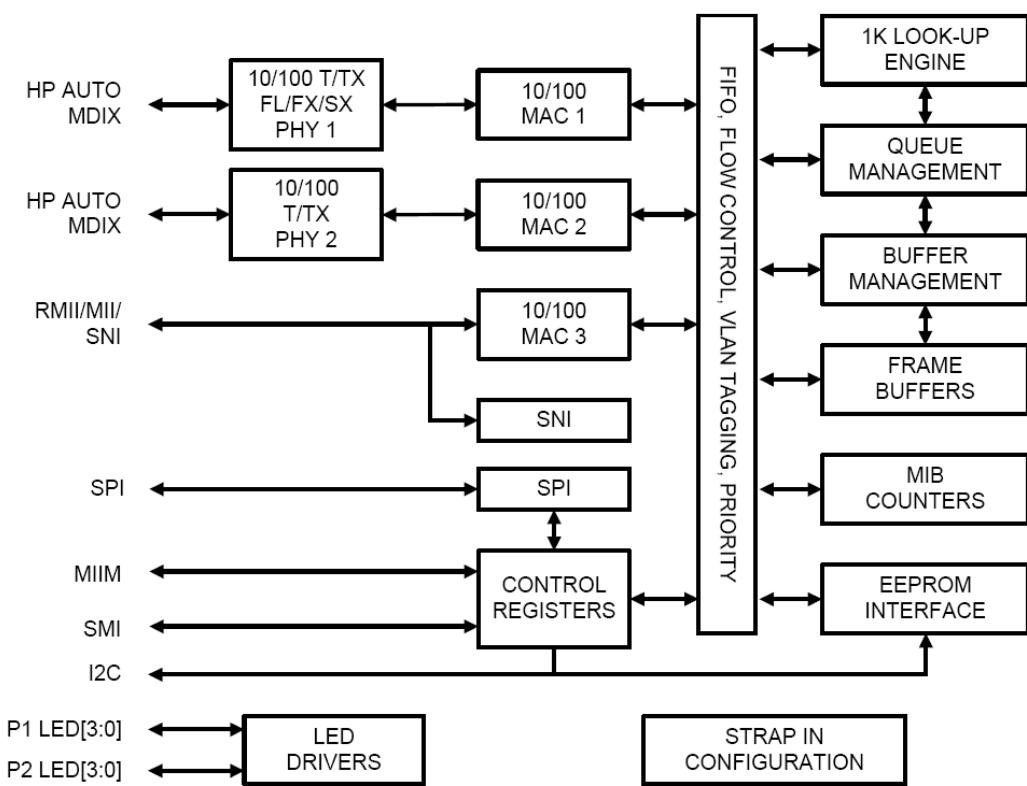


Figure 29 –Ethernet switch block diagram

Ethernet Switch VLAN Status and Settings

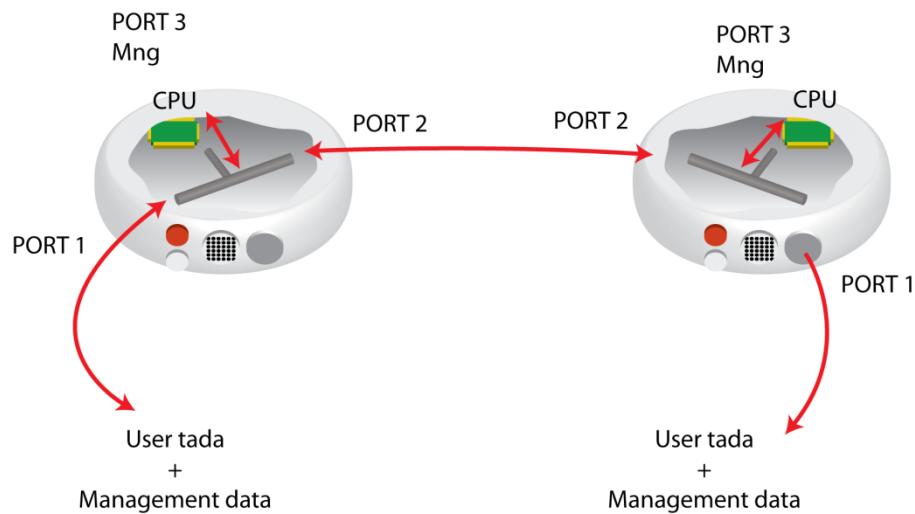


Figure 30 - System without VLANs

When VLANs are not used (Figure 4.6), user data and management data are not separated either logically, or physically.

When using VLANs (Figure 4.7), it is necessary to use external switches (Switch 3 and Switch 4). These switches add/remove VLAN tags per port basis. Thus, management data and user data have different VLAN tags and are logically separated.

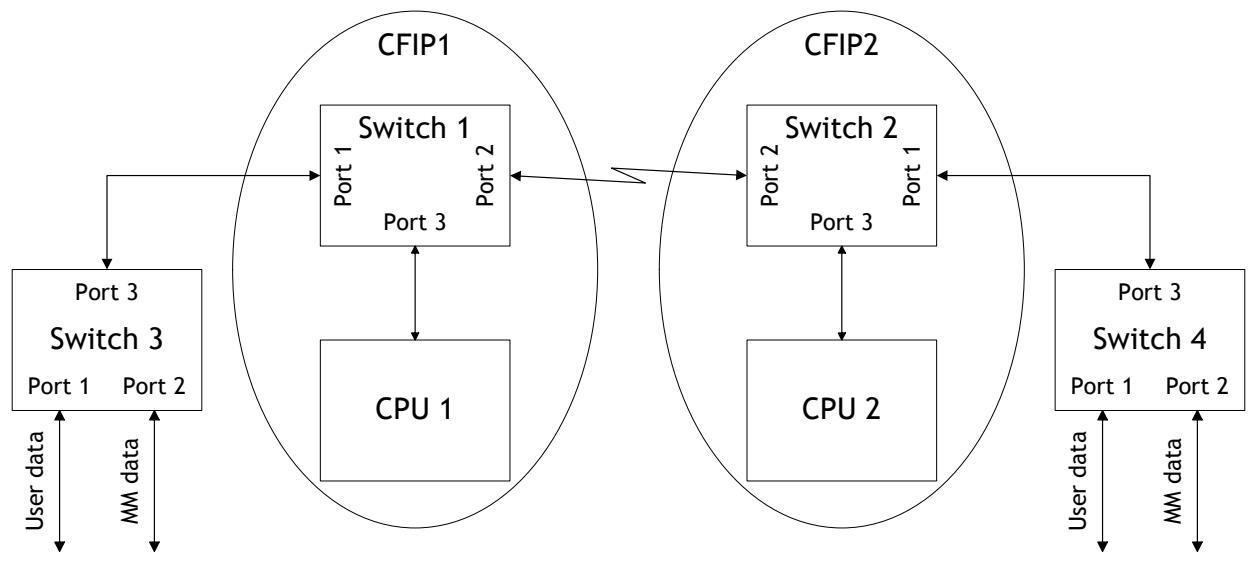


Figure 31 - System with VLANs

System with two separate VLANs – A and B. Figure below represents ports membership to VLANs.

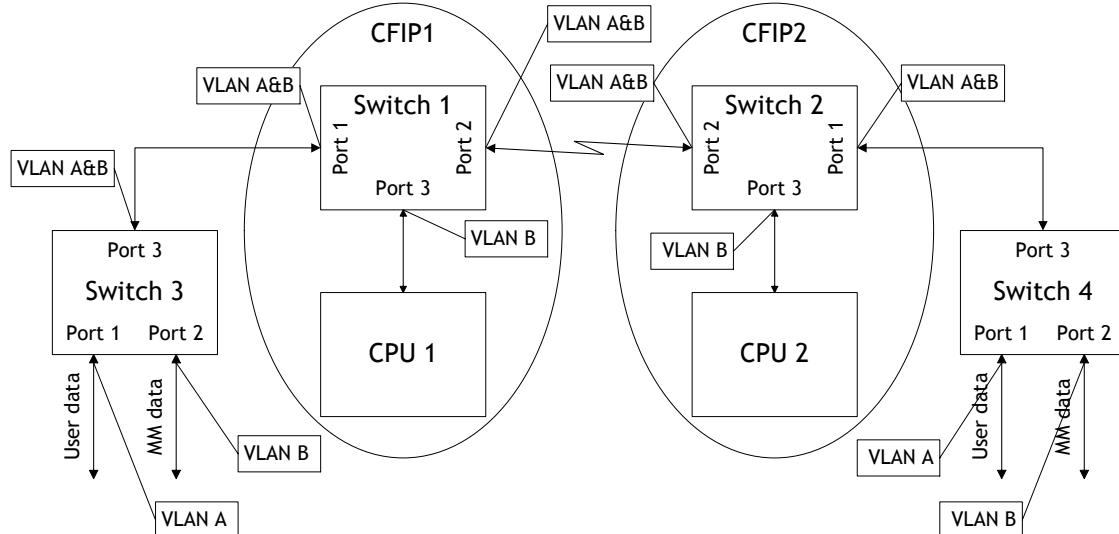


Figure 32 - VLANs and ports membership

Port 1 and port 2 of Switch 1 and Switch 2 are sending data according to VLAN ID and destination address, and adding VLAN tags for packets outgoing from port 3. Additionally, VLAN tag is removed at port 3 of Switch 1 and Switch 2.

VLAN A is the Trunk type VLAN with port 1 & 2 membership.

VLAN B is the Management type VLAN with port 1 & 2 & 3 membership.

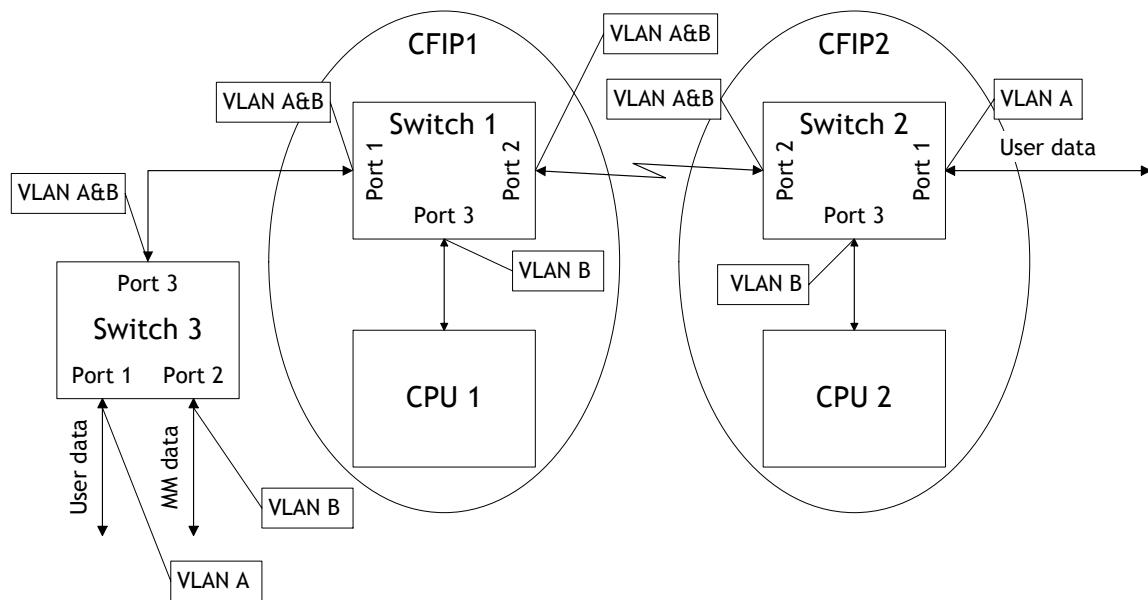


Figure 33 - Configuration with management access from one side of the link

For Switch 1:

VLAN A is the Trunk type VLAN with ports 1 & 2 membership

VLAN B is the Management type VLAN with ports 1 & 2 & 3 membership when removing VLAN tags while packet is being sent to port and inserting tag while packet is transmitting to ports 2 & 1.

For Switch 2:

VLAN A is the Access type VLAN with ports 1 & 2 membership with removing and inserting VLAN tags while packet is being transmitted to ports 1 and 2, respectively.

VLAN B is the Management type VLAN with ports 2 & 3 membership with removing and inserting VLAN tags while packet is being transmitted to ports 3 and 2, respectively.

Limitations and rules on using VLAN:

- Supports up to 16 full range VLAN IDs. If hardware VLAN table is full, software responds with the error message: "Error: VLAN table is full."
- Only one VLAN with unique IDs is allowed. When adding a different VLAN with the same IDs, the old VLAN is deleted (also the other types of VLANs).
- Simultaneous use of Access and Trunk type VLANs in the one switch is not allowed.
- After the VLAN table initialization is completed, 802.1Q VLAN mode must be enabled by using the command "**Ethernet VLAN enable**".
- Use the "Access" VLAN type only for remote FODU, because after setting the "Access" VLAN type, access to the management CPU from LAN port is **blocked!**

Steps required for VLAN configuration:

- 1) Configure switches for VLAN tag encapsulation on both ends of the link;
- 2) Set preferable VLAN configuration in "VLAN configuration" of remote link side LigoPTP 24 FODU Web management;
- 3) Set preferable VLAN configuration in "VLAN configuration" of local link side LigoPTP 24 FODU Web management.



VLAN tagging already must be configured on the switch and known to you; otherwise, incorrect VLAN configuration may disable access to management port.

Examples of VLAN usage:

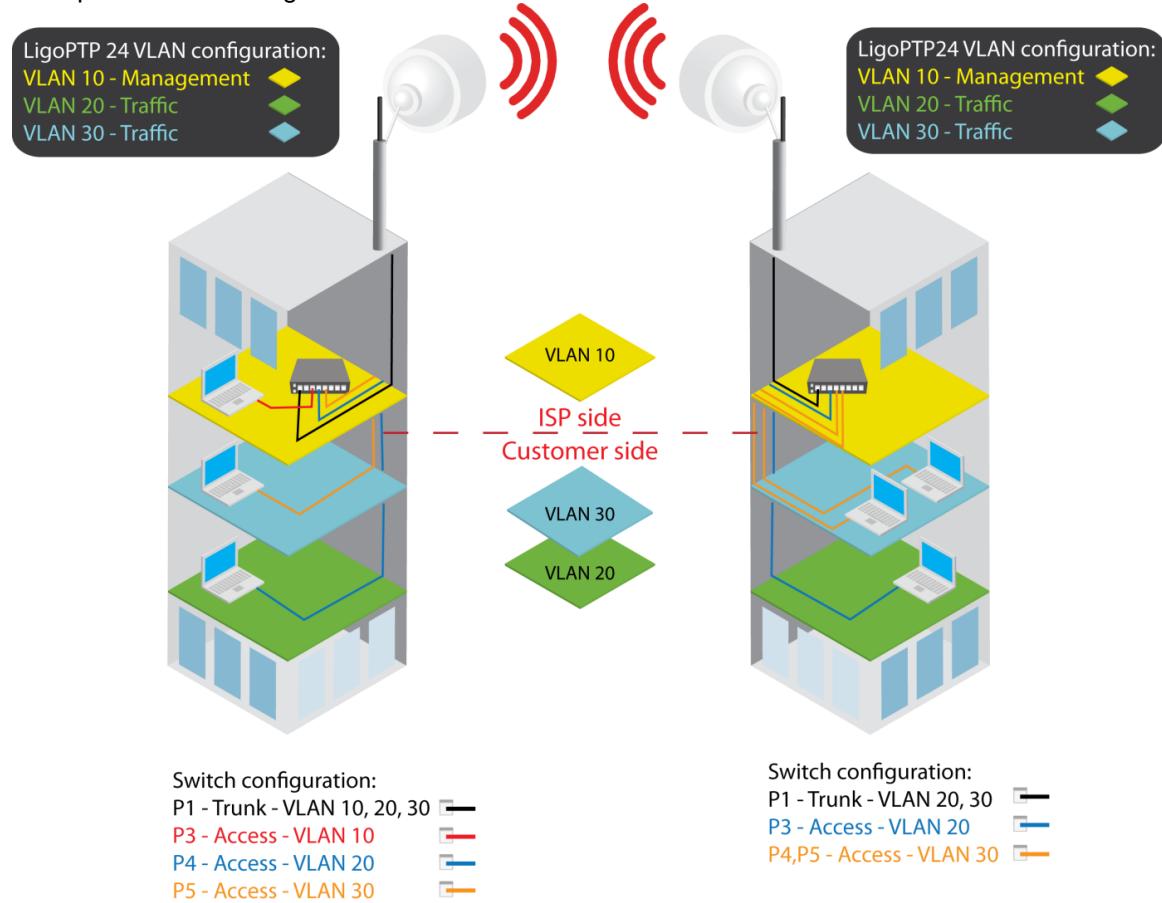


Figure 34 – VLAN configuration with VLAN tag encapsulation on the ISP side

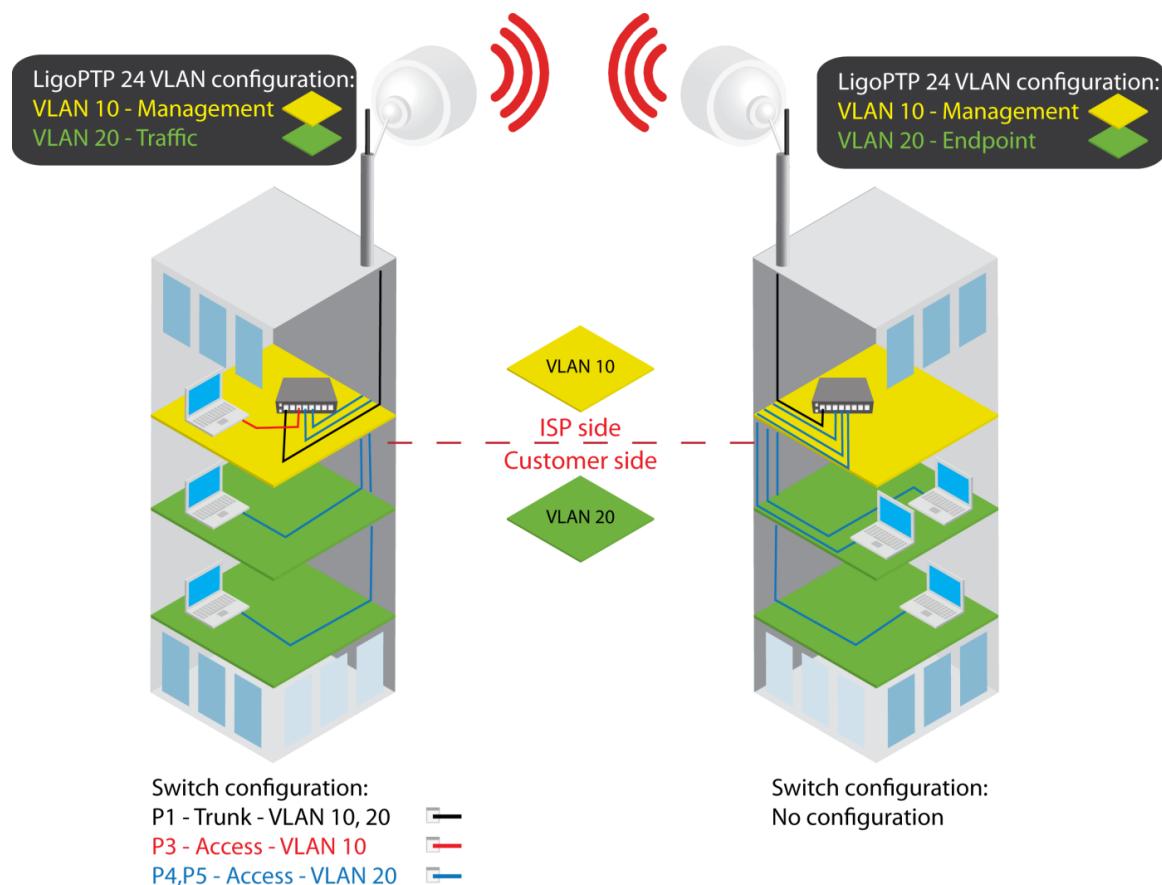


Figure 35 – VLAN configuration with 'Access' VLAN

QoS

QoS Status

QoS status provides control over main QoS parameters, accordingly allowing enabling or disabling QoS 802.1p, DiffServ or port based priorities and change priority queuing mode.

| QoS 802.1p configuration | | | |
|--------------------------|---|----------|---|
| QoS Status | | | |
| QoS 802.1p | <input type="radio"/> Enabled <input checked="" type="radio"/> Disabled | DiffServ | <input type="radio"/> Enabled <input checked="" type="radio"/> Disabled |
| Name | P1 (LAN) | P2 (WAN) | P3 (Mng) |
| Port based priority | 1 | 1 | 1 |
| Priority queuing mode | <input type="radio"/> Fixed <input checked="" type="radio"/> Weighted | | |

QoS 802.1p – enables or disables 802.1p priorities for all three ports – LAN, WAN and Mng (command line – ethernet QoS 802.1p {[enable | disable <Port>] | [map]});

DiffServ – enables or disables DiffServ (DSCP) priorities for all three ports – LAN, WAN and Mng (command line – ethernet QoS DSCP [enable | disable <port>] | map);

Port based priority – allows passing packets from ports (LAN, WAN or Mng) directly to a specific priority queue. By default port based priority queuing passes packets from all ports to lowest (1) priority queue (command line – ethernet QoS port <port> <priority>);

Priority queuing mode – allows choosing fixed priority queuing or weighted queue (command line – ethernet QoS queuing {[Fixed | Weighted]}):

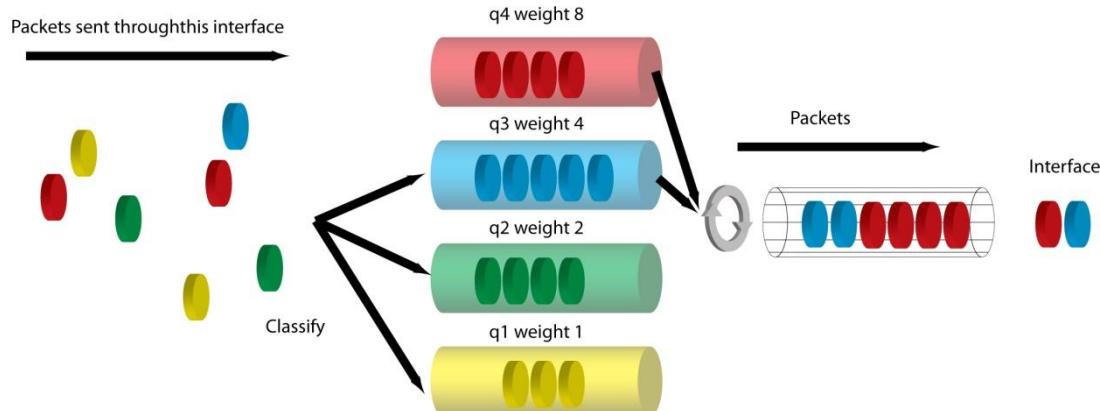


Figure 36 - Weighted priority queuing mode

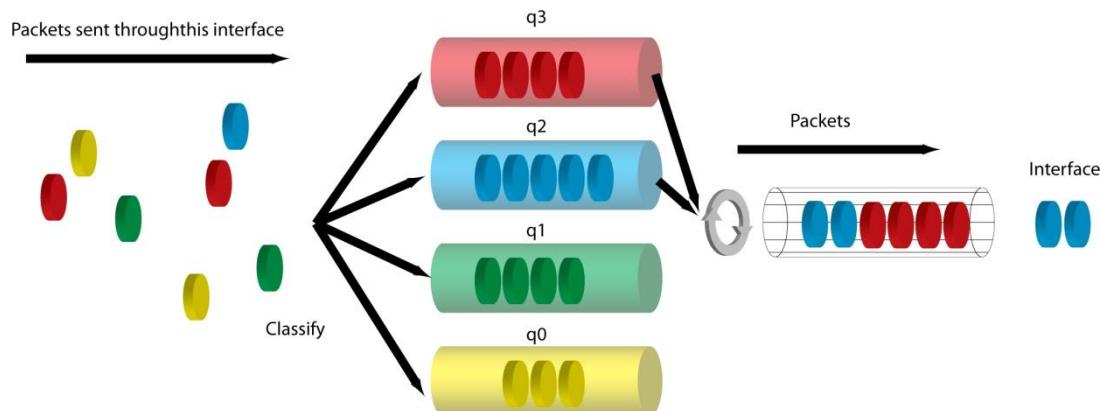


Figure 37 - Fixed priority queuing mode

In case of weighted priority queuing mode, highest (q3) priority buffer may pass up to 8 consecutive packets subsequently proceeding to lower priority buffer (q2), which may pass up to 4 consecutive packets. This means that highest priority after passing 8 consecutive packets will wait no longer than until 7 packets of lower priorities pass ($4(q2)+2(q1)+1(q0)$).

If any queues are empty, the highest non-empty queue gets one more weighting. For example, if q2 is empty, q3:q2:q1:q0 becomes (8+1):0:2:1.

In case of fixed queuing mode, highest priority buffer (q3) will pass packets as long as its buffer is full.

By default weighted priority queuing mode is enabled.

Priority Buffers – shows the state of priority buffers (command line – ethernet QoS);

QoS 802.1p – enables or disables 802.1p priorities for all three ports – LAN, WAN and Mng (command line – ethernet QoS 802.1p {[enable | disable <Port>] | [map]});

DiffServ – enables or disables DiffServ (DSCP) priorities for all three ports – LAN, WAN and Mng (command line – ethernet QoS DSCP [enable | disable <port>] | map);

Port based priority – allows passing packets from ports (LAN, WAN or Mng) directly to a specific priority queue. By default port based priority queuing passes packets from all ports to lowest (1) priority queue (command line – ethernet QoS port <port> <priority>);

Multiple Tx priority queues – enables or disables multiple Tx priority queues (command line – ethernet QoS priorities {{enable | disable} <Port>});

QoS 802.1p Configuration

QoS 802.1p provides configuration of QoS 802.1p priority mapping. You are able to map 8 different traffic 802.1p values (0 – 7) into 4 priority queues (1 – 4).

| QoS 802.1p configuration | |
|-----------------------------|-------------|
| QoS 802.1p priority mapping | |
| 802.1p value | Queue value |
| 0 | 1 |
| 1 | 1 |
| 2 | 2 |
| 3 | 2 |
| 4 | 3 |
| 5 | 3 |
| 6 | 4 |
| 7 | 4 |

Rollback on

FODU returned: Ok

QoS 802.1p priority mapping – allows assigning queue values to specific 802.1p values.

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied;

Write to config file – writes to configuration file all the changes made on the whole page (command line – cfg write);

FODU returned - in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

DSCP Configuration

QoS DSCP provides mapping of different traffic DSCP classes to priority queues.

| DSCP configuration | | | | | | | |
|--------------------|-------|------|-------|------|-------|------|-------|
| DSCP mapping | | | | | | | |
| DSCP | Queue | DSCP | Queue | DSCP | Queue | DSCP | Queue |
| 0 | 1 | 16 | 2 | 32 | 3 | 48 | 4 |
| 1 | 1 | 17 | 2 | 33 | 3 | 49 | 4 |
| 2 | 1 | 18 | 2 | 34 | 3 | 50 | 4 |
| 3 | 1 | 19 | 2 | 35 | 3 | 51 | 4 |
| 4 | 1 | 20 | 2 | 36 | 3 | 52 | 4 |
| 5 | 1 | 21 | 2 | 37 | 3 | 53 | 4 |
| 6 | 1 | 22 | 2 | 38 | 3 | 54 | 4 |
| 7 | 1 | 23 | 2 | 39 | 3 | 55 | 4 |
| 8 | 1 | 24 | 2 | 40 | 3 | 56 | 4 |
| 9 | 1 | 25 | 2 | 41 | 3 | 57 | 4 |
| 10 | 1 | 26 | 2 | 42 | 3 | 58 | 4 |
| 11 | 1 | 27 | 2 | 43 | 3 | 59 | 4 |
| 12 | 1 | 28 | 2 | 44 | 3 | 60 | 4 |
| 13 | 1 | 29 | 2 | 45 | 3 | 61 | 4 |
| 14 | 1 | 30 | 2 | 46 | 3 | 62 | 4 |
| 15 | 1 | 31 | 2 | 47 | 3 | 63 | 4 |

Rollback on Execute configuration

Write to config file

FODU returned: Ok

DSCP mapping – allows assigning queues for different DSCP classes. You may have up to 64 different traffic DSCP classes;

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied;

Write to config file – writes to configuration file all the changes made on the whole page (command line – cfg write);

FODU returned - in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

QoS 802.1p Bandwidth Configuration

QoS 802.1p bandwidth provides configuration of bandwidth limiting on all three ports, thus allowing you to gain best results from your LigoPTP 24 based system.

QoS 802.1p bandwidth configuration

| | Out |
|---------------------------------------|-------------------------------------|
| Port 1. LAN Bandwidth limiting | |
| Priority1 | <input type="button" value="Full"/> |
| Priority2 | <input type="button" value="Full"/> |
| Priority3 | <input type="button" value="Full"/> |
| Priority4 | <input type="button" value="Full"/> |
| Port 2. WAN Bandwidth limiting | |
| Priority1 | <input type="button" value="Full"/> |
| Priority2 | <input type="button" value="Full"/> |
| Priority3 | <input type="button" value="Full"/> |
| Priority4 | <input type="button" value="Full"/> |
| Port 3. Mng Bandwidth limiting | |
| Priority1 | <input type="button" value="Full"/> |
| Priority2 | <input type="button" value="Full"/> |
| Priority3 | <input type="button" value="Full"/> |
| Priority4 | <input type="button" value="Full"/> |

Rollback on

FODU returned: Ok

QoS 802.1p port limiting – allows limiting bandwidths of priority queues on all three ports (LAN, WAN and Mng) for both egress and regressive directions. Possible choices are varying from 64Kbps to 88Mbps;

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied;

Write to config file – writes to configuration file all the changes made on the whole page (command line – cfg write);

FODU returned - in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

SNMP Configuration

The SNMP configuration window provides the configuration of SNMP communities, host and trap addresses.

Explanation of customization fields:

SNMP Community Configuration

SNMP community configuration

| | |
|-----------------------------------|--|
| Read (Max length: 31 characters) | <input type="text" value="public"/> |
| Write (Max length: 31 characters) | <input type="text" value="private"/> |
| SNMP trap address | <input type="text" value="255.255.255.255"/> |

Rollback on

Read - Specifies the SNMP community name of the agent to enable parameters to be read (command line – snmp community read <communityname>);

Write – specifies the community name of the agent to enable parameters to be written (command line – snmp community write <communityname>);

SNMP trap address – sets the IP address of the management terminal with the installed Trap Manager software, based on SNMP platform. The LigoPTP 24 FODU management controller sends SNMP traps to the Trap Manager with IP address specified here. The SNMP Trap Manager is a PC with installed SNMP trap management software. The default Trap Manager IP address is 255.255.255.255 meaning that no trap packets are sent by the management controller (command line – snmp trap <ipaddr>);

Pressing **Execute configuration** applies changes made to the corresponding section only for the local side LigoPTP 24 FODU. If **Rollback on** is selected, configuration will be reverted in case of erroneous configuration changes applied.

SNMP Allowed Hosts Configuration



SNMP host list – shows the list of available SNMP hosts; adds or deletes the host IP address to the LigoPTP 24 SNMP host table. If the SNMP host connected to the LigoPTP 24 is not added to the LigoPTP 24 SNMP host table, the LigoPTP 24 will not respond to the SNMP requests from that host. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied. (command line – snmp host {add | delete} <ipaddr>);

Write to config file – writes to configuration file all the changes made on the whole page (command line – cfg write);

FODU returned - in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

Performance and Alarm Management

Alarm Management

Alarms and Events Structure

All alarms and events are placed in indexed table. Low level raw alarms and events are placed in the first table. Raw alarms and events are merged in groups, which are placed in the second indexed group table. Raw alarm table and group table are related one to many, or one to one if each alarm has a separate group (see Figure 5.1.). Group is in SET state if one or more group members are in SET state. If there is no info about any group member alarm or event state, then there is no info about group state too.

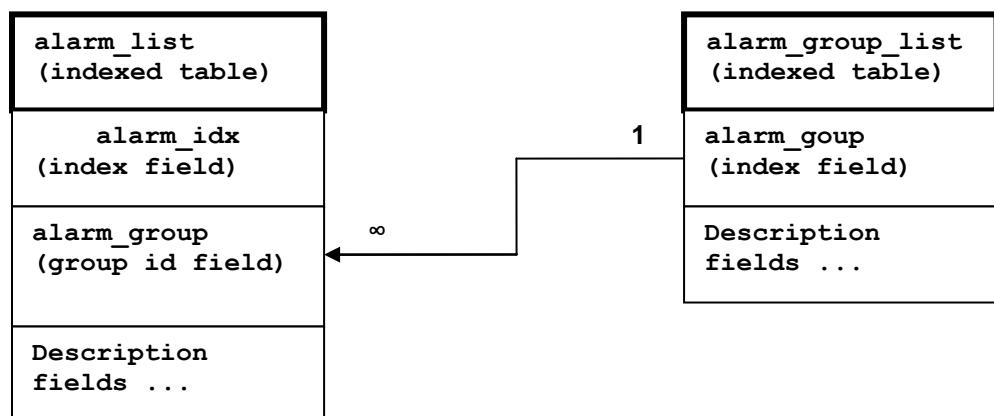


Figure 38 – Alarm and group table relation

Alarms-Events and Groups Tables

Most groups write log when group state changes (Set/Reset), but some groups are only rising.

Alarms events and event groups:

| Alarm ID | Group ID | Alarm-Event name | Description |
|----------|----------|--|---|
| 1 | 1 | ==> System Start | Software started [Only rising] |
| 2 | 2 | Invalid device license | License is not valid |
| 3 | 3 | License expired | License validity has expired |
| 4 | 4 | License will soon expire | License validity will soon expire |
| 5 | 5 | Log was Cleared | Entered when 'Log Clear' command was called [Only rising] |
| 6 | 6 | Log ERROR | Log data structure missing |
| 7 | 7 | Log TEST | Log test was made |
| 8 | 8 | Counters was Cleared | System performance counters were cleared [Only rising] |
| 9 | 9 | Config was Written | Configuration was written [Only rising] |
| 10 | 10 | System CPU restart ==> | Entered when system restart was called [Only rising] |
| 11 | 11 | No data from system temperature sensor | No data from temperature sensor connected via I2C interface |
| 12 | 12 | System temperature fault | Temperature is out of defined range |

| Alarm ID | Group ID | Alarm-Event name | Description |
|----------|----------|--|---|
| 13 | 13 | No data from main PSU ADC | No data from the main PSU ADC |
| 14 | 14 | Main supply voltage failure | Main supply voltage is out of defined range |
| 15 | 15 | Main supply current failure | Main supply current is out of defined range |
| 16 | 16 | Main supply power failure | Main supply power is out of defined range |
| 17 | 17 | No data from power supply ADC | No data from ADC connected via I2C interface |
| 18 | 18 | 1,2V failure | Power supply voltage out of defined range |
| 19 | 18 | 1,5V failure | Power supply voltage out of defined range |
| 20 | 18 | 3,3V failure | Power supply voltage out of defined range |
| 21 | 18 | 5,0V failure | Power supply voltage out of defined range |
| 22 | 18 | Permanent 7,5V failure | Power supply voltage out of defined range |
| 23 | 18 | Switchable 7,5V failure | Power supply voltage out of defined range |
| 24 | 18 | 12,0V failure | Power supply voltage out of defined range |
| 25 | 18 | -5,0V failure | Power supply voltage out of defined range |
| 26 | 19 | No data from RADIO | No data from radio (for future compatibility) |
| 27 | 20 | Rx level alarm | Rx alarm level is out of defined range |
| 28 | 21 | Tx PLL error alarm | Tx PLL failure |
| 29 | 22 | Rx PLL error alarm | Rx PLL failure |
| 30 | 23 | No data from MODEM | No data from MODEM connected via UART interface |
| 31 | 24 | Acquire status alarm | Modem acquire failure status |
| 32 | 25 | Last acquire error status | Modem last acquire failure status |
| 33 | 26 | Radial MSE | Radial MSE is out of defined range |
| 34 | 27 | LDPC decoder stress | LDPC decoder stress is out of defined range |
| 35 | 28 | ACM profile was changed | ACM profile was changed |
| 36 | 29 | RX carrier offset | Error in Rx carrier offset |
| 37 | 30 | No data from modem temperature sensor | No data from modem temperature sensor |
| 38 | 31 | Modem temperature fault | Modem temperature is out of defined range |
| 39 | 32 | ATPC Tx power correction was changed | ATPC Tx power correction was changed |
| 40 | 33 | Rollback initiate system CPU restart ==> | System restart was called by rollback [Only rising] |
| 41 | 34 | System CPU reset was WDT initiated ==> | System restart was called by watchdog [Only rising] |

| Alarm ID | Group ID | Alarm-Event name | Description |
|----------|----------|--------------------------|---|
| 42 | 35 | PM log flash write error | Error while writing pm log to flash |
| 43 | 36 | Command from interface | Message about command execution from particular interface |
| 44 | 37 | Message | Informative message |
| 45 | 38 | E1 interface | E1 interface failure |
| 46 | 39 | Ethernet interface | No connection to Ethernet LAN port |

Alarm Status Window

'Status → Alarm status' in navigation bar shows you all the current alarms.

Date and time represents the time the alarm appeared, so you can easily evaluate for how long the alarm has been active. 'Alarm gr.' is the number of alarm group in which the specific alarm is grouped. Complete list of alarm individual IDs and group IDs can be seen in the table above or using the command '**alarm list**' in the command prompt.

To configure representation of alarms, refer to chapter *Adaptive Equalizer*.

| Alarm status | | | |
|--------------|------------|----------|--------------------|
| Alarm gr. | Date | Time | Alarm |
| 30 | 2008-11-22 | 12:39:36 | E1 interface |
| 31 | 2008-11-22 | 12:39:36 | Ethernet interface |

Figure 39 - Alarm status window

Alarm Log

To view alarms history, go to 'Performance → Alarm log'.

Alarm log shows 21 latest alarm entries per page and about 2000 latest alarm entries in total.

Alarm entries are mostly distributed in two groups – 'Set' when alarm appears and 'Reset' when alarm disappears.

To view earlier log entries, please enter the number of log entry and press 'Previous 21' or 'Next 21' to view 21 entries before or after entered entry number.

Note that the alarm ID (for example, '032' in the *Figure 40 - Alarm log window*) here is an individual ID, not a group ID.

You also have fast access to alarm filtering, where it is possible to choose which alarm ID you are willing to search among all log entries. To configure detailed and permanent alarm representation, refer to the next chapter *Alarm and Alarm Threshold Configuration*.

Alarm log

```

0001: 2009-05-05 17:12:35 - 005 - Log was Cleared - Set
0002: 2009-05-05 17:12:49 - 041 - Command from interface - TASK> modem modulation 16APSK wide ACM
0003: 2009-05-05 17:12:52 - 031 - Acquire status alarm - [ACQUIRE_IN_PROGRESS]-> Set
0004: 2009-05-05 17:12:52 - 032 - Last acquire error status - [ACQUIRE_ERR_FREQ_SWEEP]-> Set
0005: 2009-05-05 17:12:52 - 033 - Radial MSE - [2.7]-> Set
0006: 2009-05-05 17:12:54 - 027 - Rx level alarm - [-91]-> Set
0007: 2009-05-05 17:12:54 - 027 - Rx level alarm - [-39]-> Reset
0008: 2009-05-05 17:12:54 - 031 - Acquire status alarm - [ACQUIRE_LOCKED]-> Reset
0009: 2009-05-05 17:12:54 - 032 - Last acquire error status - [ACQUIRE_SUCCESS]-> Reset
0010: 2009-05-05 17:12:54 - 033 - Radial MSE - [-26.2]-> Reset
0011: 2009-05-05 17:12:55 - 035 - ACM profile was changed - [16APSK]
0012: 2009-05-05 17:13:04 - 041 - Command from interface - WEB> log show
0013: 2009-05-05 17:13:23 - 041 - Command from interface - WEB> cfg rollback on
0014: 2009-05-05 17:13:23 - 041 - Command from interface - WEB> cfg rollback exe
0015: 2009-05-05 17:13:25 - 041 - Command from interface - WEB> cfg rollback accept
0016: 2009-05-05 17:13:44 - 041 - Command from interface - WEB> cfg show
0017: 2009-05-05 17:13:45 - 041 - Command from interface - WEB> cfg write
0018: 2009-05-05 17:13:45 - 009 - Config was Written - Set
0019: 2009-05-05 17:13:47 - 041 - Command from interface - WEB> cfg show
0020: 2009-05-05 17:14:06 - 041 - Command from interface - WEB> log show
End
|< Previous 21 | 20 | Next 21 >| Filter: none
> Alarm-event log file <
Clear alarm log

```

Figure 40 - Alarm log window

Alarm and Alarm Threshold Configuration

The alarm configuration screen allows you to configure alarm representation. You have a choice to see specific alarm groups globally in alarm status (Global), in alarm log (Log) or in NMS system (SNMP). By default all alarms are enabled.

| Alarm & log configuration | Global | Log | SNMP |
|---|-------------------------------------|-------------------------------------|-------------------------------------|
| [1] ==> System Start | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [2] Invalid device license | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [3] License expired | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [4] License will soon expire | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [5] Log was Cleared | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [6] Log ERROR | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [7] Log TEST | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [8] Counters was Cleared | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [9] Config was Written | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [10] System CPU restart ==> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [11] No data from system temperature sensor | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [12] System temperature fault | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [13] No data from main PSU ADC | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [14] Main supply voltage failure | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [15] Main supply current failure | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [16] Main supply power failure | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [17] No data from power supply ADC | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [18] Power supply voltage failure | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [19] No data from RADIO | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [20] Rx level alarm | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [21] Tx PLL error alarm | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [22] Rx PLL error alarm | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [23] No data from MODEM | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [24] Acquire status alarm | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [25] Last acquire error status | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [26] Radial MSE | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [27] LDPC decoder stress | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [28] ACM profile was changed | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [29] RX carrier offset | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [30] No data from modem temperature sensor | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [31] Modem temperature fault | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [32] ATPC Tx power correction was changed | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [33] Rollback initiate system CPU restart ==> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [34] System CPU reset was WDT initiated ==> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [35] PM log flash write error | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [36] Event of command execution starting | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [37] Event of string message | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [38] E1 interface | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| [39] Ethernet interface | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| | | Execute configuration | |
| | | | Write to config file |
| FODU returned: | | Ok | |

Figure 41 – Alarm configuration window

Alarm threshold configuration screen allows you to define specific threshold levels to bound alarms to desirable values, so that you are able to adapt alarm system to your individual needs.

Alarms in bold font represent group alarms and alarms in normal font – individual alarms.

| Alarm threshold configuration | | | | | | |
|--|-----------------------------|--|--|---|---------------------------------------|----------------|
| 10(G.ID) System temperature fault | | | | | | |
| 12(A.ID) | System temperature fault | L= <input type="text" value="-33.0"/> C | H= <input type="text" value="85.0"/> C | D= <input type="text" value="1.0"/> C | Value=43.0 C | |
| 14(G.ID) Main supply voltage failure | | | | | | |
| 14(A.ID) | Main supply voltage failure | L= <input type="text" value="36.00"/> V | H= <input type="text" value="57.00"/> V | D= <input type="text" value="1.00"/> V | Value=47.12 V | |
| 15(G.ID) Main supply current failure | | | | | | |
| 15(A.ID) | Main supply current failure | L= <input type="text" value="0.000"/> A | H= <input type="text" value="0.660"/> A | D= <input type="text" value="0.010"/> A | Value=0.452 A | |
| 16(G.ID) Main supply power failure | | | | | | |
| 16(A.ID) | Main supply power failure | L= <input type="text" value="0.00"/> W | H= <input type="text" value="25.00"/> W | D= <input type="text" value="0.50"/> W | Value=21.32 W | |
| 18(G.ID) Power supply voltage failure | | | | | | |
| 18(A.ID) | 1.2V failure | L= <input type="text" value="1.15"/> V | H= <input type="text" value="1.32"/> V | D= <input type="text" value="0.03"/> V | Value=1.27 V | |
| 19(A.ID) | 1.5V failure | L= <input type="text" value="1.43"/> V | H= <input type="text" value="1.57"/> V | D= <input type="text" value="0.03"/> V | Value=1.49 V | |
| 20(A.ID) | 3.3V failure | L= <input type="text" value="3.15"/> V | H= <input type="text" value="3.60"/> V | D= <input type="text" value="0.03"/> V | Value=3.39 V | |
| 21(A.ID) | 5.0V failure | L= <input type="text" value="4.50"/> V | H= <input type="text" value="5.50"/> V | D= <input type="text" value="0.03"/> V | Value=5.05 V | |
| 22(A.ID) | Permanent 7.5V failure | L= <input type="text" value="6.75"/> V | H= <input type="text" value="8.25"/> V | D= <input type="text" value="0.05"/> V | Value=7.52 V | |
| 23(A.ID) | Switchable 7.5V failure | L= <input type="text" value="6.75"/> V | H= <input type="text" value="8.25"/> V | D= <input type="text" value="0.05"/> V | Value=7.58 V | |
| 24(A.ID) | 12.0V failure | L= <input type="text" value="10.80"/> V | H= <input type="text" value="13.20"/> V | D= <input type="text" value="0.05"/> V | Value=11.78 V | |
| 25(A.ID) | -5.0V failure | L= <input type="text" value="-5.50"/> V | H= <input type="text" value="-4.50"/> V | D= <input type="text" value="0.03"/> V | Value=-5.04 V | |
| 20(G.ID) Rx level alarm | | | | | | |
| 27(A.ID) | Rx level alarm | L= <input type="text" value="-87"/> dBm | H= <input type="text" value="-30"/> dBm | D= <input type="text" value="1"/> dBm | A <input checked="" type="checkbox"/> | Value=-45 dBm |
| 26(G.ID) Radial MSE | | | | | | |
| 33(A.ID) | Radial MSE | | H= <input type="text" value="-12.0"/> dB | D= <input type="text" value="1.0"/> dB | A <input checked="" type="checkbox"/> | Value=-33.2 dB |
| 27(G.ID) LDPC decoder stress | | | | | | |
| 34(A.ID) | LDPC decoder stress | | H= <input type="text" value="5.0e-03"/> | | A <input checked="" type="checkbox"/> | Value= 0.0e+00 |
| 29(G.ID) RX carrier offset | | | | | | |
| 36(A.ID) | RX carrier offset | L= <input type="text" value="-700"/> KHz | H= <input type="text" value="700"/> KHz | D= <input type="text" value="10"/> KHz | Value=-3 kHz | |
| 31(G.ID) Modem temperature fault | | | | | | |
| 38(A.ID) | Modem temperature fault | L= <input type="text" value="-33.0"/> C | H= <input type="text" value="95.0"/> C | D= <input type="text" value="1.0"/> C | Value=53.0 C | |
| Execute configuration | | | | | | |
| Write to config file | | | | | | |
| FODU returned: | Ok | | | | | |

Figure 42 – Alarm threshold configuration window

Alarm Management Commands

To manage alarms in command prompt, the commands are as follows:

| Command | Description |
|--------------------------------------|---|
| Log show [<start line>] | The management controller maintains event log, - events include configuration changes, management controller restarts, and local site alarm changes. The “log show” or “log” commands display the latest 20 log entries, the log entries are numbered, - entry with the largest number is the latest event. The “log show” command can be followed up with an entry number to display the latest 20 entries beginning from the entry specified by the number, e.g., “log show 100” will display entries 100...120. |
| Log filter <alarm ID> [<num>] | Filters event list by specific alarm ID. <start line> ; works similarly to ‘log show’ command. |
| Log file <file name> | Makes event log file with specified filename. |
| Alarm stat | Lists alarm groups currently set. |
| Alarm list | Displays the list of all alarms, their group IDs and alarm IDs. |
| Alarm groups | Displays the list of all alarms and their group IDs. |

| Command | Description |
|--|--|
| Alarm cfg <groupID>[<global><led><aux><log><snmp>] | Allows defining detailed alarm representation settings. [<global> <led> <aux> <log> <snmp>] must be defined in a row of '1's or '0's of 5 values for specified group ID with <group ID>. '1' means the values are 'on' and '0' – 'off'. |
| Alarm threshold {stat} {<Alarm ID>lo hi delta <value>} | Sets threshold values outside which alarm status will be shown. |

Performance Management

The main aim of the *performance management* is to register mostly critical device performance event values in predefined time intervals.

Performance Management Data Collection

The performance parameters are collected within time intervals of 1 min., 15 min. and 1 hour. List reserved space for every time interval is 1440 records (see *Figure 43 – Functional architecture for data collection, history and thresholding treatment*).

Second-by-second the input performance event values are stored by updating previous second values. The register is called **current register**. The **current register** contains the performance values collected second-by-second from the reset instant to the present second.

At the end of period the contents of current registers are transferred to the history registers (records), with a time-date stamp to identify the period, after which the current register must be reset.

Some current register values are passed to the threshold crossing control unit for triggering threshold crossing notification.

Optionally, the same values are output to the Message Communication Function (MCF) to be forwarded to the managing system.

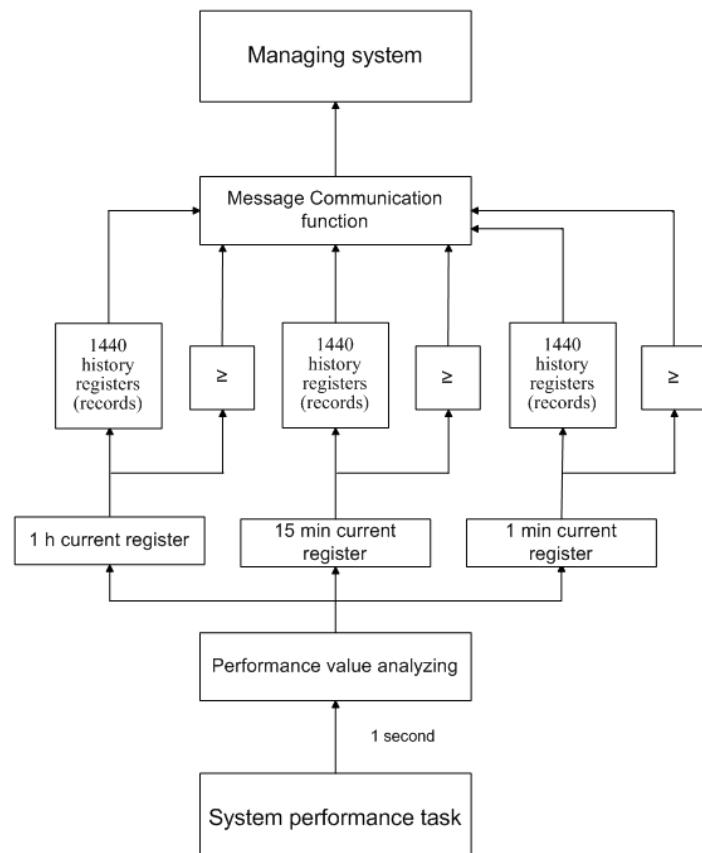


Figure 43 – Functional architecture for data collection, history and thresholding treatment

Performance Values

Threshold Seconds (TS)

The TS is defined as one second period during which the detected value is outside of predefined thresholds. The current value of the counter associated with a TS shall be readable by the managing system on request. In case a threshold associated to a TS counter is changed, the current value of the counter shall be reset to zero.

Tide Mark (TM)

The TM is a mechanism that records the maximum and the minimum value reached during measurement period. The tide mark values are automatically reset to the current value assumed at the beginning of each measurement period. The TM is therefore composed of two values: the minimum and the maximum value. Comparison between the current value and the minimum and maximum values is performed on a second basis.

Performance Management in Web GUI

The main performance management tool in the LigoPTP 24 FODU is the Web interface, allowing user to review performance measurements in a very convenient and visualized way.

Going to ‘Performance → Performance log’ in navigation panel on the left side of the Web GUI window will lead you to the log parameters’ selection screen, where you will be able to choose between 6 different parameters to display in summarizing performance log or pick ‘ALL’ to display all 6 parameters in conjoint log which is shown in figure below:

| Performance log field selection | |
|---|---|
| Select objects to display | <input type="checkbox"/> ALL <input checked="" type="checkbox"/> Uptime <input checked="" type="checkbox"/> Rx level <input checked="" type="checkbox"/> Tx level <input checked="" type="checkbox"/> System temperature <input checked="" type="checkbox"/> Radial MSE <input checked="" type="checkbox"/> LDPC decoder stress |
| <input type="button" value="Save&Proceed"/> | |

Figure 44 – Selecting performance log parameters

| Performance log | | | | | | | | | | | | | | | | | | |
|-----------------|----------|-------|-------|-----|----|--------|-----|----|-------|----------------|------|-----|-------|-------|-----|---------|---------------------|---|
| Nr | Date | Time | Radio | | | System | | | Modem | | | | | | | | | |
| | | | Min | Max | TS | Min | Max | TS | Val | System temp, C | Min | Max | TS | Min | Max | TS | LDPC decoder stress | |
| 1419 | 09-05-05 | 16:54 | -42 | -42 | 0 | 17 | 17 | 0 | 8164 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 9.2e-07 | 0 |
| 1420 | 09-05-05 | 16:55 | -42 | -42 | 0 | 17 | 17 | 0 | 8224 | 48.0 | 48.0 | 0 | -30.1 | -29.6 | 0 | 0.0e+00 | 1.2e-06 | 0 |
| 1421 | 09-05-05 | 16:56 | -42 | -42 | 0 | 17 | 17 | 0 | 8284 | 48.0 | 48.0 | 0 | -30.0 | -29.5 | 0 | 0.0e+00 | 9.2e-07 | 0 |
| 1422 | 09-05-05 | 16:57 | -42 | -42 | 0 | 17 | 17 | 0 | 8344 | 48.0 | 48.0 | 0 | -30.0 | -29.5 | 0 | 0.0e+00 | 1.2e-06 | 0 |
| 1423 | 09-05-05 | 16:58 | -42 | -42 | 0 | 17 | 17 | 0 | 8404 | 48.0 | 48.0 | 0 | -30.0 | -29.5 | 0 | 0.0e+00 | 1.0e-06 | 0 |
| 1424 | 09-05-05 | 16:59 | -42 | -42 | 0 | 17 | 17 | 0 | 8464 | 48.0 | 48.0 | 0 | -30.2 | -29.5 | 0 | 0.0e+00 | 1.9e-06 | 0 |
| 1425 | 09-05-05 | 17:00 | -42 | -42 | 0 | 17 | 17 | 0 | 8524 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 1.4e-06 | 0 |
| 1426 | 09-05-05 | 17:01 | -42 | -42 | 0 | 17 | 17 | 0 | 8584 | 48.0 | 48.0 | 0 | -30.1 | -29.6 | 0 | 0.0e+00 | 1.3e-06 | 0 |
| 1427 | 09-05-05 | 17:02 | -42 | -42 | 0 | 17 | 17 | 0 | 8644 | 48.0 | 48.0 | 0 | -30.0 | -29.5 | 0 | 0.0e+00 | 2.5e-06 | 0 |
| 1428 | 09-05-05 | 17:03 | -42 | -42 | 0 | 17 | 17 | 0 | 8704 | 48.0 | 48.0 | 0 | -30.1 | -29.6 | 0 | 0.0e+00 | 1.1e-06 | 0 |
| 1429 | 09-05-05 | 17:04 | -42 | -42 | 0 | 17 | 17 | 0 | 8764 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 9.4e-07 | 0 |
| 1430 | 09-05-05 | 17:05 | -42 | -42 | 0 | 17 | 17 | 0 | 8824 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 1.4e-06 | 0 |
| 1431 | 09-05-05 | 17:06 | -42 | -42 | 0 | 17 | 17 | 0 | 8884 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 1.7e-06 | 0 |
| 1432 | 09-05-05 | 17:07 | -42 | -42 | 0 | 17 | 17 | 0 | 8944 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 2.3e-06 | 0 |
| 1433 | 09-05-05 | 17:08 | -42 | -42 | 0 | 17 | 17 | 0 | 9004 | 48.0 | 48.0 | 0 | -30.1 | -29.6 | 0 | 0.0e+00 | 1.4e-06 | 0 |
| 1434 | 09-05-05 | 17:09 | -42 | -42 | 0 | 17 | 17 | 0 | 9064 | 48.0 | 48.0 | 0 | -30.1 | -29.6 | 0 | 0.0e+00 | 1.4e-06 | 0 |
| 1435 | 09-05-05 | 17:10 | -42 | -42 | 0 | 17 | 17 | 0 | 9124 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 2.3e-06 | 0 |
| 1436 | 09-05-05 | 17:11 | -42 | -42 | 0 | 17 | 17 | 0 | 9184 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 1.4e-06 | 0 |
| 1437 | 09-05-05 | 17:12 | -42 | -42 | 0 | 17 | 17 | 0 | 9249 | 48.0 | 48.0 | 0 | -30.0 | -29.6 | 0 | 0.0e+00 | 1.0e-06 | 0 |
| 1438 | 09-05-05 | 17:13 | -42 | -37 | 0 | 16 | 17 | 0 | 9311 | 48.0 | 48.0 | 0 | -30.3 | 2.7 | 3 | 0.0e+00 | SyncLos | 3 |
| 1439 | 09-05-05 | 17:14 | -41 | -41 | 0 | 16 | 16 | 0 | 9371 | 48.0 | 48.0 | 0 | -30.5 | -29.8 | 0 | 0.0e+00 | 0.0e+00 | 0 |
| 1440 | 09-05-05 | 17:15 | -41 | -41 | 0 | 16 | 16 | 0 | 9431 | 48.0 | 48.0 | 0 | -30.4 | -29.6 | 0 | 0.0e+00 | 0.0e+00 | 0 |

Select time interval Start date Start time End date End time Show

Figure 45 – Performance log window

Time interval can be chosen between 1 min, 15 min or 1 hr. You can also define the start time and the start date. When start values are defined, it is also possible to define the end time and the end date.

TS (threshold seconds) show the amount of seconds in a chosen period (1min, 15min or 1h) when the parameter had been out of bounds set by performance thresholds in ‘Configuration → Performance log configuration’.

To define thresholds outside of which TS (threshold seconds) will be counted, you must go to ‘Configuration → Performance log configuration’ and enter preferable threshold values. Refer to sections *Performance Management Data Collection* and *Performance Values* for further details on threshold seconds.

| Performance log configuration | | | | | | | |
|---|------------|------------------------------------|-----|-----------|--------------------------------------|-----|-------------------------------|
| <input type="checkbox"/> All to default | | | | | | | |
| <input checked="" type="checkbox"/> Rx level | min (-120) | <input type="text" value="-90"/> | dBm | max (-20) | <input type="text" value="-30"/> | dBm | <input type="checkbox"/> auto |
| <input checked="" type="checkbox"/> System temperature | min (-50) | <input type="text" value="-33.0"/> | C | max (90) | <input type="text" value="+85.0"/> | C | <input type="checkbox"/> auto |
| <input checked="" type="checkbox"/> Radial MSE | | | | max (-10) | <input type="text" value="-12.0"/> | dB | <input type="checkbox"/> auto |
| <input checked="" type="checkbox"/> LDPC decoder stress | | | | max (1) | <input type="text" value="5.0e-03"/> | | <input type="checkbox"/> auto |
| <input type="button" value="Execute configuration"/> | | | | | | | |
| <input type="button" value="Write to config file"/> | | | | | | | |
| FODU returned: | Ok | | | | | | |

Figure 46 – Performance log configuration window

The main advantage in terms of demonstration means is obtained from ‘Performance graphs’, which are found in ‘Performance → Performance graph’ section.

You are able to choose between 5 parameters – Rx level; Tx level; System temperature; Radial MSE and LDPC stress – and to view their graphs. It is possible to choose between 8 scales – from 12 last minutes to the maximum of 6 last days to be displayed in the graph. It is also possible to choose time period to be displayed, defining date and time till which the graph will be shown.



Figure 47 – Performance graph showing system temperature and Rx level in period of last 6 hours

Time scale selector. The user can select the scale and accuracy (1 / 15 / 60 minutes). The lower the accuracy is, the longer the period available for data (mechanism of the performance management system)

- Updates the performance graph; the newest data is shown
- Shows / hides period settings (point 5)
- Performance data selector. Two and only two performance parameters can be selected at a time
- Period settings. Allows the user to specify time period for the graph
- Date and time fields. The date format is “yy-mm-dd”, the time format is “hh:mm”
- Sets date and time fields (point 6) one screen back / forth
- Shows / updates the performance graph using the period settings (point 5)
- Performance graph. Displays two performance parameters. Each parameter is shown with the minimum and maximum curves, which are in the same color. The curves in red have the scale on the left, while the curves in blue have the scale on the right
- Time scale. Shows the time scale chosen from the time scale selector (point 1) for the performance data available. If no data is available for the according moment, “__:_” is shown
- Legend for the curves of the performance graph. Contains the color, the name and the unit of measurement, if available.

In case no performance data has been recorded, or the period specified has no data, “No data” is shown (instead of points 9, 10, 11).

Constellation Diagram

A constellation diagram is a representation of a signal modulated by the digital modulation schemes 32APSK, 16APSK or QPSK. It displays the signal as a two-dimensional scatter diagram in the complex plane at symbol sampling instants. Measured constellation diagram can be used to recognize the type of interference and distortion in a signal.

For the purpose of analyzing the received signal quality, some types of corruption are evident in the constellation diagram. For example:

1. Gaussian noise is displayed as fuzzy constellation points:

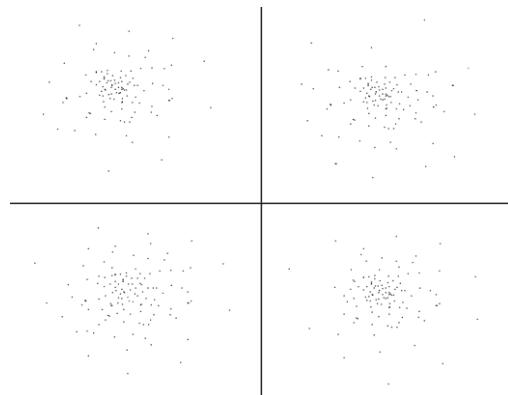


Figure 48 – Gaussian noise (QPSK)

2. Non-coherent single frequency interference is displayed as circular constellation points:

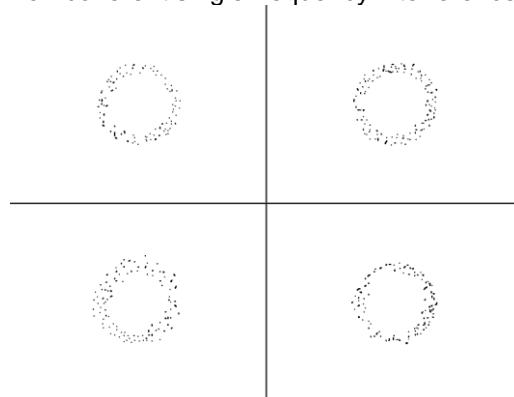


Figure 49 – Non-coherent single frequency interference (QPSK)

3. Phase noise is displayed as rotationally spreading constellation points:

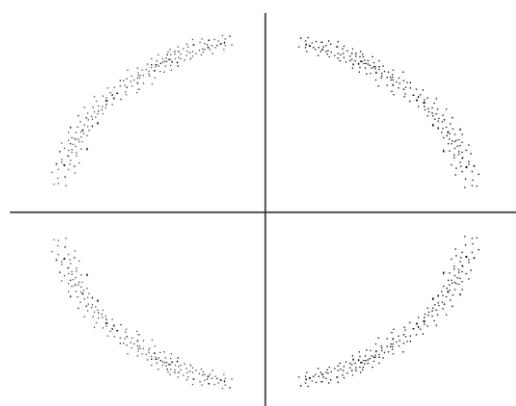


Figure 50 – Phase noise (QPSK)

4. Amplitude compression causes the corner points to move towards the centre:

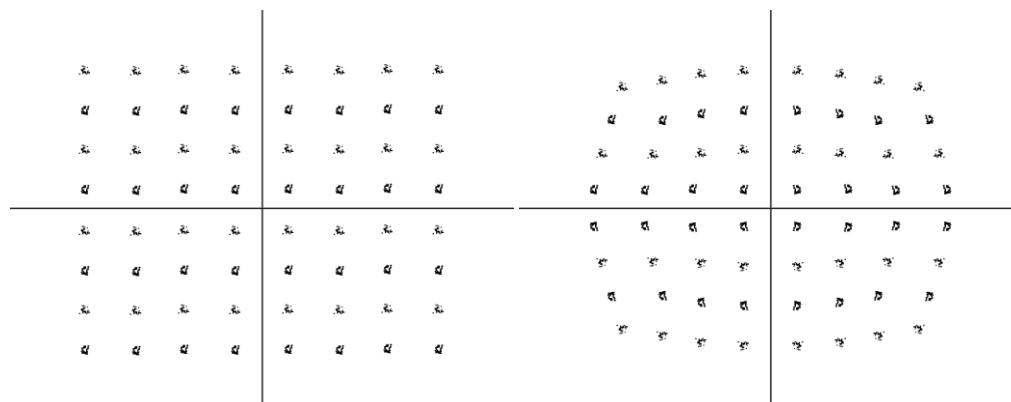


Figure 51 – Amplitude compression (64QAM)

Examples of LigoPTP 24 constellation diagrams under excellent conditions are shown below:

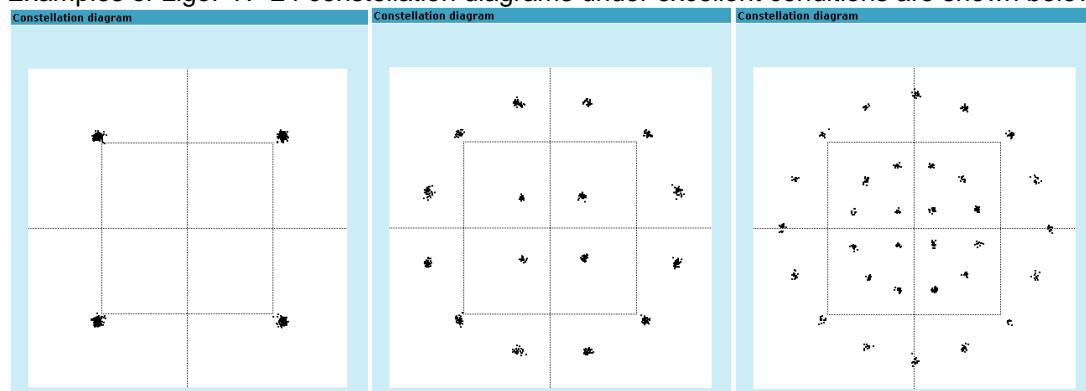
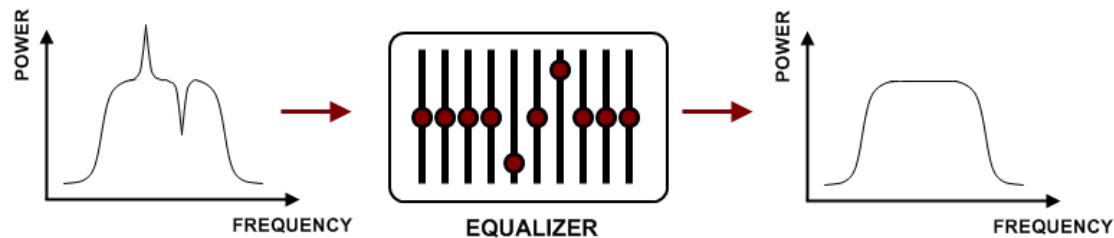


Figure 52 – Constellation diagram – QPSK, 16APSK, 32APSK

Adaptive Equalizer

LigoPTP 24 FODU features adaptive equalizer, which is a filter that automatically adapts to time-varying properties of a communication channel with selective fading, having a target to compensate the inequalities in frequency response, mitigating the effects of multipath propagation. In wireless telecommunications, using QAM modulation this filter equalizes not only a separate quadrature channel, but provides a cancellation of cross-interference between them.

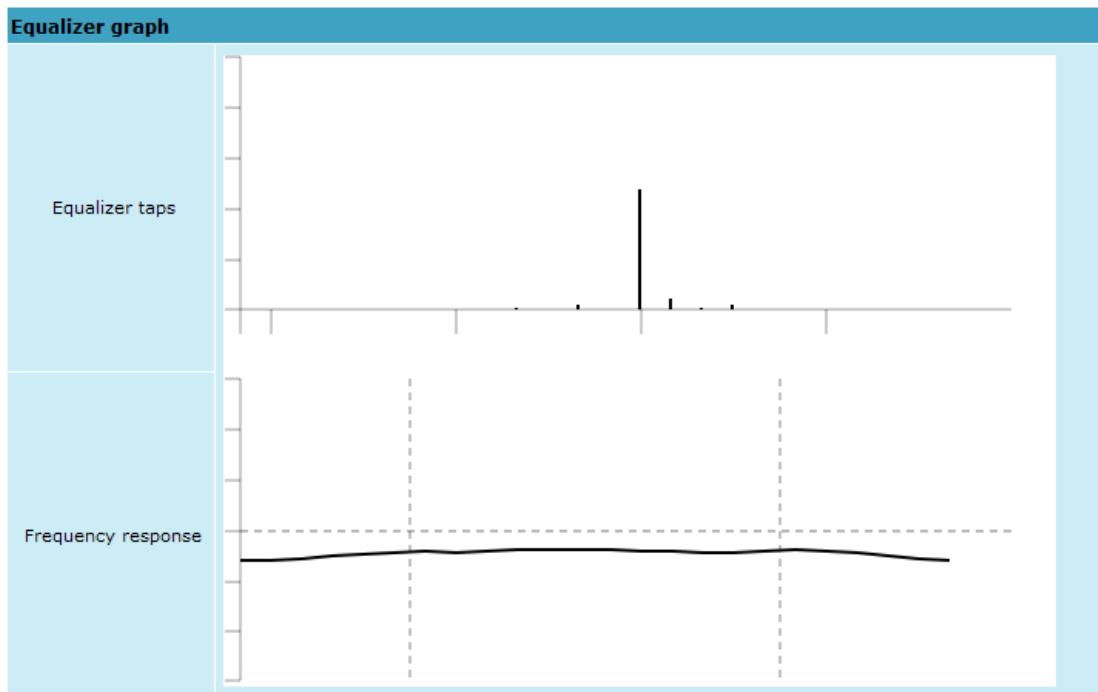
In current LigoPTP 24 device an adaptive equalizer is realized as complex-arithmetic 24-taps digital FIR (Finite Impulse Response) filter. In other words, equalizer is a selective frequency amplifier and attenuator, a device, which application to IF (Intermediate Frequency) bandlimited signal is schematically shown in the picture below:



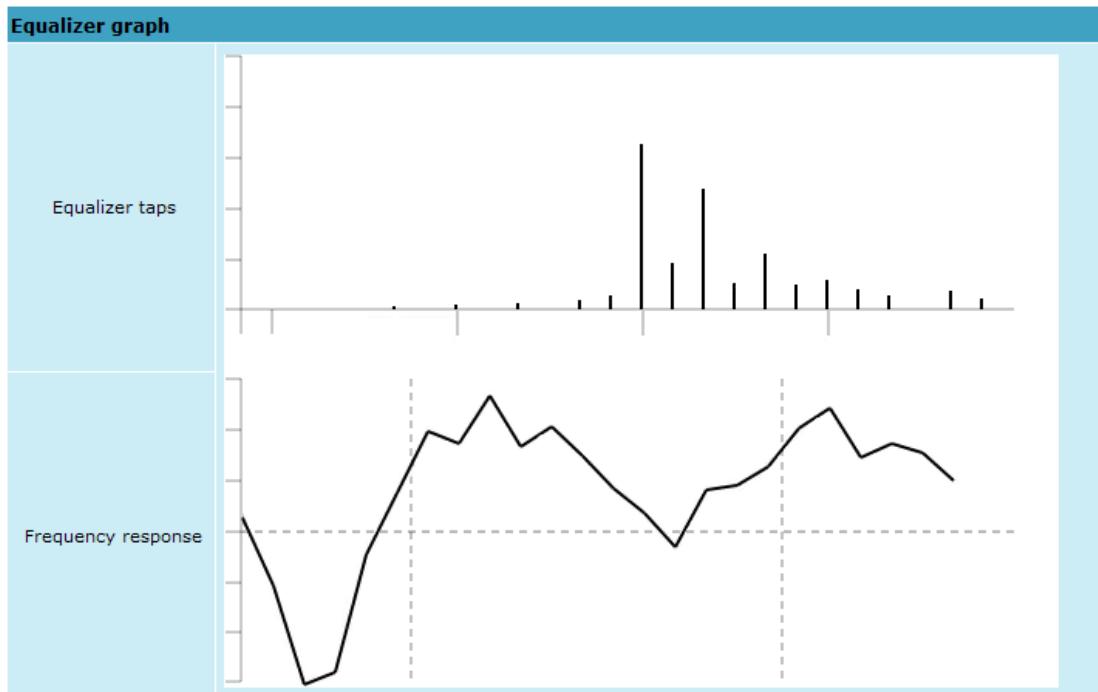
Equalizer Graph

Equalizer graph window shows adaptive equalizer taps' coefficients, which at a set time moment minimize multipath fading effect in channel.

Example of equalizer taps' coefficients and its frequency response in case of a normal operation is shown below:



During normal operation frequency response curve is smooth and the only equalizer tap towers are in the centre of equalizer taps graph, otherwise frequency response curve will appear jagged and many equalizer taps will become visible. The latter case most probably will indicate to multipath issue, which must be inspected with use of precise and accurate path profiling. An example of multipath caused equalization is shown on the picture below. Taps mainly on the right side designate a weaker reflected signal in comparison with the main signal.



Performance Management Commands

It is also possible to view performance log in command prompt. The list of available commands in Telnet/serial interface:

| Command | Description |
|--|---|
| pm log <interval> {<last rec count>} {<start date>} <start time> <end date> <end time>}} | Lists performance management log with selected <interval> of 1min, 15min or 1hr. Allows choosing the number of last records to be shown (<last rec count>) or to define start and end time and date. Note that end time and date values must be entered after entering start time or date respectively. |
| pm select {Up_TIME . Rx_LEVEL . Tx_LEVEL . SYS_TEMPER . RADIAL_MSE . LDPC_STRES.} {ALL NOT} | Allows selecting the system parameters to be monitored and shown in the performance management log. |
| pm logclear | Clears performance log. |
| pm threshold stat auto {{ Rx_LEVEL Tx_LEVEL SYS_TEMPER RADIAL_MSE LDPC_STRES} {min max <value>}} auto } | Sets threshold levels for parameters outside which TS (Threshold Seconds) are counted and shown in the performance log. |

Ethernet Statistics

Ethernet statistics window shows the full statistics of LigoPTP 24 Ethernet switch since unit start or statistics reset. All statistics are also accessible using command prompt command **etherent statistics**.

Explanation of fields:

| Ethernet statistics | | | |
|-------------------------------|------------|---------------------|-------------------------|
| Statistics for 1 day 22:40:03 | | | |
| Modem state | Ok | | Clear statistics |
| Name | Rx | Name | Tx |
| Truncated frames | 0 | Vlan tags | 0 |
| Log events | 0 | Backpres. events | 0 |
| Vlan tags detected | 0 | Pause frames | 0 |
| Unsup. opcodes | 0 | Control frames | 0 |
| Pause frames | 0 | Wire byte counter | 3357985167 |
| Control frames | 0 | Underruns | 0 |
| Dribble nibbles | 0 | Giants | 0 |
| Broadcasts | 11036 | Late collisions | 0 |
| Multicasts | 11054 | Max collisions | 0 |
| Dones | 21245712 | Excessive defers | 0 |
| Out of range errors | 0 | Non-exc. defers | 0 |
| Length check errors | 0 | Broadcasts | 21383 |
| CRC errors | 0 | Multicasts | 21437 |
| Code errors | 0 | Dones | 21282030 |
| False carrier errors | 0 | Length check errors | 0 |
| Rx Dv event | 0 | CRC errors | 0 |
| Prev. pkt dropped | 0 | Collisions | 0 |
| Byte counter | 3364556166 | Byte counter | 3357985167 |
| Name | GFP | Name | QoS |
| FCS errors | 0 | Rx Q1 frames | 21245712 |
| CHEC errors | 10758 | Rx Q1 dropped | 0 |
| Dropped frames | 0 | Rx Q2 frames | 0 |
| Delineation errors | 10758 | Rx Q2 dropped | 0 |
| | | Tx frames | 21282031 |
| | | Tx dropped | 0 |

Ethernet statistics - displays the time during which statistics have been gathered;

Modem state – shows if the modem is operating correctly;

Clear statistics – resets all statistics counters (not available for “guest” account);

Truncated frames – number of truncated received frames;

Long events – frames having byte count greater than MAXIMUM FRAME SIZE parameter (1518, 1536 or 1916 bytes);

Vlan tags detected – VLAN tagged frames;

Unsup. opcodes – frames recognized as control frames but contained an Unknown Opcode;

Pause frames – frames received are control frames with valid PAUSE opcodes;

Control frames – frames received as control frames;

Dribble nibbles – indicates that following the end of the packet additional 1 to 7 bits are received. A single nibble, named the dribble nibble, is formed but not sent to the system;

Broadcasts – packets, which destination address contained broadcast address;

Multicasts – packets, which destination address contained multicast address;

Dones – reception of packets successfully completed;

Out of range errors – frame Type/Length field larger than 1518 (Type Field) bytes;

Length check errors – frame length field in the packet does not match the actual data byte length and is not a Type Field;

CRC errors – frame CRC do not match the internally generated CRC;

Code errors – one or more nibbles are signalled as errors during reception of the packet;

False carrier errors – indicates that following the last received statistics vector, a false carrier was detected, noted and reported with this the next receive statistics. The false carrier is not associated with this packet. False carrier is activated on the receive channel that does not result in a packet receive attempt being made;

Rx Dv event – indicates that the last receive event seen is too short to be a valid packet;

Prev. pkt dropped – indicates that since the last RSV, a packet is dropped (i.e. interframe gap too small);

Byte counter – total number of bytes received on the wire, not counting collided bytes;

FCS errors – number of generic framing procedure (GFP) frames with CRC errors received by the de-encapsulation block;

CHEC errors – number of generic framing procedure (GFP) frames with CHEC errors received by the de-encapsulation block;

Dropped frames – number of generic framing procedure (GFP) frames that were dropped in the de-encapsulation block;

Delineation errors – number of ‘lost of synchronization’ events;

Vlan tags – number of VLAN tagged packets, 32-bit counter;

Backpres. events – carrier-sense-method backpressure was previously applied;

Pause frames – frames transmitted are control frames with a valid PAUSE opcodes;

Control frames – frames transmitted are control frames;

Wire byte counter – total number of bytes transmitted on the wire, including all bytes from collided attempts;

Underruns – underruns occur during frame transmission;

Giants – frames having byte count greater than the MAXIMUM FRAME SIZE parameter (1516, 1536 or 1916 bytes);

Late collisions – Collisions occurred beyond the collision window (512 bit times);

Max collisions – packets aborted after number of collisions exceeded the RETRANSMISSION MAXIMUM parameter;

Excessive defers – packets deferred in excess of 6,071 nibble times in 100 Mbps mode, or 24,287 bit-times in 10 Mbps mode;

Non-exc. defers – packets deferred for at least one attempt, but less than an excessive defer;

Broadcasts – packets, which destination address contained broadcast address;

Multicasts – packets, which destination address contained multicast address;

Dones – transmission of packets successfully completed;

Length check errors – frame length field in the packet does not match the actual data byte length and is not a Type Field;

CRC errors – frame CRC do not match the internally generated CRC;

Collisions – number of collisions the current packet incurred during transmission attempts. Note: bits 19 through 16 are the collision count on any successfully transmitted packet and as such will not show the possible maximum count of 16 collisions;

Byte counter – total count of bytes transmitted on the wire not including collided bytes;

Rx Q1 frames – number of frames received on Q1;

Rx Q1 dropped – number of frames dropped on Q1;

Rx Q2 frames – number of frames received on Q2;

Rx Q2 dropped – number of frames dropped on Q2;

Tx frames – number of frames passed through TX FIFO;

Tx dropped – number of frames dropped in TX FIFO.

Miscellaneous Controls in Web

These controls are located in the Navigation Panel under the “Tools” item.

Configuration File

This section allows working with LigoPTP 24 configuration script.

The management module has RAM and EEPROM chips onboard. When LigoPTP 24 is booted up, bootstrap is loaded from the EEPROM into RAM. The bootstrap contains the parameters that were previously stored in EEPROM using **write** and/or **cfg write** commands. These parameters are stored in EEPROM in the form of script and when booting up, the script parameters are loaded into RAM. These parameters can be freely changed in run-time, - changing the data in RAM. If the LigoPTP 24 is shut down without saving the current configuration (script) in EEPROM, the original configuration will be restored from EEPROM on the next boot-up.

Example of script can be observed on the screenshot below.

The script can be edited:

- string can be added by simply entering required string (see Nr. 7 on the screenshot below) or by executing command in CLI or in the appropriate Web GUI section (the script will be supplemented with the new string or the instant string entry will be updated);
- string can be deleted by entering appropriate line number (see Nr. 2 on the screenshot below) or by using “**cfg delete <string#>**” in CLI.

The changes can be saved in EEPROM by pressing **Cfg write** button (see Nr. 3 on the screenshot below) or by entering “**cfg write**” command in CLI.



The parameters that are not specified in the configuration script will have their default values when the LigoPTP 24 is restarted.

Explanation of customization fields:

| Configuration file | |
|---|--|
| <pre>01: net ip addr 192.168.205.10 02: net ip mask 255.255.255.0 03: net ip gw 255.255.255.255 04: net ip remaddr 192.168.205.11 05: modem bandwidth 30 06: modem modulation 32APSK wide ACM</pre> | |
| Delete entry # | <input type="button" value="Delete"/> |
| Configuration file commands: | |
| <input type="button" value="Cfg write"/> | - Save edited configuration file |
| <input type="button" value="Cfg run"/> | - Execute current configuration |
| Input file name to backup cfg in FODU memory: | <input type="text" value="cfg_backup"/> |
| | <input type="button" value="Cfg backup"/> |
| Input file name to restore cfg from FODU memory: | <input type="text"/> |
| | <input type="button" value="Cfg restore"/> |
| Enter string, which you want to save in cfg: | <input type="text"/> |
| | <input type="button" value="Cfg add"/> |
| <input type="button" value="Cfg factory"/> | - Load factory configuration file |
| To save cfg file on your computer click here. | |

Configuration file – window shows contents of configuration script. Commands contained in this configuration script are executed at every system start-up (command line – **cfg show**);

Delete entry # – allows deleting a specific line of configuration script. You must type the number represented in configuration script to proceed with deleting and press **Delete** (command line – **cfg delete <line>**);

Save edited configuration file – to confirm the changes made, you must write configuration script into EEPROM, otherwise changes will not be saved (command line – **cfg write**);

Execute current configuration – executes commands present in configuration script (command line – **cfg run**);

Input file name to backup cfg in FODU memory – allows choosing file name under which current configuration script will be saved in the *LigoPTP 24 flash memory* (command line – **cfg backup <file>**);

Input file name to restore cfg from FODU memory – allows loading configuration script from previously saved backup file (command line – **cfg restore <file>**). To view the contents of flash memory, go to 'Tools --> Command line' and type in 'tfs ls';

Enter string, which you want to save in cfg – allows you to enter desirable command, which will be added to the configuration script as the last line (command line – **cfg add <cmdline>**);

Load factory configuration file – Resets the configuration by loading in EEPROM the script with default settings. This command performs the following actions (in the following order):

- 1. clears the current script from EEPROM,
- 2. creates and stores in EEPROM the new script with the following settings:
 - - net ip addr 192.168.205.10 or 192.168.205.11 (as marked on the label)
 - - net ip remaddr 192.168.205.11 or 192.168.205.10
 - - net ip mask 255.255.255.0
 - - net ip gw – 255.255.255.255 (default gateway - none)
 - - SNMP trap 255.255.255.255 (none)
- 3. restarts the management controller. (command line – **cfg factory**);

To save cfg file on your computer click here – allows downloading configuration script and saving it on your hard drive.

Additional commands for script editing in Telnet/serial interface is displayed in the table below:

| Command | Description |
|--|--|
| Cfg load | Loads the configuration script from EEPROM into RAM. |
| Cfg clear | Clears the script stored in RAM. |
| Cfg insert <line> <cmdline> | Inserts typed command line with specified line number into configuration script stored in RAM. |
| Cfg cmd <file with commands> | Restarts CPU of management controller and loads configuration script from the specified file. |
| Cfg group | Groups commands in configuration script. |

License Management

License management allows specifying data transmit parameters and functionality for specific time period or for unlimited time.

LigoPTP 24 without licensing option will operate with full functionality, but LigoPTP 24 with licensing option but without activated licenses will operate with minimum functionality (7MHz channel bandwidth, QPSK modulation, no ACM, no E1 channels). Functionality may be expanded using appropriate license key.

Explanation of fields:

| License management | |
|-------------------------------|--|
| Current license status | |
| License status | Ok |
| Left time | Unlimited |
| Key | PAV2B-6MK34-GMDRQ-6KKNR |
| Time | Unlimited |
| Allowed features | |
| Bandwidth | Modulation max |
| 7000 KHz | 32APSK |
| 14000 KHz | 32APSK |
| 28000 KHz | 32APSK |
| ACM | Disabled |
| E1 channels | 0 |
| License management | |
| Available licenses | PAV2B-6MK34-GMDRQ-6KKNR/Unlimited time HJFOJ-KCISO-54ATQ-DPSZB/21 hours 1 minute 23 seconds PYQGP-HMF75-02TWW-PSGOB/Time expired |
| License key | <input type="text"/> <input type="button" value="Add"/> |
| FODU returned: | Ok |

License status – shows if management CPU was able to read license data;

Left time – shows the amount of time left for the active license;

Key – displays currently active license;

Time – shows the overall time for the active license;

7000 KHz – shows the maximum modulation that can be used together with 7 MHz channel bandwidth;

14000 KHz – shows the maximum modulation that can be used together with 14 MHz channel bandwidth;

28000 KHz – shows the maximum modulation that can be used together with 28 MHz channel bandwidth;

ACM – shows if adaptive coding and modulation (ACM) is allowed for the active license;

E1 channels – shows the amount of E1 channels that can be used with the active license;

Available licenses – shows the list of entered licenses. To activate any license, select it. **Add** will transform into “Activate”, which should be pressed;

License key – allows entering a license key. Entering a license key twice, activates it;

FODU returned – in case of error or incorrectly entered parameter value, or other problems on the whole page – the info message is being shown here. Otherwise it says “Ok”.

Command Line

In the command line you are able to execute all the commands to manage the LigoPTP 24 FODU which are available through serial/telnet interface. This dialog box translates commands to Telnet commands and sends them to the device. The initial screen shows you the available commands. To view help on a command, type in “<command> ?”, where <command> stands for the specific command.

| Command management | |
|---------------------------|--|
| Valid commands: | |
| | status radio atpc modem loopback ethernet el diagnostics system cfg tfs net license alarm log pm web snmp access cls ver help |
| Enter Command | <input type="text"/> <input type="button" value="Execute"/> |

Additional commands for script editing in Telnet/serial interface is displayed in the table below:

| Command | Description |
|-----------------------------|--------------------------------------|
| Cls | Clears the screen. |
| Help <command> | Provides help messages for commands. |

File System

The software used by the LigoPTP 24 management controller is organised in files, which are stored on Flash disk.

Firmware and Boot Configuration Files

The following files are required for the LigoPTP 24 to start:

- **boot.ini** file, - device boot configuration file. This file is a text file and contains the name of the firmware file which must be executed on start-up. The file name can be freely changed, but its default name is 'boot.ini' ; hereinafter, it is assumed that this file has default filename. The most important factor concerning this file is that it must be uploaded with 'B' and 'e' attribute flags (flags are case sensitive!), only then it will be treated as executive script. Attribute flags for 'boot.ini' file:
B – query run at boot; **e** – executive script

For information how to upload files in the Flash disk, please refer to the respective chapter *Updating Software*.

- **Firmware** file, - this file is the main firmware executable for the appropriate LigoPTP 24 model. The file name can be freely changed, but its default name will contain the version and LigoPTP 24 model. The most important factor concerning this file is that it must be uploaded with 'E' and 'c' attribute flags, otherwise this file will not be used as the firmware. Attribute flags for firmware file:
E – executable binary; **c** - compressed

Notes:

- The files are uploaded from PC to Flash disk using TFTP/FTP (via Ethernet management port), or using Xmodem protocol (via RS232 serial port), for more information about file upload please refer to the respective chapter *Updating Software*; configuration backup files are created by LigoPTP 24 management system.
- The flash disk may store other files as well, for example - previous firmware versions, configuration backup files, - up to 7.7 Mb (about 11 firmware files).
- The attribute flags for files are case sensitive.
- The file names can be changed, but it is very important that the file has the necessary attribute flags; otherwise, the file will not be used either as firmware, or as 'boot.ini' type file.
- There are no file extensions in the file system; either file, when edited, is treated as ASCII text file.
- When uploading the file, if the Flash disk stores the file with the same filename as for the file being uploaded, it will be overwritten with the new file.

Configuration Backup Files

Using 'cfg backup <filename>' command, the user can create the backup file of the current LigoPTP 24 configuration. The configuration backup file is a text file and, when created, contains the current configuration script, - the same configuration script that are stored in EEPROM. Please refer to the respective chapter *Updating Software* for more information on configuration script.

The configuration backup files are stored on Flash disk, where they can be edited or downloaded to PC. The backup configuration file can be applied in run-time, by consecutively entering 'cfg restore <filename>' and 'cfg run' commands. Note: the configuration restored from file is not stored in EEPROM and, therefore, will be lost when LigoPTP 24 is restarted. To save it in EEPROM use 'write' command.

The user can create and store several configuration files to quickly revert to other LigoPTP 24 site configurations.

Working with Files

The following commands are intended to operate with files stored on the Flash disk on the management controller.

| Command | Description |
|--------------------|--|
| tfs edit <file> | <p>Edits the specified file. This command is applied for editing configuration backup files and boot configuration file (boot.ini). For example, <code>edit boot.ini,Be</code></p> <p>– file ‘boot.ini’ will be opened for editing. ‘Be’ specifies that this file will be saved with attributes ‘B’ and ‘e’. If boot.ini file is intended to be modified, it should always be opened specifying ‘B’ and ‘e’ flags as in the example above, this will ensure that file is saved with these attributes (flags).</p> <p>To close the file and save changes press Ctrl+Z, to close the file without saving changes press Ctrl+Q.</p> <p>The configuration backup files do not require specific attributes.</p> |
| tfs ls | <p>Displays the list of files stored on the Flash disk and the number of bytes, both free and used by these files.</p> <p>‘tfs dir’ can also be used.</p> |
| tfs cat <filename> | <p>Displays the contents of the text file.</p> <p>‘tfs type’ can also be used.</p> |
| tfs del <filename> | <p>Deletes the specified file from Flash disk.</p> <p>‘tfs rm’ can also be used.</p> |

Security Commands

Telnet server supports one user only, web server supports up to 32 users simultaneously. By default the username and password for Web server, FTP server and Telnet terminal is:

- Username (login): `admin`
- Password: `changeme`

The username and password can be changed in Web GUI “System configuration → User configuration”

‘**access set <username> <password> [plaintext]**’ command.

Take note of upper case and lower case type: it should be taken into account for the password!

The passwords may contain spaces; if using space(s), the password should be entered in quotation marks.

For Telnet, FTP and Web GUI the password can be changed by simply entering the security command ‘**access set <username> <password> [plaintext]**’ while logged on and then saving the configuration in EEPROM by using ‘`write`’ command.

To terminate Telnet session press Ctrl+D.



“Guest” account is unable to change its access password.

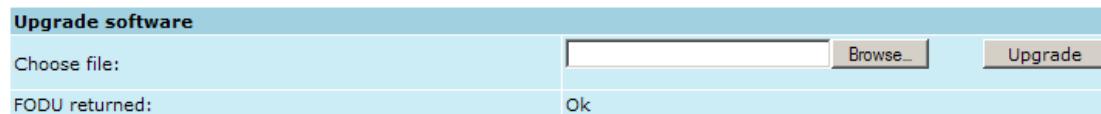


Specification of the password should always be followed by saving the configuration script (using “cfg write” command); otherwise, the password request will be ignored after the restart of LigoPTP 24.

Updating Software

To simplify the software update process, LigoWave provides special update package, as a new version is available. This update pack is available as archive (e.g. zip), which includes firmware file (with *.elf.ezip extension), boot configuration file (with *.ini extension) and other files needed for update process. To receive update pack, please contact your LigoWave distributor.

The main method for software upgrade is Web GUI software upgrade, which automates the whole software upgrade process. To perform software upgrade from Web GUI, please go to “Configuration → System configuration” and in “Upgrade software” section press **Browse...** button and locate software upgrade file on your hard disc (see Chapter 4.2.4 for detailed explanation of Web GUI upgrade).



Besides there are other various ways how the user can update the LigoPTP 24 management software by uploading the appropriate firmware file to the LigoPTP 24 FODU flash disk and further editing boot configuration file if necessary. The file upload can be performed:

- via Ethernet management port using update package,
- via Ethernet management port using FTP,
- via Ethernet management port using TFTP, or
- via RS232 serial port using Xmodem protocol.

Following chapters describe other methods how to update the software without using update pack.

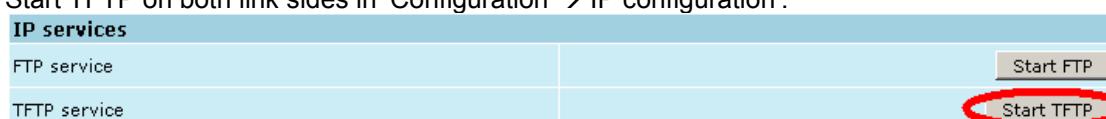
Update Software with Update Pack

To update LigoPTP 24 software by using the update pack, proceed as follows:

- uncompress the package;
- change the LigoPTP 24 IP address to 192.168.205.10, or edit ‘send.205.xx’ files by replacing “192.168.205.10” with actual LigoPTP 24 IP address;

```
arp -d
ttftp.exe 192.168.205.10 put boot.ini,Be
ttftp.exe 192.168.205.10 put cfipf000.elf.ezip,Ec
rem ttftp.exe 192.168.205.10 put help.txt
```

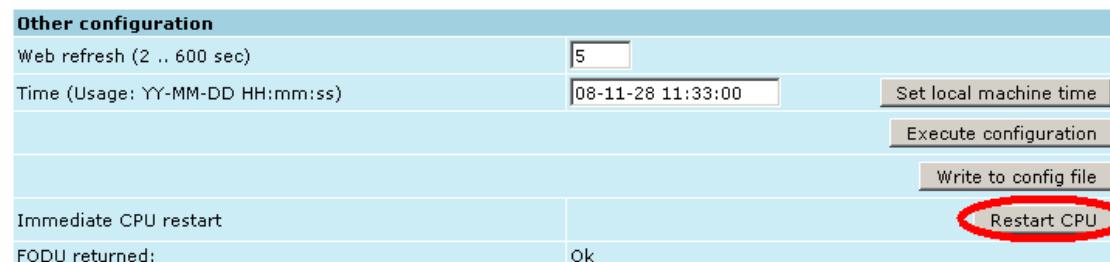
- `arp -d ip_addr [if_addr]` deletes the host specified by `ip_addr`. If another host with a duplicate IP address exists on the network, the ARP cache may have had the MAC address for the other computer placed in it. `arp -d` is used to delete an entry that may be incorrect. By default no host is specified.
- `rem ttftp.exe 192.168.205.10 put help.txt` ignores command execution
- `ttftp.exe 192.168.205.10 put cfipf000.elf.ezip,Ec` uploads firmware file named ‘cfipf000.elf.ezip’ with attribute flags ‘E’ and ‘c’ to host LigoPTP 24 with IP address 192.168.205.10.
- Start TFTP on both link sides in ‘Configuration → IP configuration’:



- run 'send.205.xx.cmd' to perform update, where „xx” represents last number of actual LigoPTP 24 IP address. In case the memory is full, upload will halt and error message will be displayed. In this case user must first delete some files to free enough memory on the LigoPTP 24 Flash disk.
- Update process screen is shown below:

```
C:\>arp -d
C:\>ttftp.exe 192.168.205.10 put boot.ini.Be
File boot.ini.Be: 19 bytes
.
C:\>ttftp.exe 192.168.205.10 put cfipf000.elf.ezip.Ec
File cfipf000.elf.ezip.Ec size: 626796 bytes
```

- To activate new firmware, firstly restart the management CPU of the remote link side LigoPTP 24 FODU and then the local side LigoPTP 24 FODU (traffic flow won't be interrupted) in 'Configuration → System configuration':



Uploading File via Ethernet Management Port (TFTP)

Assuming that the LigoPTP 24 IP settings are properly configured, proceed as follows:

- Connect the LigoPTP 24 to network or directly to PC;
- Make sure TFTP is running on LigoPTP 24 (by default, the TFTP is switched off); to run the TFTP on LigoPTP 24, connect to LigoPTP 24 with Telnet client and enter the following command: 'start tftp';
- Run the program that enables to use TFTP service, for example command interpreter (cmd.exe) if using Windows, see **Figure 7.1**;
- For example, to upload the firmware file 'cfipf000.elf.ezip' with attribute flags 'E' and 'c', enter command:

tftp -i 192.168.205.11 put C:\files\cfipf000.elf.ezip cfipf001.elf.ezip.Ec
where:

'-i' – key which specifies that file must be transferred in binary image transfer mode;

'192.168.205.11' – LigoPTP 24 Ethernet management port IP address (host);

'C:\files\cfipf000.elf.ezip' – firmware file (source);

'cfipf001.elf.ezip' – file name in the LigoPTP 24 flash memory (destination);

'Ec' – file attribute flags 'E' and 'c'; the attribute flags are separated from file name or source

with comma (only comma and no space) and there are no commas or spaces between flags;

```
C:\>tftp -i 192.168.205.10 put C:\cfip\cfipf000.elf.ezip cfipf001.elf.ezip,Ec
Transfer successful: 625068 bytes in 3 seconds, 208356 bytes/s
C:\>
```

If uploaded file is large (like firmware file), it is recommended to defragment Flash disk. Use ‘*ts clean*’ command from Telnet or ASCII terminal to perform defragmentation.

If the uploaded file is the firmware file which should be used by LigoPTP 24, it is necessary to edit ‘boot.ini’ file by deleting the entry with the old file name and to write file name of the new firmware file; the ‘boot.ini’ file must be saved with ‘B’ and ‘e’ flags (file attributes). For more information how to edit files, please refer to the chapter *Working with Files*.



To copy file from LigoPTP 24 Flash disk to PC hard disk via TFTP, use the following command:

tftp -i 192.168.205.11 get filename destination_filename
where:

‘192.168.205.11’ – LigoPTP 24 port IP address (host);

‘filename’ – file to be copied from LigoPTP 24 to PC; ‘destination_filename’ – destination path where the file will be saved on PC hard disk.

```
C:\>tftp -i 192.168.205.10 get 28_32_5.bin C:\cfip\28_32_5.bin
Transfer successful: 9625 bytes in 1 second, 9625 bytes/s
C:\>
```

Uploading File via Ethernet Management Port (FTP)

Before uploading file via FTP, make sure the LigoPTP 24 FTP server is running. To start it, go to ‘Configuration → IP configuration’ in Web GUI and press ‘Start FTP’:

| IP services | |
|--------------|---|
| FTP service | <input type="button" value="Start FTP"/> |
| TFTP service | <input type="button" value="Start TFTP"/> |

1. Open command window.
2. Start FTP client by entering “**ftp**” command (“**ftp>**” prompt will appear).
3. Connect to LigoPTP 24 FTP server using command “**open < LigoPTP 24_IP_address>**”. Type in username and password when prompted (by default username is admin and password is changeme).
4. Enter the command “**type binary**” to make sure the binary transfer mode is selected.
5. Use command **send <local file> <remote file>, <flags>** to upload files to LigoPTP 24 Flash disk. For example:
`send c:\boot.ini boot.ini,Be`

Use flags ‘E’ and ‘c’ if the file is a firmware file; if the file is a boot configuration file (boot.ini), the flags must be ‘B’ and ‘e’ (‘Be’); the flags for configuration backup files may not be specified.

Use command “ls” to list files on LigoPTP 24 flash disk.

Use command “delete <filename>” to delete the file from the LigoPTP 24 Flash disk.

6. Proceed with steps 5. and 6. in chapter *Update Software with Update Pack*.

You can also use any preferable FTP client if you wish.

Uploading File via Serial Port (Xmodem)

File upload via serial port takes much longer time compared to using TFTP and should be used only in case Ethernet connection with the LigoPTP 24 management system is not available, or does not start normally.

1. Connect the ASCII console to the LigoPTP 24 serial port, make connection with the following properties: Bits per second: 19200; Data bits: 8; Parity: none; Stop bits: 1; Flow control: none; if using ‘Hyper Terminal’ program, please refer to the respective section *RS-232 Serial Management Port* for information how to make a connection.
2. Type ‘restartcpu’ and, while LigoPTP 24 is booting, press any key when ‘boot.ini?’ prompt appears. This will stop executing script in ‘boot.ini’ file and the LigoPTP 24 will remain in MicroMonitor mode. This is the system start-up mode which loads the management system firmware;



Note: while in MicroMonitor mode, the ‘uMON>’ prompt will be displayed, instead of normal prompt with LigoPTP 24 name (default ‘LigoPTP>’)

3. In MicroMonitor mode enter the following command:

```
xmodem -cd -F <file_path-no_flags> -f Ec
```

where

<file_path-no_flags> - file name with no flags specified

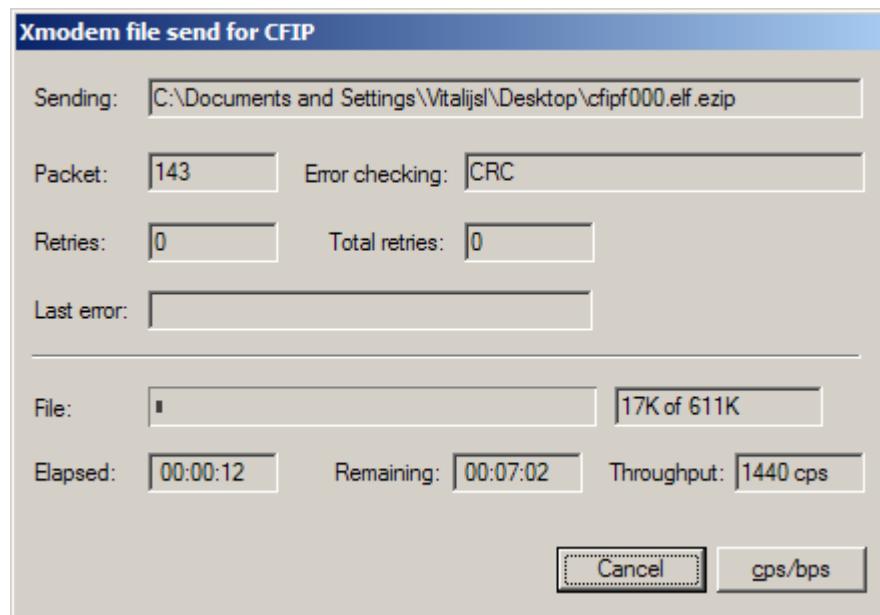
‘Ec’ – file flags, in case the file is firmware file - ‘E’ and ‘c’ flags must be used; if the file is boot configuration file (boot.ini), the flags must be ‘Be’ (‘B’ and ‘e’); the flags for configuration backup files may not be specified, in that case the command will be

```
xmodem -cd -F <file_path-no_flags>
```

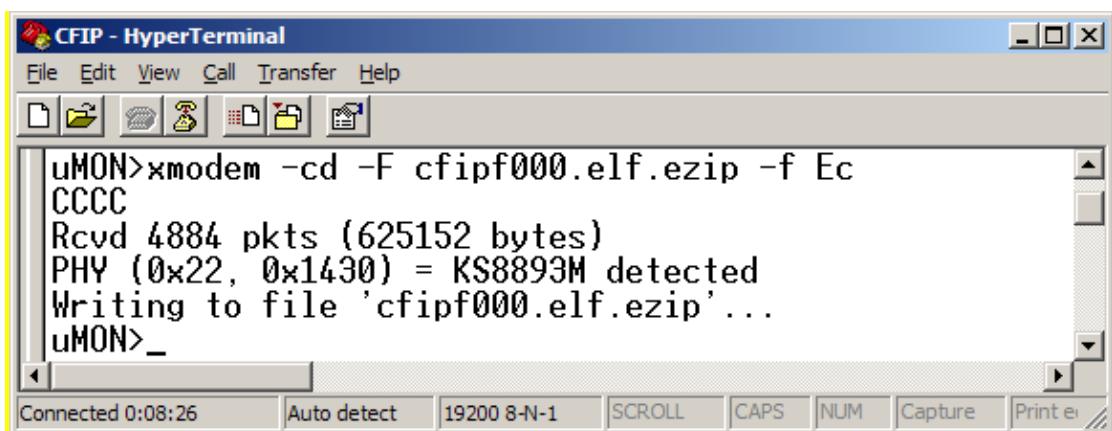
After xmodem command execution, proceed to the next step.

4. Use terminal emulation software with file upload function, such as *Hyper Terminal* (in Windows) to upload the firmware file to LigoPTP 24 as binary image (use binary transfer mode), using *Xmodem* protocol.

If using *Hyper Terminal*, proceed as follows: from menu select ‘Transfer→Send File…’, then select file and in ‘protocol’ box select *Xmodem* protocol and press **Send** button. The following box should appear:



When upload is complete, the following information will be displayed:



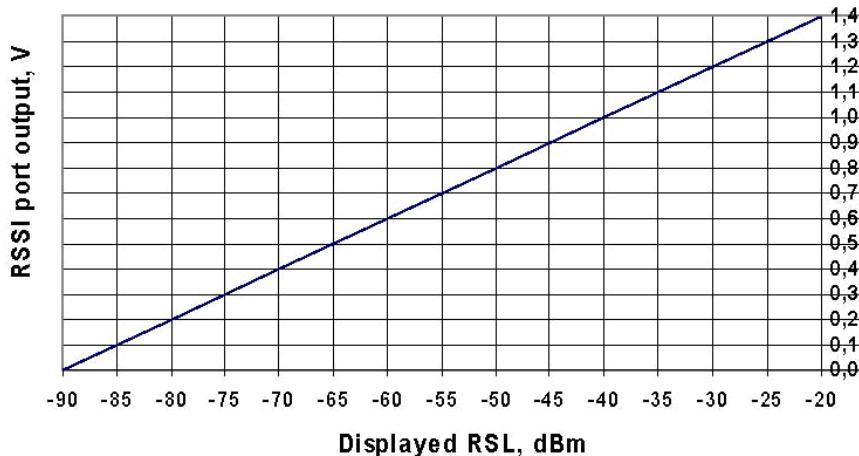
5. Enter 'reset' command to exit from MicroMonitor mode and restart the LigoPTP 24.
6. Proceed with steps 5. and 6. in the chapter *Update Software with Update Pack*.

RSSI Port

RSSI (Received Signal Strength Indicator) port is used to adjust the alignment of antenna for best performance (for both rough and fine adjustment); this can be done using digital multimeter which is connected to the RSSI port. The output of the RSSI port is DC voltage and varies depending on received signal level.

The following chart and table shows typical relationship of the received signal level (Rx level) displayed by LigoPTP 24 vs. RSSI port output voltage (RSSI – Received Signal Strength Indicator). The RSSI port is located on FODU. The evaluated Rx level has the error +/- 2 dBm.

Typical RSSI=f(RSL) chart

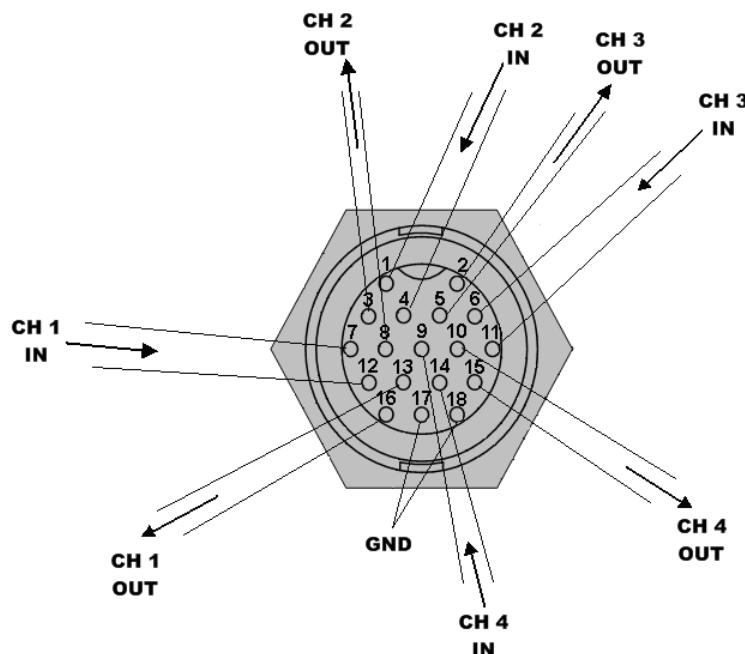


| Displayed RSL, dBm | RSSI, V |
|--------------------|---------|
| -90 | 0 |
| -85 | 0,1 |
| -80 | 0,2 |
| -75 | 0,3 |
| -70 | 0,4 |
| -65 | 0,5 |
| -60 | 0,6 |
| -55 | 0,7 |
| -50 | 0,8 |
| -45 | 0,9 |
| -40 | 1 |
| -35 | 1,1 |
| -30 | 1,2 |
| -25 | 1,3 |
| -20 | 1,4 |

Pinouts

18-pin Connector

The pinouts for the 18-pin port connector (on the LigoPTP 24 FODU) are given on the picture below. The displayed pin layout corresponds to the cable connector solder side.



| | |
|---------|----------------|
| 7 & 12 | Input E1 CH 1 |
| 13 & 16 | Output E1 CH 1 |
| 1 & 4 | Input E1 CH 2 |
| 3 & 8 | Output E1 CH 2 |
| 6 & 11 | Input E1 CH 3 |
| 2 & 5 | Output E1 CH 3 |
| 9 & 14 | Input E1 CH 4 |
| 10 & 15 | Output E1 CH 4 |
| 17 & 18 | GND |

All the E1 Input/Output signals are $120\ \Omega$ balanced.

The GND pins are not to be used for lightning protection; there is a special grounding screw (M6) on the front of the unit intended for lightning protection; the LigoPTP 24 Full ODU must be grounded using the grounding screw.

Twin BNC Connector

Twin BNC connector is used for RS-232 serial port. RS-232 – USB convector cable can be used. Pinouts are shown in picture below.

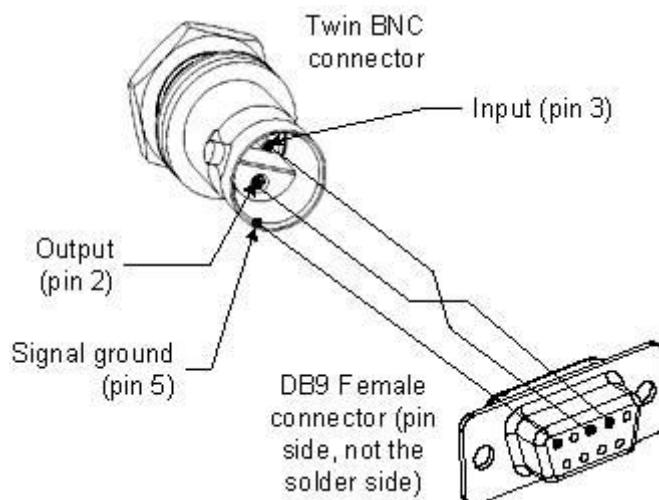


Figure 53 – RS-232 port pinouts, pin numbers refer to DB9 female connector

Sealed RJ-45 Socket

The pinouts of that socket are as follows:

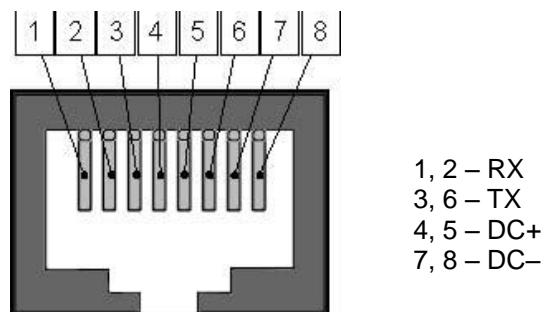
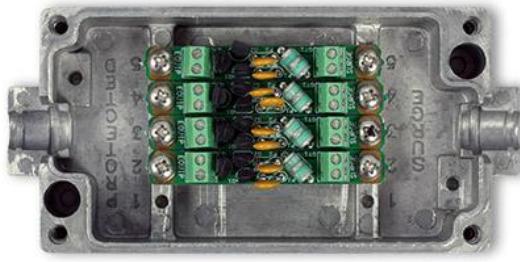


Figure 54 – RJ-45 socket pin numbering

Available Accessories

| Item | Description |
|---|--|
|  | FODU RJ-45 LTW cable connector case P/N FOACNR03 |
|  | FODU 18-pin cable connector, hermetically sealed, intended for cable connecting to FODU with termination panel or user equipment P/N FOACNL01 |
|  | FODU RJ-45 connector 8P shield solid P/N FOACNR02 |
|  | AC/DC for passive injector 100-240V/48V/0.75A P/N CFGB4806 |

| Item | Description |
|---|---|
|  | 13/15GHz Flexible Waveguide 60cm UBR-PBR P/N C15WF201 |
|  | 18/23GHz Flexible Waveguide 2ft/6 P/N C22WF201 |
|  | LigoPTP 24 Lightning Protection RJ45 Indoor P/N I0ALAI01 |
|  | Power over Ethernet Single-Port Passive Injector P/N I0ATPI01 |
|  | BNC connector for antenna RSSI alignment |

| Item | Description |
|---|--|
|  | <p>FODU twin BNC RG108A connector for RS-232 console port for FODUs P/N FOACNT01</p> |
|  | <p>Lightning arrestor for Ethernet patch cable</p> |
|  | <p>Lightning arrestor for E1 10-pair cable</p> |
|  | <p>LigoPTP 24 Power over Ethernet Injector, 100-240V, 2xRJ45 P/N I0ATPI02</p> |
|  | <p>LigoPTP 24 Lightning Protection RJ45 Outdoor P/N I0ALAO01</p> |

| Item | Description |
|---|--|
|  | Test equipment 13/15 GHz P/N C15TST02 |
|  | Coaxial attenuator 40 dB P/N CLA40A01 |
|  | FODU UTP cable cat5 4P outdoor solid P/N FOACET02 |
|  | LigoPTP 24-TP4 terminal power injector w.4E1 P/N I0GTP401 |
|  | RSSI cable for ODU align 1m BNC – 2 plug-in P/N CLGCRS01 |

Other Available Accessories

- Test equipment 18/23GHz (P/N C22TST02);
- ODU Mounting bracket for 2xODU LigoPTP 24 (P/N CLGRFB06);
- ODU Mounting bracket for LigoPTP 24 (P/N CLGRFB05);
- FODU cable 10P FTP 3kat outdoor solid (P/N FOAC1001).

Appendix

List of Abbreviations

The list of abbreviations used in this manual is provided in the table below:

| Abbreviation | Description |
|----------------------|--|
| 3G | third generation |
| AC | Alternating Current |
| ACI | Adjacent-Channel Interference |
| ACM | Adaptive Coding and Modulation |
| AGC | Automatic Gain Control |
| APSK | Amplitude and Phase Shift Keying |
| ASCII | American Standard Code for Information Interchange |
| ATPC | Automatic Transmit Power Control |
| BER | Bit-Error Ratio |
| BNC connector | Bayonet Neill-Concelman coaxial connector |
| CCI | Co-Channel Interference |
| CLI | Command-Line Interface |
| CPU | Central Processing Unit |
| CRC | Cyclic Redundancy Check |
| DC | Direct Current |
| DiffServ | Differentiated Services |
| DSCP | Differentiated Services Code Point |
| EEPROM | Electrically Erasable Programmable Read-Only Memory |
| EMI | Electromagnetic Interference |
| ETS | European Telecommunication Standard |
| ETSI | European Telecommunications Standards Institute |
| FIR | Finite Impulse Response |
| FODU | Full Outdoor Unit |
| FTP | File Transfer Protocol |
| GFP | Generic Framing Procedure |
| GND | Ground |
| GSM | Global System for Mobile communications |
| GUI | Graphical User Interface |
| IEEE | Institute of Electrical and Electronics Engineers |
| IF | Intermediate Frequency |
| ISP | Internet Service Provider |
| ITU-T | International Telecommunication Union – Telecommunication Standardization Sector |
| LAN | Local Area Network |

| Abbreviation | Description |
|---------------|---|
| LDPC | Low-Density Parity-Check Code |
| LED | Light-Emitting Diode |
| LTE | Long-Term Evolution |
| MAC | Media Access Control |
| MSE | Mean Square Error |
| NMS | Network Management System |
| PC | Personal Computer |
| PDH | Plesiochronous Digital Hierarchy |
| PLL | Phase-Locked Loop |
| PoE | Power over Ethernet |
| QAM | Quadrature amplitude modulation |
| QoS | Quality of Service |
| QPSK | Quadrature Phase-Shift Keying |
| RAM | Random Access Memory |
| RSL | Received Signal Level |
| RSSI | Received Signal Strength Indicator |
| Rx | Receive |
| SNMP | Simple Network Management Protocol |
| SNR | Signal-to-Noise Ratio |
| STM-1 | Synchronous Transport Module - 1 |
| TCP/IP | Internet Protocol Suite (Transmission Control Protocol / Internet Protocol) |
| TDM | Time-Division Multiplexing |
| TFTP | Trivial File Transfer Protocol |
| TM | Tide Mark |
| TP | Twisted Pair |
| TS | Threshold Seconds |
| Tx | Transmission |
| UART | Universal Asynchronous Receiver/Transmitter |
| USB | Universal Serial Bus |
| UTP | Unshielded Twisted Pair |
| VLAN | Virtual Local Area Network |
| WAN | Wide Area Network |