



Hypercable

Wi700 Gigabit Series
FODU Wi700 Full Outdoor Unit
ODU & IDU Wi700 CFIP & CFIP M Xpic

Technical Description & Configuration Guide

Product code: I0DGET02

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To get up to date information about accessories and their availability, please contact sales representative.

Note: Wi700/FODU does not contain serviceable parts. Warranty will not be applicable in the event Wi700/FODU has been hermetically unsealed.

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1 Overview

This document briefly describes the **FODU Wi700 series Full Outdoor Unit (FODU)** covering the built-in management system, configuration functionality, hardware features, etc.

1.1 FODU Full Outdoor Units

FODU 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 FODU Wi700 radio is Gigabit Ethernet. As FODU is capable of providing bit rate of **up to 366Mbps**, it is a perfect addition to SAF portfolio. The excellent FODU Wi700 radio and modem performance allows achieving perfect system capacity by employing 256-decision states modulation scheme by user's choice. Apart from the **full system capacity of 366Mbps**, it is possible to configure the radio to any of 20, 28, 30, 40, 50 and 56 MHz channels as well as to any of **QPSK, 16APSK, 32APSK, 64QAM, 128QAM and 256QAM modulations**, thus providing various capacities to suit particular needs.

Hypercable has employed most modern design solutions and components to create high performance compact radio with **low power consumption** – 25-35W (standard power) and 29-41W (high power) per radio.

FODU Wi700 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.

1.2 FODU Feature Summary

1.2.1 Main Features

- Full Outdoor solution
- Capacity: up to **366 Mbps**
- Channel Bandwidth: **20/28/30/40/50/56** MHz
- Modulations: **QPSK, 16APSK, 32APSK, 64QAM, 128QAM, 256QAM**
- Interfaces: **1000Eth (optical)** or **10/100/1000Eth (electrical)**
- Traffic: Ethernet only
- Frequency bands: **7 / 8 / 10 / 11 / 13 / 15 / 18 / 23 / 24 / 38** GHz
- Green Radio – **25-35W** (standard power) and **29-41W** (high power) power consumption per radio
- **ACM** and **ATPC** with **QoS** four priority queues
- **802.1Q VLAN** support

1.2.2 Mechanical Features

- Compact unit, **285x285x80mm, 3.9kg**, antenna adaption backwards compatible with all **CFM** and **CFQ** series units
- **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 1.1: FODU Wi700 Full Outdoor Unit

1.2.3 Interfaces/Management

- FODU Wi700 unit provides **5 connectors** and a grounding screw
- **User and NMS traffic** is carried over **FO cable**
- 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
- **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

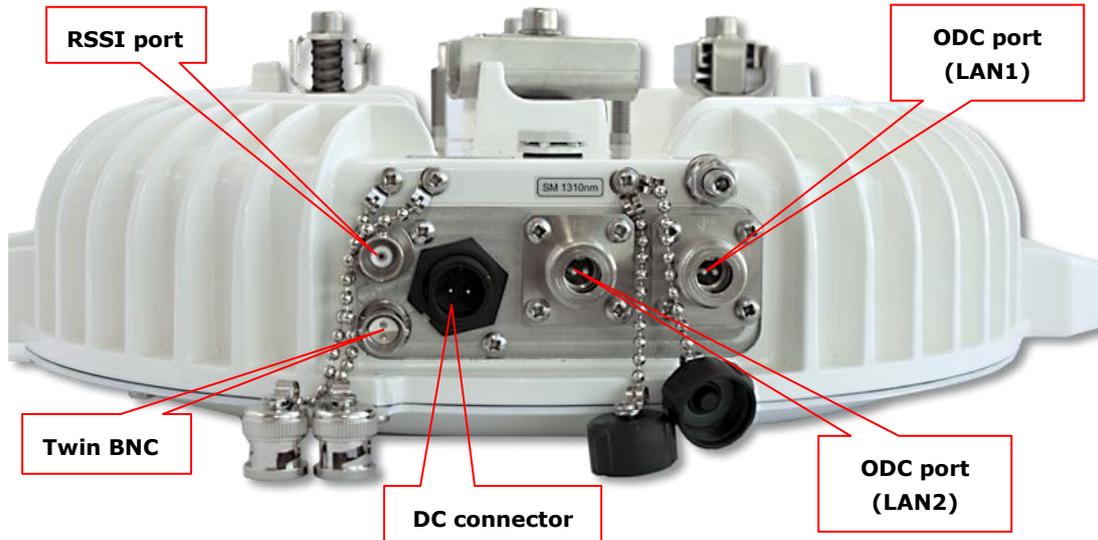


Figure 1.2: Optical FODU Wi700 FODU connectors

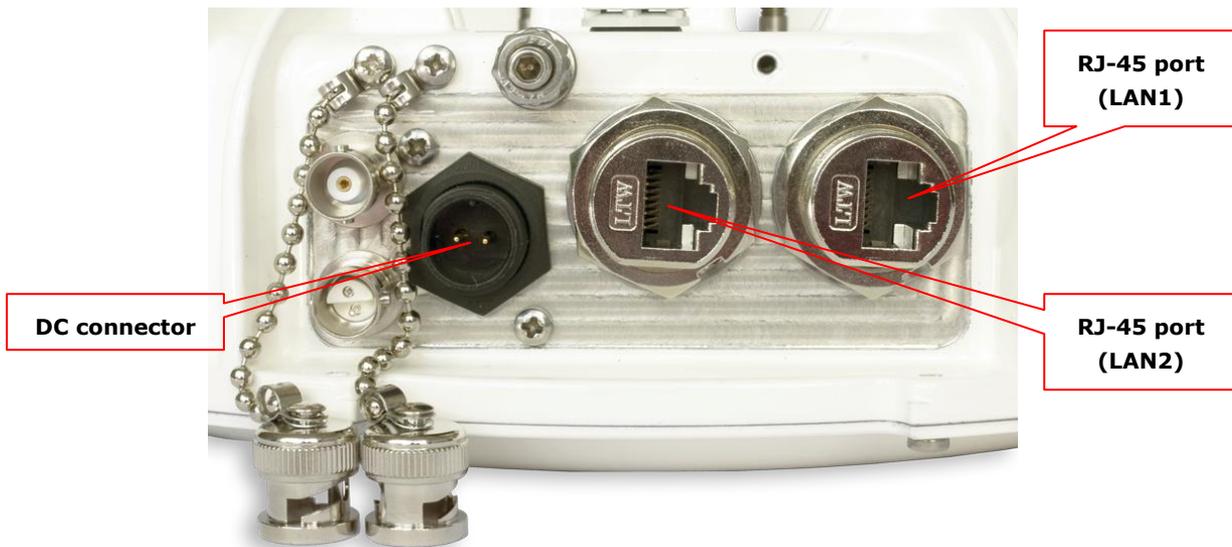


Figure 1.3: Electrical FODU Wi700 FODU connectors

1.3 Radio Parameters

- FODU Wi700 is a good example of latest achievements in modem and transceiver development, providing both excellent radio parameters (System Gain), due to use of **APSK and QAM modulations** and efficient yet consuming little power Tx/Rx part of the system.
- RSL Threshold at BER 10^{-6} , 56MHz, 256QAM, 366Mbps: **-62 dBm**.
- System Gain with guaranteed max Tx power and Rx sensitivity is **74 dB**.
- FODU provided the capability to replace typical 34Mbps PDH radio to **366Mbps** 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
- **ATPC**, 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

1.4 Application Examples

1.4.1 Carrier Gigabit Ethernet Trunk Distribution with FODU Wi700

- Superb for extending Fiber Optics network over high capacity radio;
- Ideal for crossing mountains and interconnecting Gigabit Ethernet networks;
- Designed for building Ethernet backhaul network

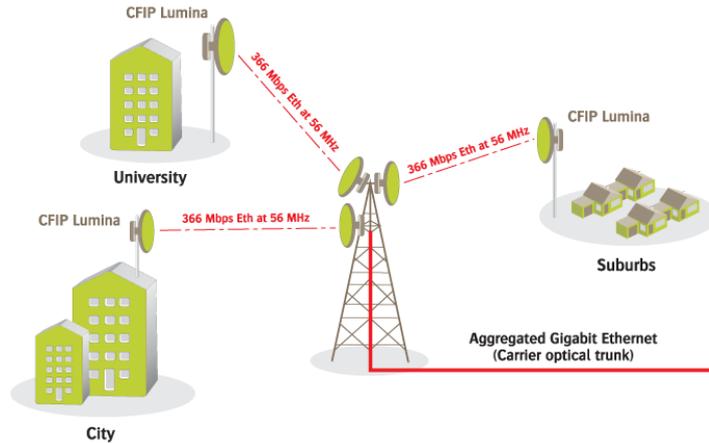


Figure 1.4

1.4.2 Dual Homing Protected Chain of 2+0 FODU Wi700

A chain of 2+0 radios with full protection by employing 2 Ethernet switches (with Spanning Tree Protocol and link aggregation support) per site

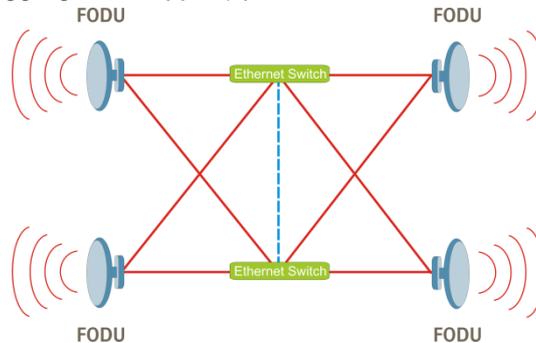


Figure 1.5

1.4.3 FODU Wi700 East/West Chain

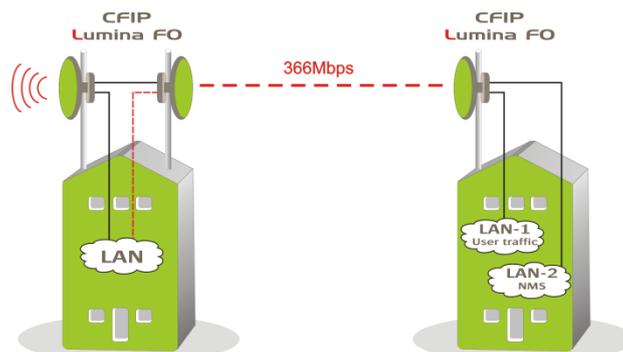


Figure 1.6

1.4.4 FODU Wi700 24GHz ring topology

- Utilization of STP protocol allows FODU Wi700 operation in ring topology

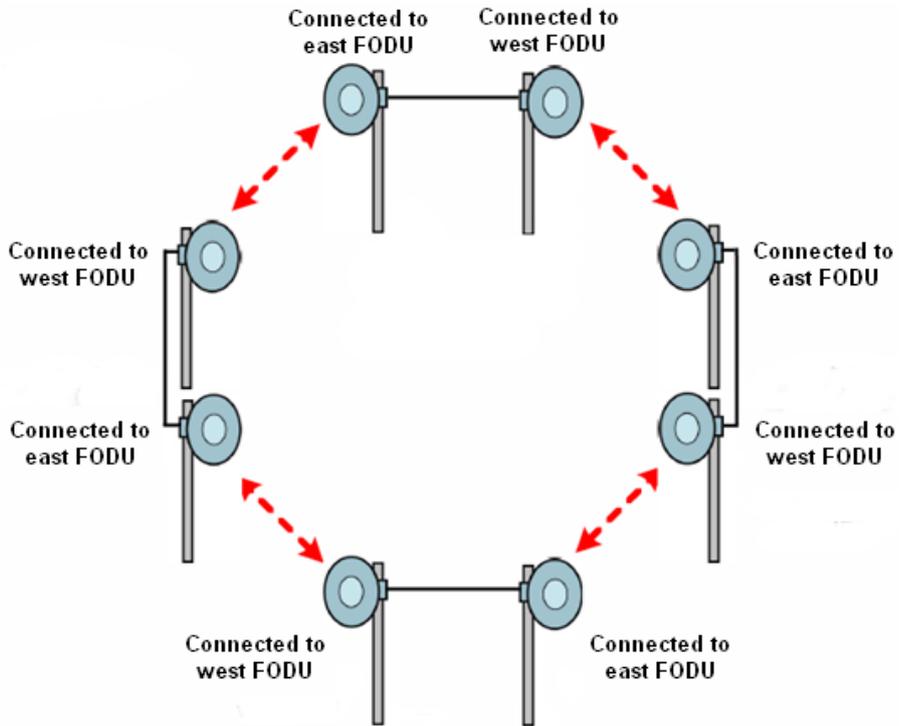


Figure 1.7

1.5 Technical Specifications

| III FODU Wi700 FODU technical specification | | | | | | | |
|---|--|--------|--------|--------|---------------|--------|--------|
| Frequency range (GHz) | 7/8 | 10/11 | 13/15 | 18/23 | 24 | 26* | 38 |
| Channel Bandwidths (MHz)** | 20, 28, 30, 40, 50, 56 | | | | | | |
| Modulation | QPSK / 16APSK / 32APSK / 64QAM / 128QAM / 256QAM | | | | | | |
| Capacity (Mbps) | 24 – 366 | | | | | | |
| III Performance | | | | | | | |
| Configuration | 1+0, 2+0 Frequency Diversity | | | | | | |
| Frequency stability (ppm) | +/-7 | | | | | | |
| Traffic Interfaces | 1 or 2 Gigabit Ethernet (electrical or optical) | | | | | | |
| III Ports | | | | | | | |
| Flange | UBR84 | UBR100 | UBR140 | UBR220 | Circular 10mm | UBR260 | UBR320 |
| Ethernet | Optical 1 or 2 ODC ports Electrical 1 or 2 RJ-45 | | | | | | |
| RSL port, RSSI, BNC connector | Output voltage vs RSL: 0 to 1.4V vs -90 to -20dBm | | | | | | |
| Serial port for configuration | RS-232, Twin BNC connector | | | | | | |
| III Management features | | | | | | | |
| Management port | Ethernet VLAN or Separate Ethernet (RJ-45 or ODC) | | | | | | |
| SNMP | Yes, SNMP traps, MIB, SNMP v1/v2c | | | | | | |
| EMS | Web based, HTTP | | | | | | |
| ATPC feature | Yes | | | | | | |
| ACM feature | Hitless 0ms | | | | | | |
| Loopbacks | Yes, modem, IF loopback | | | | | | |
| III Ethernet | | | | | | | |
| QoS | 64 level DiffServ (DSCP) or 8 level 802.1p mapped in 4 prioritization queues with VLAN support | | | | | | |
| QoS queuing | Fixed or weighted (configurable weights) | | | | | | |
| Max frame size | 9728 bytes | | | | | | |
| Flow Control | Yes | | | | | | |
| 802.1q VLAN support | Up to 4093 concurrent traffic VLANs | | | | | | |
| QinQ (Double Tagging) | Yes | | | | | | |
| III Mechanical & Electrical | | | | | | | |
| Stationary use | Ref. ETSI EN 300 019-2-4, class 4.1E; non weather-protected locations | | | | | | |
| Temperature Range | -33°C to +55°C | | | | | | |
| Dimensions: HxWxD, mm / weight, kg | 288x288x80 / 3.9 | | | | | | |
| Input DC voltage | -48 V DC ±10% | | | | | | |
| Max. power consumption | 25-35W (Standard Tx power), 29-41W (High Tx power) | | | | | | |

III FODU Wi700 24GHz Rx sensitivity, payload capacity

| Modulation | FEC** | Channel Bandwidth (MHz) | | | | | |
|------------|--------|-------------------------|------------------|------------|------------------|------------|------------------|
| | | 28 | | 40 | | 56 | |
| | | RSL dBm | Bit rate Mbps | RSL dBm | Bit rate Mbps | RSL dBm | Bit rate Mbps |
| QPSK | Strong | -88 | 34 | -87 | 48 | -85 | 71 |
| | Weak | -85 | 43 | -83 | 60 | -81 | 89 |
| 16APSK | Strong | -82 | 69 | -80 | 97 | -77 | 143 |
| | Weak | -79 | 84 | -77 | 119 | -74 | 176 |
| 32APSK | Strong | -79 | 86 | -78 | 121 | -76 | 179 |
| | Weak | -76 | 104 | -74 | 146 | -73 | 216 |
| 64QAM | Strong | -76 | 115 | -75 | 162 | -73 | 239 |
| | Weak | -73 | 131 | -71 | 185 | -69 | 273 |
| 128QAM | Strong | -73 | 138 | -72 | 194 | -70 | 286 |
| | Weak | -70 | 153 | -68 | 215 | -67 | 319 |
| 256QAM | Strong | -70 | 161 | -68 | 226 | -66 | 334 |
| | Weak | -66 | 176 | -65 | 248 | -62 | 366 |

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| Modulation | FEC** | Channel Bandwidth (MHz) | | | | | | | |
|------------|--------|-------------------------|-------------------|-------------|-------------------|-------------|-------------------|-------------|-------------------|
| | | 20 | | 30 | | 40 | | 50 | |
| | | RSL, dBm | Bit rate, Mbps | RSL, dBm | Bit rate, Mbps | RSL, dBm | Bit rate, Mbps | RSL, dBm | Bit rate, Mbps |
| QPSK | Strong | -90 | 24 | -88 | 36 | -87 | 48 | -86 | 61 |
| | Weak | -86 | 30 | -84 | 45 | -83 | 60 | -81 | 76 |
| 16APSK | Strong | -84 | 49 | -82 | 73 | -80 | 97 | -79 | 122 |
| | Weak | -80 | 60 | -78 | 89 | -77 | 119 | -76 | 150 |
| 32APSK | Strong | -80 | 61 | -79 | 91 | -78 | 121 | -76 | 153 |
| | Weak | -78 | 74 | -76 | 110 | -74 | 146 | -73 | 184 |
| 64QAM | Strong | -77 | 82 | -76 | 121 | -75 | 162 | -73 | 203 |
| | Weak | -74 | 94 | -72 | 139 | -71 | 185 | -70 | 232 |
| 128QAM | Strong | -74 | 98 | -73 | 146 | -72 | 194 | -70 | 244 |
| | Weak | -71 | 109 | -69 | 162 | -68 | 216 | -67 | 271 |
| 256QAM | Strong | -71 | 115 | -69 | 170 | -68 | 226 | -67 | 285 |
| | Weak | -68 | 126 | -66 | 186 | -65 | 248 | -63 | 312 |

III FODU Wi700 Tx power

| Modulation | Standard/High Tx Power, dBm | | | | |
|---------------|-----------------------------|--------------------|-----------------|------------|--------|
| | 7, 8 GHz | 10, 11, 13, 15 GHz | 18, 23, 26* GHz | 24 GHz**** | 38 GHz |
| QPSK | +19 / +27 | +19 / +25 | +19 | -30 ... +3 | +17 |
| 16APSK | +18 / +26 | +18 / +24 | +18 | -30 ... +2 | +16 |
| 32APSK | +17 / +25 | +17 / +23 | +17 | -30 ... +1 | +15 |
| 64QAM | +15 / +23 | +15 / +21 | +15 | -30 ... -1 | +13 |
| 128QAM | +15 / +23 | +15 / +21 | +15 | -30 ... -1 | +12 |
| 256QAM | +12 / +20 | +12 / +17 | +12 | -30 ... -4 | +10 |

- * Under development
- ** According to ETSI channel plan
- *** Forward Error Correction (FEC) can be optimized either for sensitivity (Strong FEC) or for capacity (Weak FEC)
- **** Output Tx range may differ for previous hardware and software versions

1.6 Cable Requirements

Fibre optics cable

Single mode 2 channel fibre with 2 fibre ODC plug is required for management and user data. Length of the fibre optics cable using default single mode 1310nm SFP module is up to 10 kilometres. SAF Tehnika can provide pigtail cable with ODC-LC connectors and length of 3, 10 or 50 meters.



Figure 1.7: FODU Wi700 ODC-LC cable

DC power cable

FODU Wi700 power supply voltage must be between 36–57 V DC, though the nominal input voltage is 48 V DC ±10%. 2-wire outdoor cable with dedicated 2-pin LTW DC connector assembly is needed to connect to FODU Wi700. Any polarity can be used. Preferable outer diameter of power cable is 6mm in order to match FODU Wi700 FODU side connector. Cross-sectional area shall be not less than 0.75 square mm for installations up to 400 meters (25W load power). If this area is less than 0.75 square mm, the allowed maximum length of the cable is reduced due to a higher voltage drop.

| Wire cross section | Lmax @ 50W | Lmax @ 35W | Lmax @ 25W |
|---------------------|--------------|--------------|---------------|
| 0.75mm ² | 180m / 590ft | 260m / 853ft | 380m / 1246ft |
| 0.5mm ² | 120m / 393ft | 180m / 590ft | 250m / 820ft |
| 0.25mm ² | 60m / 196ft | 90m / 295ft | 125m / 410ft |

| AWG | Lmax @ 50W | Lmax @ 35W | Lmax @ 25W |
|-----|--------------|--------------|---------------|
| 18 | 206m / 677ft | 294m / 967ft | 412m / 1353ft |
| 20 | 129m / 426ft | 185m / 608ft | 259m / 851ft |
| 24 | 51m / 168ft | 73m / 240ft | 102m / 337ft |

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.

RSSI BNC

To connect the digital multimeter to the FODU Wi700 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 1.4**).



Figure 1.8. Cable for connecting the voltmeter to the FODU Wi700 RSSI port

1.7 SFP (Small Form-Factor Pluggable Transceiver)

Initial version of FODU Wi700 is equipped with internal 1310 nm Single-mode Transceiver, (1000Base-LX) SFP module (P/N I0AOM001) with following features:

- Compliant with IEEE 802.3z Gigabit Ethernet Standard;
- Compliant with Fiber Channel 100-SM-LC-L standard;
- Industry standard small form pluggable (SFP) package;
- Duplex LC connector;
- Class 1 laser product complies with EN 60825-1.



Figure 1.9. FODU Wi700 SFP 1310nm SM transceiver

On demand FODU Wi700 at factory premises can be equipped with alternative SFP modules. Specifications of available SFP modules:

| Part number | Product name | Wavelength | Media | Distance | Application | Tx power | RSL threshold | Temp |
|-------------|--|------------|-------|----------|-------------|--------------|---------------|-----------|
| I0AMOM01 | SFP 850nm MM Transceiver 1000Base-SX 3.3V | 850 nm | MMF | 550 m | 1000Base-SX | -9.5..-4 dBm | <-18 dBm | -20..+85C |
| I0AOM001 | SFP 1310nm SM Transceiver 1000Base-LX 3.3V | 1310 nm | SMF | 10 km | 1000Base-LX | -9.5..-3 dBm | <-20 dBm | -40..+85C |
| | | | | | | | | |

1.8 FODU Wi700 with FO Gigabit Ethernet Port

1. Wi700 and customer equipment connectivity options via FO cables:
 - by ordering ODC-2xLC outdoor patch cord of appropriate length (3, 10 or 50 meter patch cords can be ordered)
 - by using outdoor box to connect ODC-2xLC to LC connectorized FO cable to equipment at customer premises
 - by welding ODC terminated FO cable to FO cable to equipment at customer premises and appropriately sealing the weld

2. As Wi700 FODU DC-in port has a built in surge arrestor solution, SAF only recommends to use surge arrestor at the DC source end of the cable

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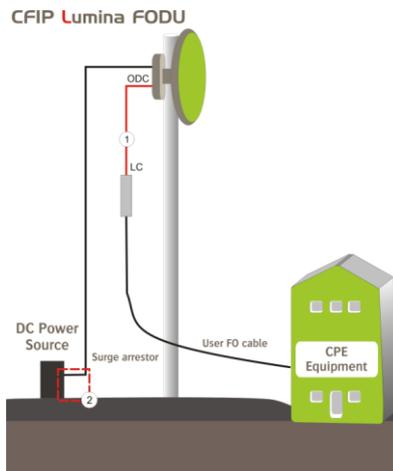


Figure 1.10. Optical FODU Wi700 site

- 1 – ODC-LC cable
2 – Surge arrestor on power cable

1.9 FODU Wi700 with RJ-45 Gigabit Ethernet Port

Electrical Gigabit interface is vulnerable to overvoltage jumps, thus elevated surge protection should be implemented – one surge arrestor should be placed at FODU, another before user equipment.

Because of two surge arrestors used, maximum length of user Ethernet Cat.5e or better cable (100 meters) will be reduced by approximately 20-30 meters.

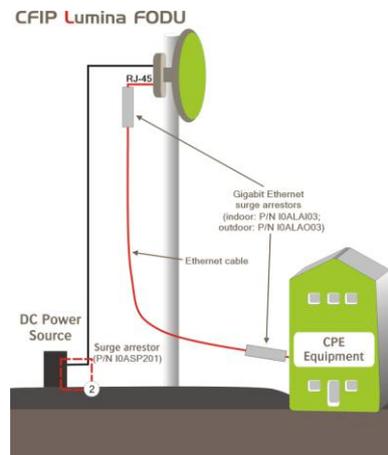


Figure 1.11. Electrical FODU Wi700 site



1.10 Labelling

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 ("FODU-18-Wi700"). The FODU model name example is:
 - FODU-13-Wi700 for 13GHz FODU,
 - FODU-23-Wi700 for 23GHz FODU,
 - FODU-24-Wi700 for 24GHz FODU, etc
- Product Number (I18GHT03L): 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 (3203601 00005); the serial number uniquely identifies the unit.

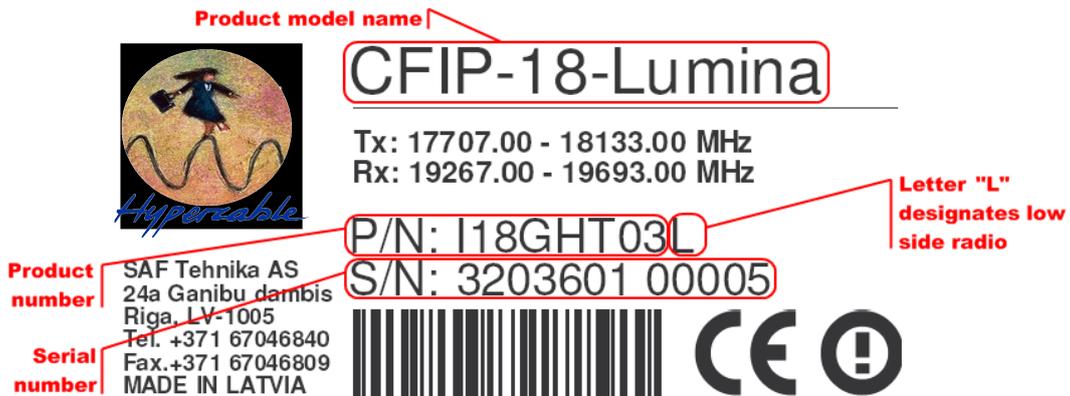


Figure 1.11. Label of the FODU Wi700 Low band side, operating in 18 GHz band

P/N Translation:

- “I” designates FODU series product;
- “18” designates Frequency range (18 GHz) of the Unit;
- “GH” designates Gigabit Ethernet 1x Electrical;
- “T” designates GET, GOT 360 Mbps, without limitation;
- “03” designates the version number of the Unit;
- “L” designates the band side in which FODU operates (H, L);

Please note that frequency range is set from the central frequency of the first 14 MHz channel to the central frequency of the last 14 MHz channel (see the Figure below).

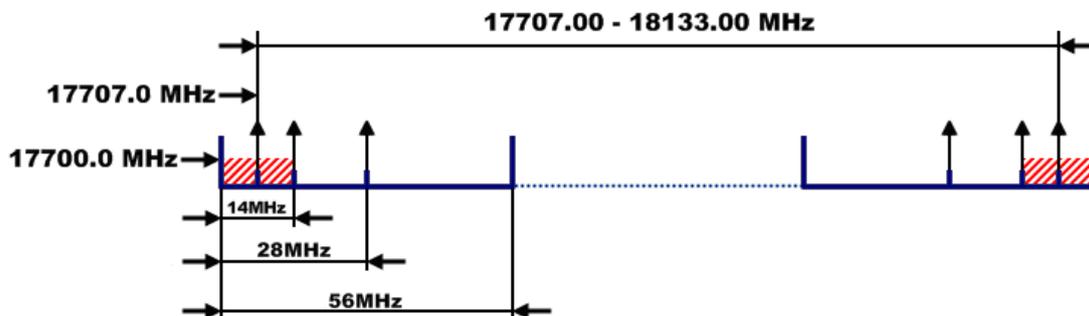


Figure 1.12. Frequency range of the low side FODU Wi700 18 GHz FODU

The Figure explains Tx frequency range of high side FODU Wi700 18 GHz radio.

2 Configuration and Management

There are four ways to adjust and read settings and operation parameters of the FODU Wi700 equipment:

1. using Web terminal connected to the ODC port,
2. using Telnet terminal connected to the ODC port,
3. using NMS or SNMP terminal, connected to the ODC port, or
4. using ASCII console connected to the serial port.

2.1 Assembling FODU Wi700 DC Connector





Figure 2.1. Assembling DC power weatherproof connector

1. You will need: (1-6) DC connector components and (7) ready 2-wire DC power cable.
2. Wider sealing rubber ring should be fitted inside from the front end of (6).
3. Narrower sealing rubber ring should be fitted inside from the rear end of (6).
4. Parts of the DC connector should be put on the cable in the sequence as shown
5. DC power cable should be soldered in any layout.
6. Afterwards, part (6) should be tightened on to part (5).
7. Assembled DC power connector after tightening the last part (1)

2.2 Resetting the FODU Wi700

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

| | |
|---|---|
| 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. |

2.3 Web Interface

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

2.3.1 ODC Port

ODC port is used to connect the FODU Wi700 to a PC or Ethernet network for Web, SNMP and Telnet management.

(!) The length of single mode FO cable can be up to 10 kilometers.

2.3.2 Ethernet Management Connection Configuration

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

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

17

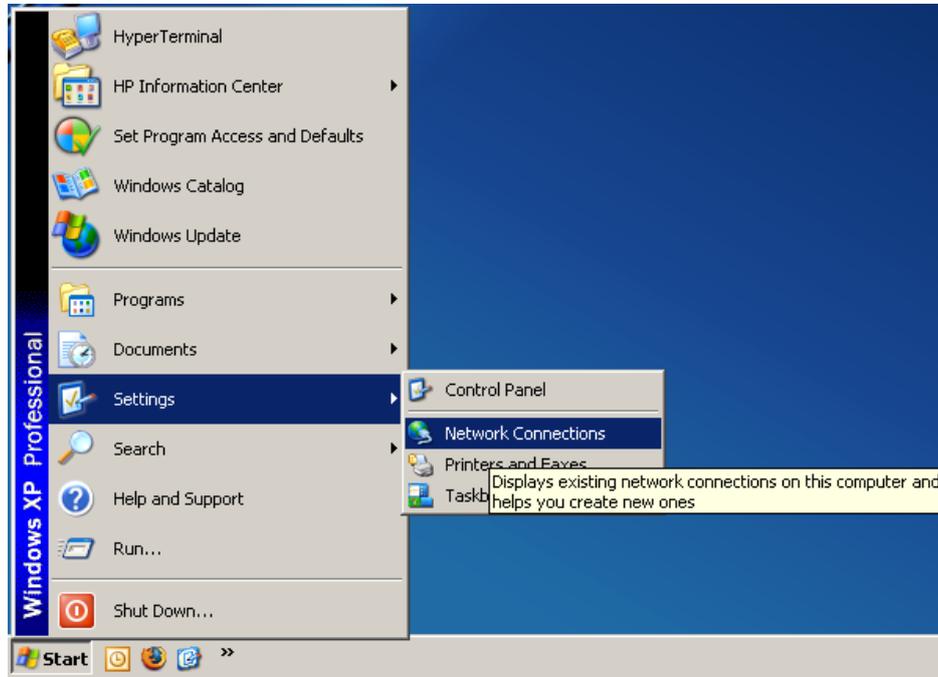


Figure 2.2.

- 2) Find 'Local Area Connection', click right mouse button on it and choose 'Properties'

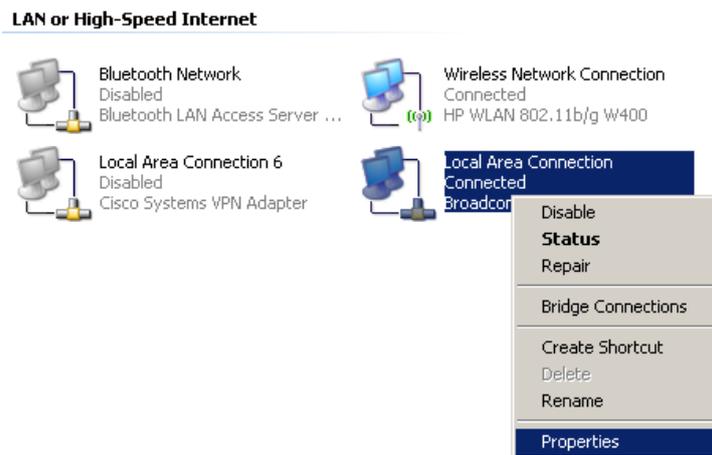


Figure 2.3.

- 3) Click on 'Internet Protocol (TCP/IP)' from the list in the dialog box and then click on 'Properties'

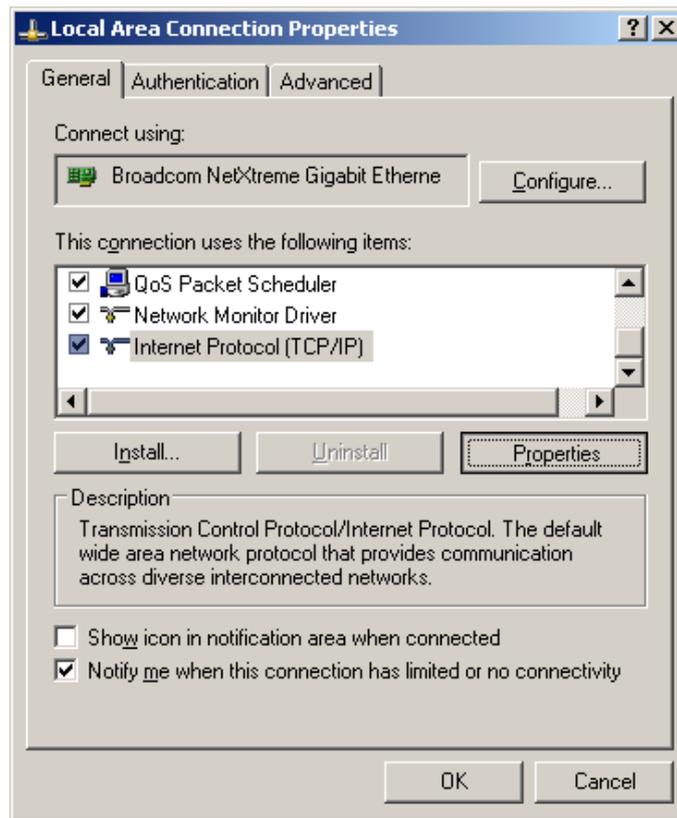


Figure 2.4.

- 4) In the dialog box enter the following values (so that your PC is in the same subnet as default FODU Wi700 addresses):

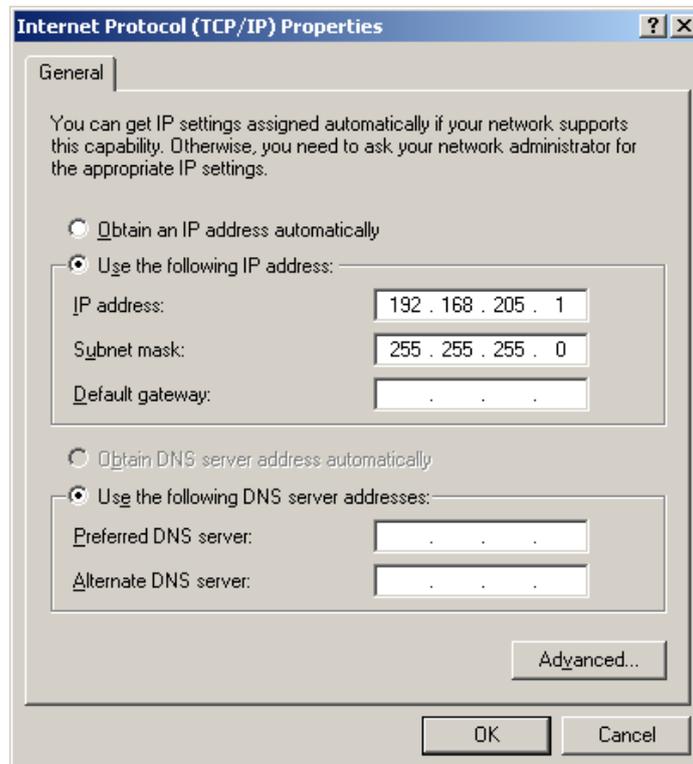


Figure 2.5.

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

2.3.3 Connecting to 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

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After web browsers selection, open it and enter address of the FODU (**Figure 2.6**).

(!) 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

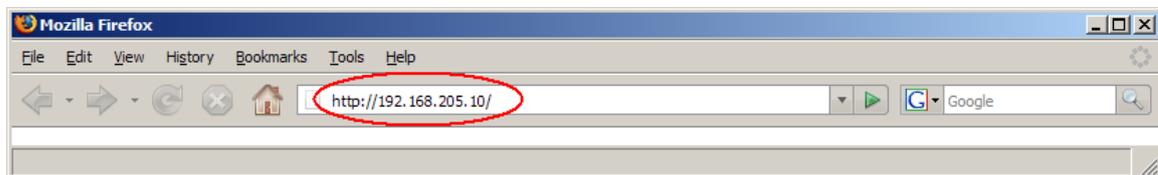


Figure 2.6. FODU Wi700 IP address

(!) 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.

At first “Configuration→Configuration wizard” should be run in order to perform basic link configuration (by default Tx power is disabled and parameters of remote side will not be seen).

If configuration was made correctly, 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.

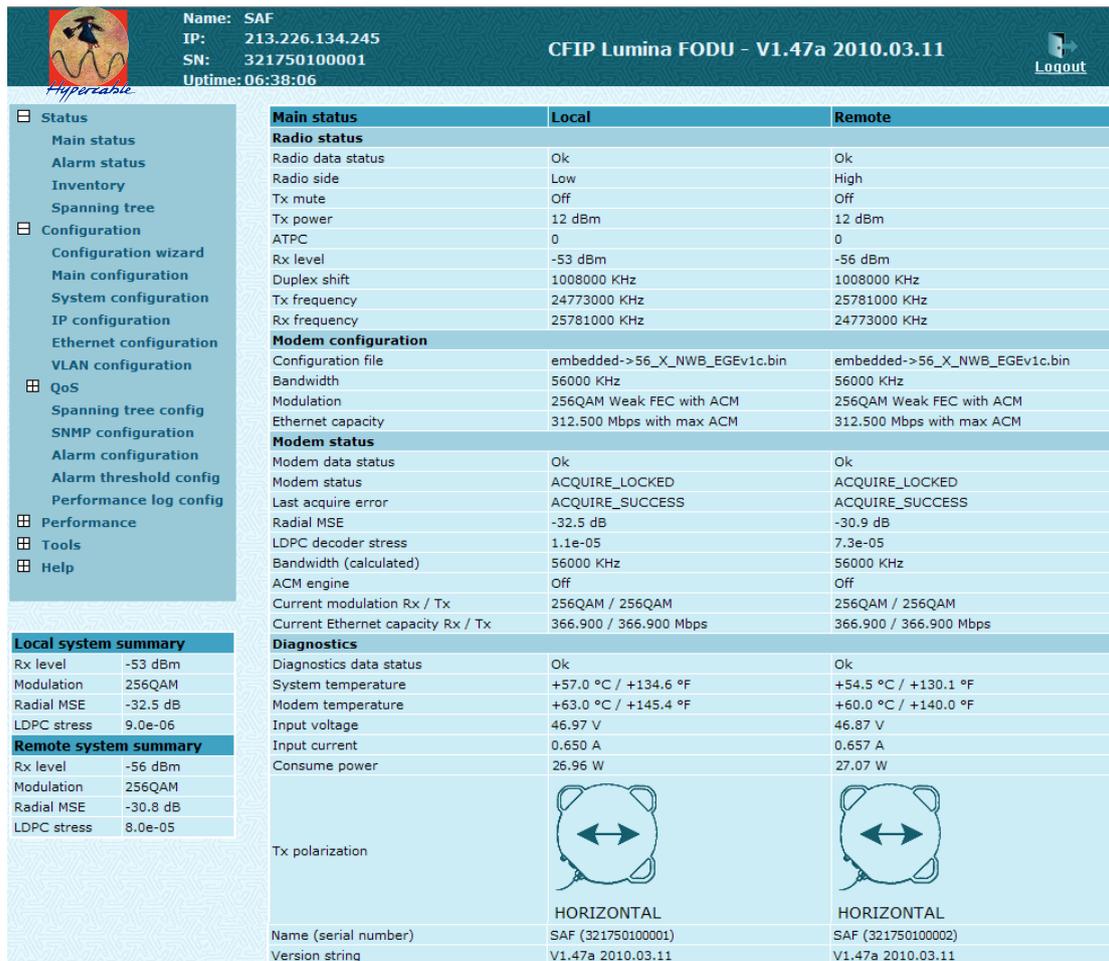


Figure 2.7. Web Interface - main window

(!) Note that FODU Wi700 24GHz utilizes both polarizations, and radios must be installed with 90 degrees offset regarding remote side. This, as well as position of cables can be verified in *Main status* Tx polarization row.

2.3.4 Interface Description

WEB interface consists of four parts, they are:

1. Top panel, that allows to log out and gives information about device type, software version, device name, IP, serial number and uptime;
2. Menu panel that is used to open links to other pages;
3. Status summary for local and remote devices: this section is available while browsing other pages.
4. 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'.

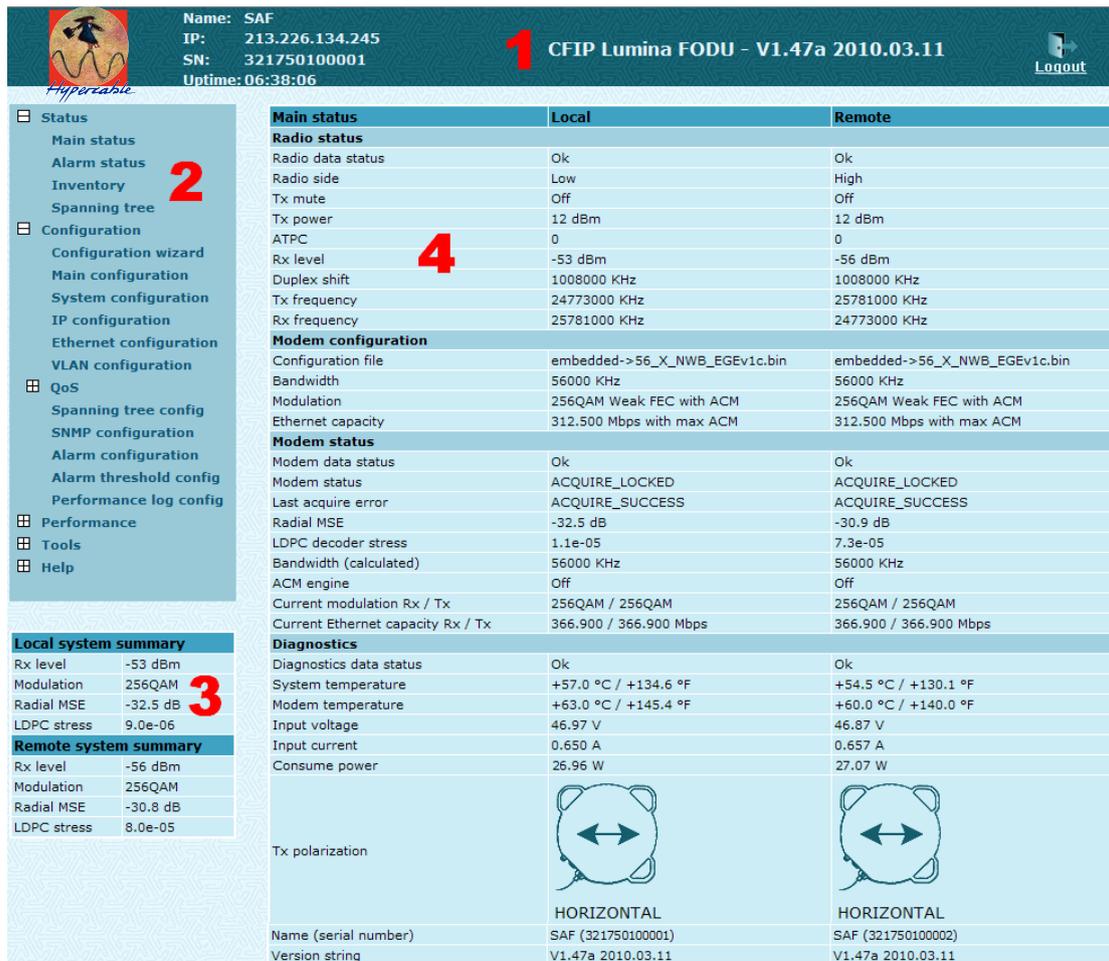


Figure 2.8. Web Interface - main window with section numbering

2.3.5 Command Execution

There is a “IP configuration” page shown in **Figure 2.9**. 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. Write to config file button, which generates “**cfg write**” CLI command, which saves changed configuration;
5. Configuration parameter name;
6. Configuration parameter **current** value;
7. 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 FODU 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 FODU Wi700 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.

The screenshot displays the 'Ethernet management port IP configuration' page. The interface includes a top header with device information (Name: SAF, IP: 192.168.205.13, SN: 321750100001, Uptime: 00:21:02) and a 'Logout' button. A left sidebar contains navigation menus for Status, Configuration, and Tools. The main content area is divided into sections: 'Ethernet management port IP configuration' (1), 'IP services' (2), and 'Static route configuration'. The IP configuration table shows fields for IP Address (192.168.205.13), IP Mask (255.255.255.0), IP Default gateway (255.255.255.255), Ethernet MAC address (00.04.A6.80.C0.04 (4)), and Remote IP Address (192.168.205.12). The IP services section has 'Start FTP' and 'Start TFTP' buttons. The static route configuration section shows a list of routes with a dropdown menu displaying '192.168.205.0/255.255.255.0/192.168.205.13'. At the bottom, there are 'Add', 'Change', and 'Delete' buttons, and a 'Write to config file' button (4). A 'System returned: Ok' message and a 'Flags' string are also visible (7).

Figure 2.9. Web Interface - IP configuration page with numbering

2.3.6 Initial Configuration with Web GUI

Your connected laptop should be in the same subnet with manageable FODU, 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.

(!) FODU Wi700 must be powered up using dedicated power supply with load power at least 35W (at least 45W for high power version). See Chapter 2.2.4 for details.

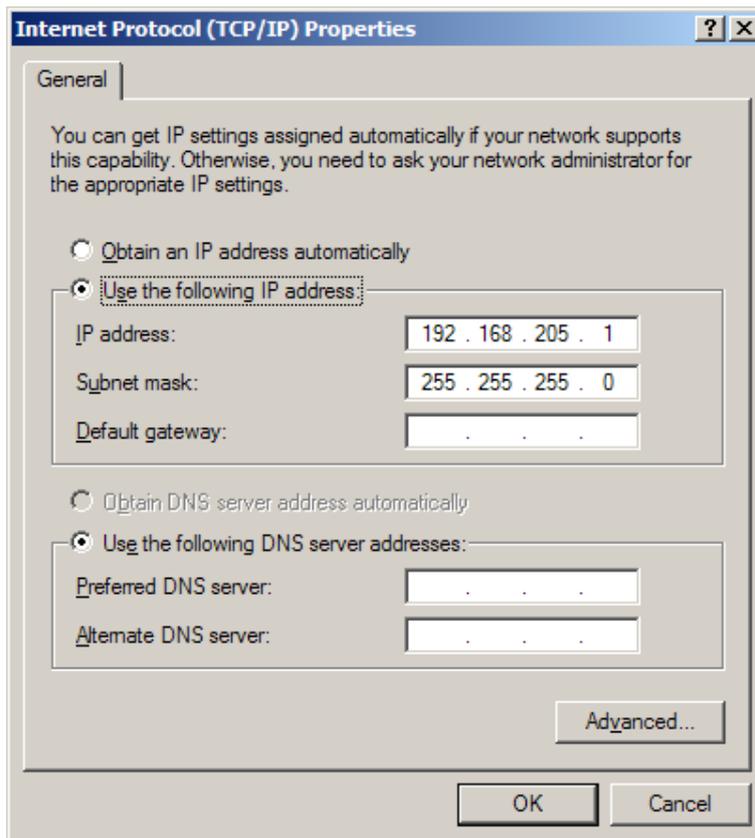


Figure 2.10.

The next step is to connect to FODU Wi700 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 2.11. Supported browsers: ‘Internet Explorer’, ‘Firefox’, ‘Safari’ and ‘Opera’

When you are connected to the FODU Wi700, you will see the window similar to the one shown in **Figure 2.7**.

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 2.12**.

Figure 2.12. 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 ‘SAF’.

Figure 2.13. 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.

Figure 2.14. STEP 2. Defining IP address, mask, default gateway and remote IP address

The third screen of the wizard is devoted to the modem and radio configuration and requires specifying utilized bandwidth (20, 28, 30, 40, 50 or 56 MHz), modulation type (QPSK, 16APSK, 32APSK, 64QAM, 128QAM or 256QAM), Tx power (range depends on modulation chosen) and Tx frequency (range depends on bandwidth chosen); besides, the modem and radio data status is being shown.

These configuration parameters will determine overall link capacity.

Figure 2.15. STEP 3. Defining modem bandwidth, modulation, Tx power and frequency

For FODU Wi700 24GHz Tx power should not trespass equivalent isotropically radiated power (EIRP) limitation of 20 dBm.

(!) In the table below please see interdependence between antenna used and allowed FODU Wi700 24GHz Tx output power range (EIRP ≤ 20 dBm).

| | Antenna size/gain | | |
|----------|-------------------|----------------|-----------------|
| | 30cm / 35.0dBi | 60cm / 40.3dBi | 120cm / 46.2dBi |
| Tx power | -30...-15 dBm | -30...-21 dBm | -30...-27 dBm |

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 4: Check parameters | |
| Please verify the parameters set. | |
| guest | |
| Password | |
| admin | |
| Password | |
| System name | SAF |
| IP address | 192.168.205.11 |
| IP mask | 255.255.255.0 |
| IP default gateway | 255.255.255.255 |
| Bandwidth | 40000 KHz |
| Modulation | 256QAM WeakFEC ACM |
| Tx power | 12 dBm |
| Tx frequency | 13151750 KHz |
| 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"/> |
| Previous step << | Rollback on <input type="checkbox"/> Execute configuration |

Figure 2.17. 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.

2.4 Command Prompt Interface

The FODU 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 ODC 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 6.1**.

(!) 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 Ethernet

traffic.

2.4.1

2.4.2 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 2.3.2**). In order to interconnect the FODU Wi700 and the management terminal directly through serial ports, a “straight through” modem cable is required.

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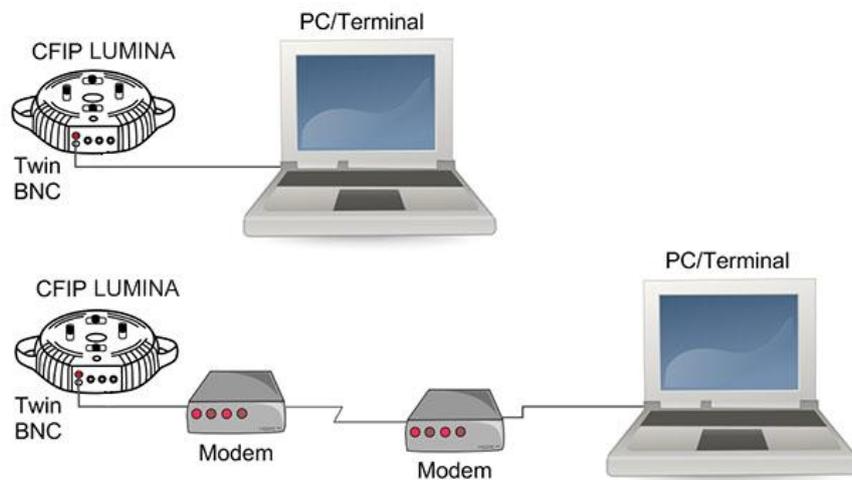


Figure 2.18. Serial connection options to FODU Wi700

When using modems, the management terminal is connected with the FODU Wi700 remotely through a telephone line. In this case, the modem connected with the FODU Wi700 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.

1. Connect the PC to the RS232 serial port by means of “straight through” or modem serial cable (null-cable).
2. Run “Hyper Terminal” program.
3. Make a *New connection* and enter connection name.



Figure 2.19.

4. Choose port (COM1 or COM2).



Figure 2.20.

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

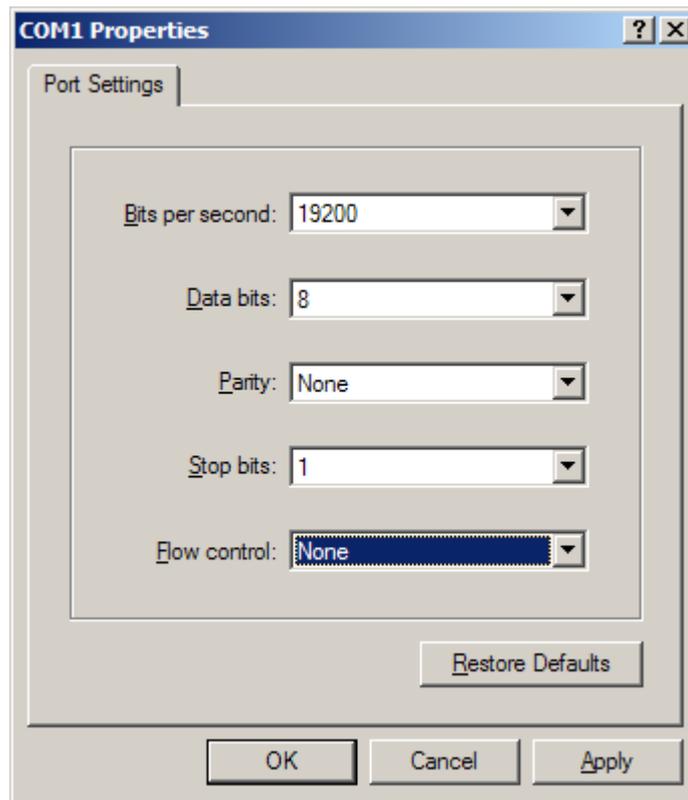


Figure 2.21.

- 6. Press OK
- 7. Press Enter. Password is disabled by default.

If successfully connected, the prompt should appear as in the picture below. See **Chapters 3-7** for available commands.

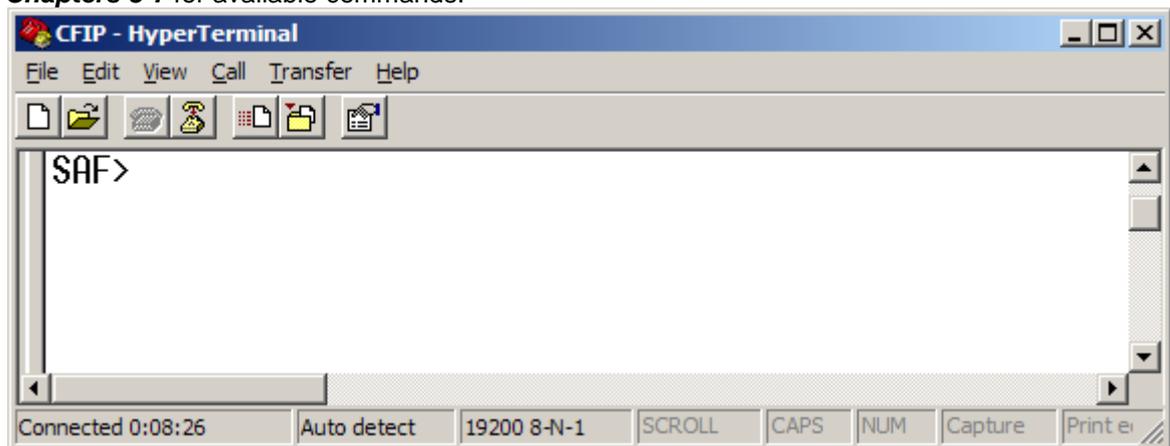


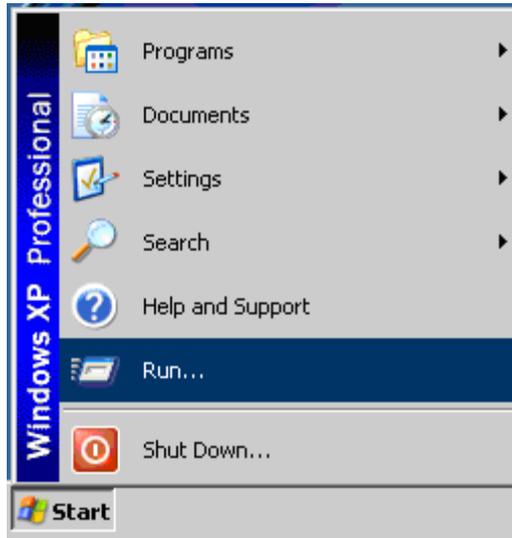
Figure 2.22.

2.4.3 Telnet connection

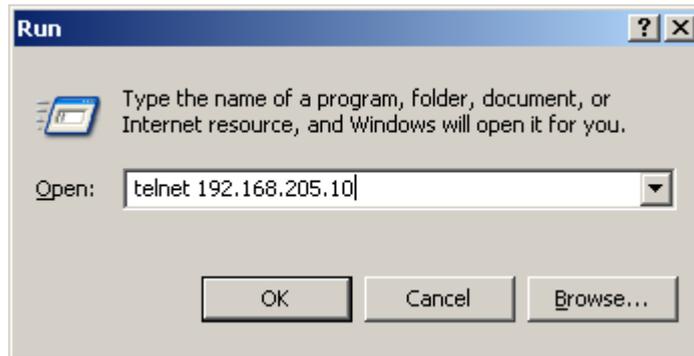
The Telnet connection to the FODU Wi700 is carried out using the Ethernet management connection. Please refer to **Chapter 2.2.2** for Ethernet management port connection details.

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

- 1) Go to Start → Run...



- 2) Type in “telnet <ip_addr>”, where <ip_addr> is IP address of the FODU Wi700 you want to connect to (refer to FODU Wi700 label - explanation in **Chapter 1.8**)



- 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 is *admin* and password – *changeme*.

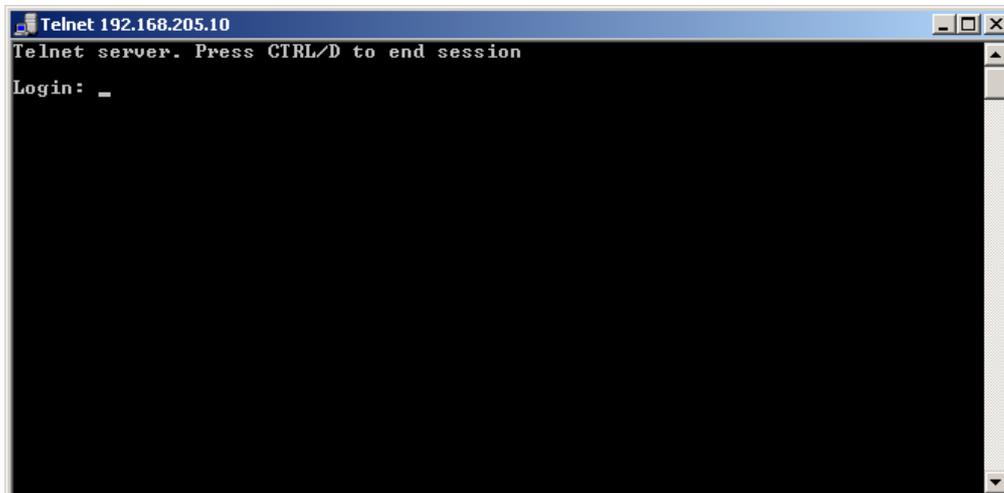


Figure 2.23.

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

2.4.4 Initial Configuration with Command Prompt

Configuration steps using command prompt are as follows:

1. Check the system settings with command '**status**'
2. Configuration required parameters:

(!) Before you set the parameters listed below, you must know what frequency and bandwidth you are allowed to use and at what power you are allowed to transmit.

(!) In the table below please see interdependence between antenna used and allowed FODU Wi700 24GHz Tx output power range (EIRP ≤ 20 dBm).

| | Antenna size/gain | | |
|----------|-------------------|----------------|-----------------|
| | 30cm / 35.0dBi | 60cm / 40.3dBi | 120cm / 46.2dBi |
| Tx power | -30...-15 dBm | -30...-21 dBm | -30...-27 dBm |

- Tx power with the command '**radio txpower** [<power dBm>]';
 - Tx frequency with the command '**radio freq** [<freq KHz>]';
 - Channel bandwidth and modulation with the command '**modem set** <20000|28000|30000|40000|50000| 56000> <min modulation> <max modulation> <WeakFEC|StrongFEC>', where you can choose among 20, 28, 30, 40, 50 or 56 MHz values;
 - Name of FODU Wi700 with the command '**system name** <name>'. Default name is 'SAF';
 - 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;
3. Save settings with the command '**cfg write**'; restarting with the command '**system reset**';
 4. Check the settings made, modem and radio status with the commands '**status**', '**modem status**' and '**radio status**' respectively.

3 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.

Figure 3.1.

1. Shows the name of this FODU Wi700, its IP address, serial number and uptime since the last restart. If uptime is displayed in red, the connection to FODU management port was lost;
2. Shows the firmware version this FODU Wi700 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 3.1**.
 - LDPC is explained below in the **Chapter 3.2**.
6. *Radio data status* – shows if management CPU was able to read data from radio;
7. *Radio side* – shows the radio side of local and remote FODU (command line – **radio side**);
8. *Tx mute* – shows if transmitter is currently muted;
9. *Tx power* – shows current transmitter power in dBm (command line - **radio status** or **status**);
10. *ATPC* – shows the amount of current ATPC correction in dBm (command line – **atpc status**);
11. *Rx level* – shows current level of received signal. It must not differ significantly from the previously calculated value (command line - **radio status** or **status**);
12. *Duplex shift* – shows the margin between the transmitting and receiving frequencies (command line - **radio status**);
13. *Tx frequency* – shows the transmitting frequency (command line - **radio status**);
14. *Rx frequency* – shows the receiving frequency (command line - **radio status**);
15. *Configuration file* – shows which configuration the modem is currently using (command line – **modem configuration**);
16. *Bandwidth* – shows width of currently utilized bandwidth in MHz (command line – **modem status** or **status**);
17. *Modulation* – shows modulation mode set (command line – **modem status** or **status**);
18. *Ethernet capacity* – shows Ethernet capacity set (command line – **modem status** or **status**);
19. *Modem data status* – shows if management CPU was able to read data from modem;

20. *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**);
21. *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**);
22. *Radial MSE* – shows radial mean square error value. Refer to **Chapter 3.1.** for detailed description (command line - **modem status** or **status**);
23. *LDPC decoder stress* – shows the load of LDPC (low-density parity-check code) decoder. Refer to **Chapter 3.2.** for detailed description (command line – **modem status** or **status**);
24. *Bandwidth (calculated)* – shows width of bandwidth read from configuration file in MHz (**command line – modem status**);
25. *ACM engine* – shows if ACM (Adaptive Coding and Modulation) engine is running (command line – **modem status** or **status**);
26. *Current modulation Rx / Tx* – shows the modulation modes currently utilized (command line – **modem status**);
27. *Current Ethernet capacity Rx / Tx* – shows the current Ethernet capacities in both directions (command line – **modem status**);
28. *Diagnostics data status* – shows if system parameters are in acceptable margins (command line - **diagnostics**);
29. *System temperature* – shows the device internal temperature in degrees by Celsius (command line - **diagnostics** or **status**);
30. *Modem temperature* – shows the temperature on modem in degrees by Celsius (command line - **diagnostics** or **status**);
31. *Input voltage* – shows the input voltage of PSU in volts (command line - **diagnostics**);
32. *Inout current* – shows the input current of PSU in amperes (command line - **diagnostics**);
33. *Power consumption* – shows the amount of power consumed by PSU in watts (command line - **diagnostics**);
34. *Tx polarization* – shows transmission polarization and position of connectors and wires at the local side (command line - **diagnostics**);
35. *Name (serial number)* – shows system name and serial number of the unit
36. *Version string* – shows firmware version installed on both local and remote sides of the link.

3.1 Radial ME

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 | 64QAM | 128QAM | 256QAM |
|-------------------|-------------|---------------|---------------|--------------|---------------|---------------|
| Strong FEC | - 8.1 dB | -13.6 dB | -15.2 dB | - 19.0 dB | -21.9 dB | -24.9 dB |
| Weak FEC | -11.3 dB | -16.5 dB | -18.3 dB | -21.7 dB | -24.5 dB | -27.3 dB |

3.2 LDPC

The **LDPC** is monitored for the number of errors being corrected on the input of LDPC decoder (see **Figure 3.1**).



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Figure 3.2 LDPC decoder structure

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

- for Strong FEC mode $\sim 4.0 \cdot 10^{-2}$;
- for Weak FEC mode $\sim 1.0 \cdot 10^{-3}$

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.

4 Detailed Configuration in Web Graphic User Interface

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

4.1 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.

4.1.1 Radio Configuration

| Radio configuration | |
|---|--|
| Radio data status | 1 Ok |
| Radio side | 2 High |
| Tx power (-7 .. 12 dBm) | 3 -7 dBm |
| Tx frequency (13151750 .. 13216500 KHz) | 4 13171000 KHz |
| Rx frequency | 5 12905000 KHz |
| Duplex shift | 6 266000 KHz |
| Tx mute | 7 off |
| | 8 Rollback on <input type="checkbox"/> Execute configuration |
| | 9 Execute for both |

1. *Radio data status* – shows if management CPU was able to read data from radio;
2. *Radio side* – shows if radio side you are currently viewing is low or high (command line – **radio side**);
3. *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 FODU model. Maximal and minimal Tx power values are shown in the brackets. (command line - **radio txpower** [*<power dBm>*]);

(!) In the table below please see interdependence between antenna used and allowed FODU Wi700 24GHz Tx output power range (EIRP ≤ 20 dBm).

| | Antenna size/gain | | |
|----------|-------------------|---------------|---------------|
| | 1ft / 35.0dBi | 2ft / 40.3dBi | 4ft / 46.2dBi |
| Tx power | -30...-15 dBm | -30...-21 dBm | -30...-27 dBm |

4. *Tx frequency (22014000 .. 22582000 KHz)* – allows you to enter preferable transmitter frequency, hence defining utilized channel (command line - **radio txfreq** [*<freq KHz>*]);
5. *Rx frequency* – shows the current receiver utilized frequency (command line - **radio freq**);
6. *Duplex shift* – shows the duplex shift between the transmitter frequency and receiver frequency (command line - **radio duplexshift**);
7. *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*]);
8. Pressing “*Execute configuration*” applies changes made to the corresponding section only for the local side FODU Wi700. 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 FODU Wi700.

4.1.2 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 | 1 <input checked="" type="radio"/> Enabled <input type="radio"/> Disabled |
| ATPC update period (1..5) | 2 <input type="text" value="1"/> sec |
| ATPC delta (1 .. 5 dB) | 3 <input type="text" value="1"/> dB |
| Tx power correction | 4 <input type="text" value="0"/> dB |
| Tx power correction limit (-19..-1 dB) | 5 <input type="text" value="-15"/> dB |
| Remote device status | 6 Ok |
| Rx (remote) level maximum (-50..-20 dBm) | 7 <input type="text" value="-45"/> dBm |
| Rx (remote) level minimum (-90..-45 dBm) | 8 <input type="text" value="-50"/> dBm |
| Rx level max/min boundaries depend on each other | |
| Rx (remote) level | -38 dBm |
| 9 | Rollback on <input type="checkbox"/> <input type="button" value="Execute configuration"/> |
| 10 | <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 (-50..-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 -50..-20 dBm>**);
- Rx (remote) level minimum (-90..-45 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..-45 dBm>**);
- Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected,

configuration will be reverted in case of erroneous configuration changes applied.

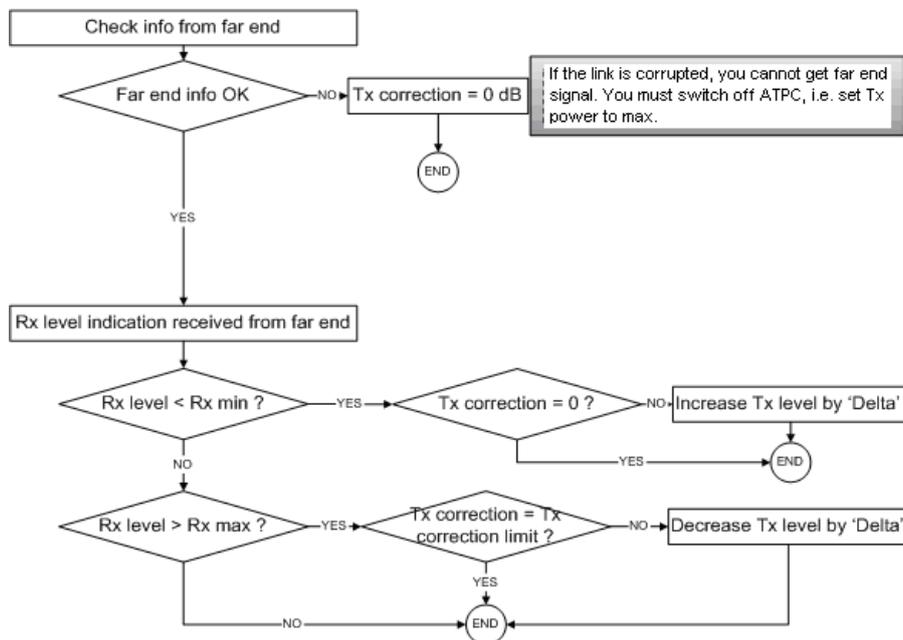
- Pressing “Execute for both” applies changes made to the corresponding section both for local and remote side FODU Wi700.

4.1.3 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 FODU Wi700 receives information (each second) about Rx level from the far-end FODU Wi700 through the service channel; depending on the received Rx level parameter, the local FODU Wi700 adjusts the transmitter power in accordance with the algorithm shown below.



Rx level - the 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 4.1. ATPC algorithm

4.1.4 Modem Configuration

| Modem configuration | |
|---------------------|--|
| Modem data status | 1 Ok |
| Bandwidth | 2 56000 KHz |
| Modulation | 3 256QAM WeakFEC ACM |
| | 4 Rollback on <input type="checkbox"/> Execute configuration |
| | 5 Execute for both |

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1. *Modem data status* – shows if management CPU was able to read data from modem;
2. *Bandwidth* – allows choosing between 20, 28, 30, 40, 50 and 56 MHz bandwidths available. The default value is 20 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 366 Mbps is possible when using 56 MHz bandwidth (command line – **modem set** *<bandwidth>* *<min_modulation>* *<max_modulation>* *<strongFEC/weakFEC>*);
3. *Modulation* – allows choosing between 256QAM, 128QAM, 64QAM, 32APSK, 16APSK and QPSK modulations. The default value is QPSK. The higher modulation order is, the higher the overall link bitrate, but worse RSL threshold. The maximum bitrate of 366 Mbps is possible when using 256QAM modulation (command line – **modem set** *<bandwidth>* *<min_modulation>* *<max_modulation>* *<strongFEC/weakFEC>*). See below the explanation for **Adaptive Coding and Modulation** and **FEC** modes;
4. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied.
5. Pressing “Execute for both” applies changes made to the corresponding section both for local and remote side FODU Wi700 link.

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 voice data – with full bandwidth capacity while adapting the bandwidth capacity of low- and mid-priority services such as Internet browsing (see **Figure 4.2**).

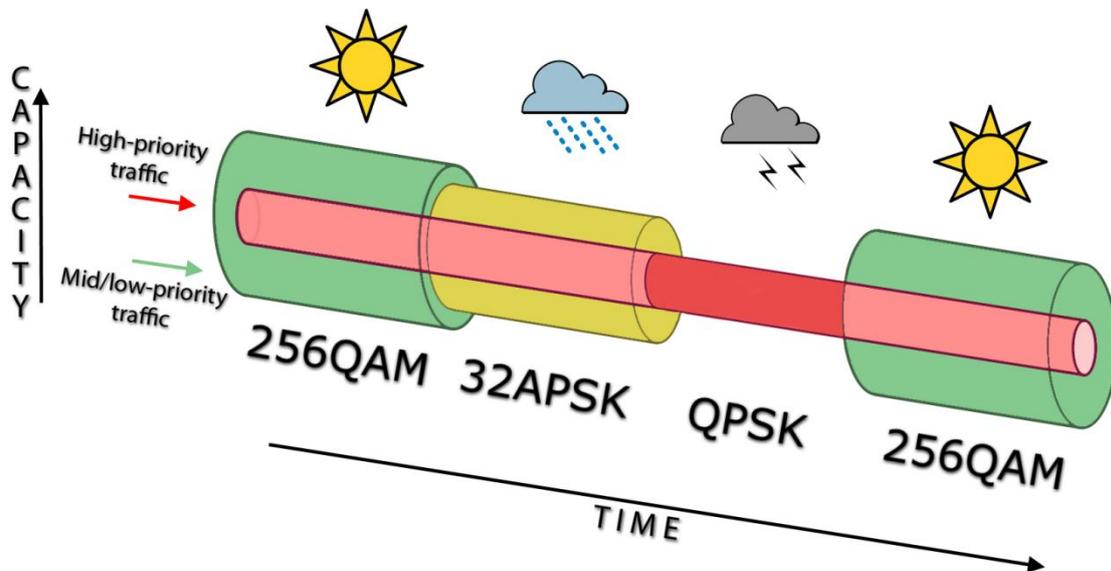


Figure 4.2. ACM bandwidth capacity adaptation

Full modulation range: 256QAM, 128QAM, 64QAM, 32APSK, 16APSK, QPSK

Traffic can be mapped into different priorities, which define the level of service for each application. **Figure 4.3** illustrates how different services – such as rich voice and video – are mapped into different classes of availability (CoA) such as 99.995% or 99.687%.

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 FODU link operating at 23 GHz with 56 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 15 kilometers.

The system operation is set to a minimal payload of 69 Mbps Ethernet for 99.995% availability.

Most of the time the system would support a 366Mbps Ethernet connection instead of a 69 Mbps connection. The system automatically monitored the link conditions and changed the capacity without interrupting the data transmission (hitless changes), as shown in **Figure 4.3**.

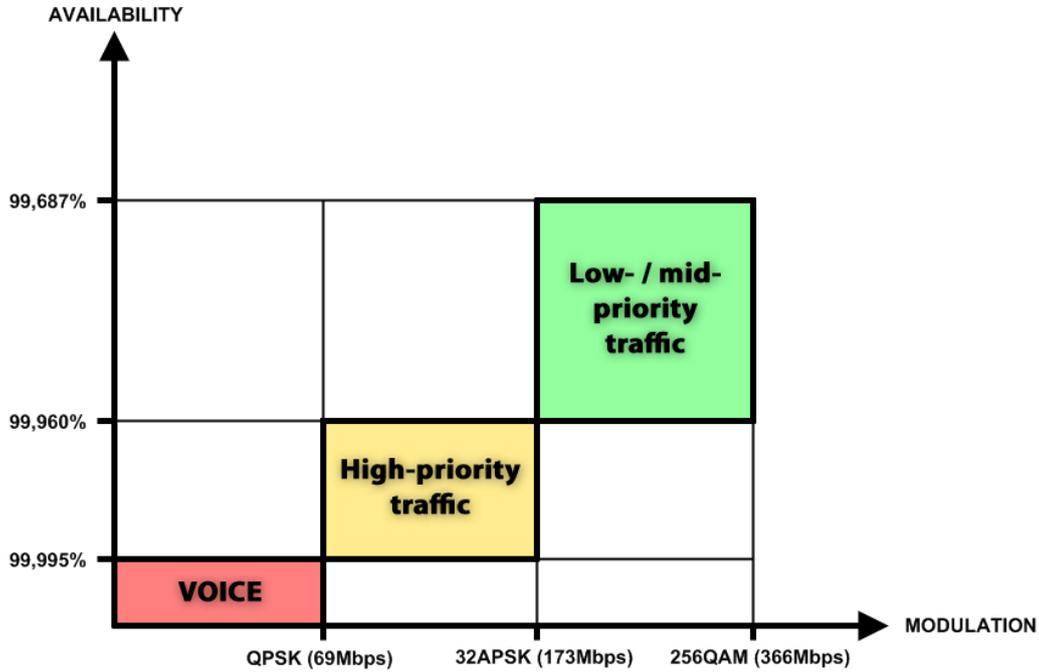


Figure 4.3. Link availability and classes of services

In comparison similar system using 256QAM and providing similar capacity would provide only 99,687% 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 **FEC** mode (Weak or Strong) allows increasing overall capacity of the link in terms of deteriorating RSL sensitivity threshold.

For more details refer to table in **Section 1.6**.

4.1.5 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).

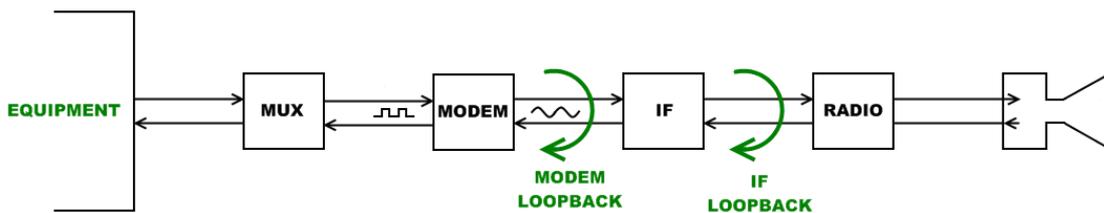


Figure 4.4. Loopback modes

- **MODEM** loopback mode loops signal back to local end after the modem;

- IF loopback mode loops signal back to local end by linking intermediate frequencies.

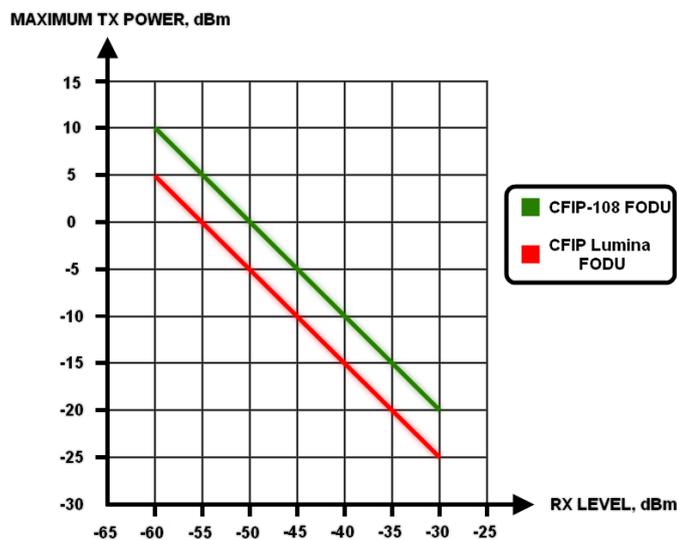
| Loopback configuration | |
|------------------------|--|
| Loopback | 1 none [] sec |
| | 2 Rollback on <input type="checkbox"/> Execute configuration |
| | 3 Write to config file |
| FODU returned: | 4 Ok |

1. *Loopback* – allows choosing loopback mode and its activity time in seconds (command line – **loopback**) {status | none | if | modem} [<time>];
2. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied.
3. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
4. *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”.

4.1.6 Radio frequency loopback

In order to check performance of FODU Wi700 24GHz, radio frequency loopback should be used:

- a. In “Tools→Command line” enter command “radio txpower -10” in order to set transmit output power to -10 dBm;
- b. In “Tools→Command line” enter command “loopback rf <time_in_second>”, where “<time_in_seconds>” should be substituted by sufficient time of loopback operation;
- c. Observe Rx level during radio frequency loopback operation (“Status → Main status” → Rx level” or “System summary”)
- d. Using chart below Tx power shouldn't be set (for ATPC) above Maximum Tx power at appropriate Rx level observed:



For example, if radio frequency loopback indicated Rx level = -55dBm, Tx power shouldn't be set above 0dBm.

| Additional radio and modem configuration commands in Telnet/serial interface | |
|---|--|
| 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 | |
|--|-----------------------------------|
| Command | Description |
| Loopback status | Displays status of loopback mode. |
| Loopback {status none if modem} [<time>] | Sets the specified loopback mode. |

4.2 System Configuration

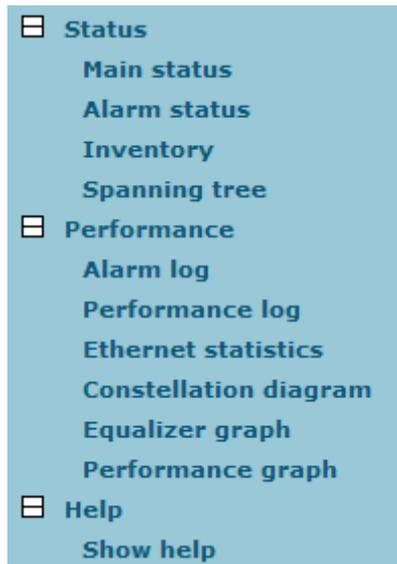
The system configuration window provides the configuration of web access, telnet and FTP interfaces; allows changing system name, web data refresh time and system time.

Explanation of customization fields:

4.2.1 User Configuration

| User configuration * | |
|---|--|
| guest | |
| Enter new password (length: 4..30 characters) | 1 <input type="text"/> |
| admin | |
| Enter new password (length: 4..30 characters) | 2 <input type="text"/> |
| Hide password(-s) | 3 <input checked="" type="checkbox"/> |
| 4 | <input type="button" value="Execute configuration"/> |

- 1. 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:

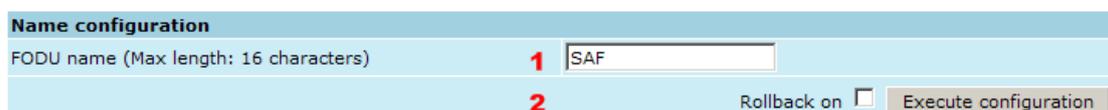


2. **admin** – Enter new password (length: 4..30 characters) – allows entering preferable ‘admin’ account password. Maximal length of the user name cannot exceed 30 symbols. By default password for ‘admin’ account is ‘changeme’. Admin account has full control of the FODU configuration process.
3. **Hide password(-s)** – Hides typed in password. Unchecking this option will display typed in password in plaintext.
4. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. 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). |

4.2.2 Names Configuration



1. **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 'SAF' (command line – **system name** <name>);
- Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied.

4.2.3 Other configuration

| Other configuration | |
|---------------------------------|--|
| Web refresh (2 .. 60 sec) | 1 <input type="text" value="5"/> |
| Time (Usage: YY-MM-DD HH:mm:ss) | 2 <input type="text" value="09-04-17 16:17:24"/> <input type="button" value="Set local machine time"/> |
| | 3 <input type="checkbox"/> Rollback on <input type="button" value="Execute configuration"/> |
| | 4 <input type="button" value="Write to config file"/> |
| Immediate CPU restart | 5 <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 FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied.
- Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
- Restarts FODU Wi700 you are connected to.

(!) Note that after restarting the FODU will use only those settings, which are written to the configuration script. Other settings will be set to default values.

(command line – **system reset**);

| Additional system commands in Telnet/serial interface | |
|---|---|
| Command | Description |
| System status | Displays the name of the device and its uptime. |
| System inventory [show] | Displays the FODU Wi700 product code, serial number and additional information. |
| System aliases [list all basic off add remove clear] | <p>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”);</p> <p>all – all the aliases will be used;</p> <p>basic – only basic (built-in, hidden and user) aliases will be used;</p> <p>off – no aliases will be used;</p> <p>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;</p> |

| | |
|--|---|
| | 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. |
| 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. |

4.2.4 Upgrade Software

| | |
|-------------------------|---|
| Upgrade software | |
| Choose file: | <div style="display: flex; align-items: center;"> 1 <input style="width: 150px;" type="text"/> <input style="margin-left: 10px;" type="button" value="Browse..."/> <input style="margin-left: 20px;" type="button" value="Upgrade"/> </div> |
| System returned: | <div style="display: flex; align-items: center;"> 2 <input type="button" value="Ok"/> </div> |

1. *Choose file* – allows choosing location of software upgrade file (e.g. FODU140.elf.ezip) stored on your hard disk. Software upgrade file must have *.elf.ezip extension;
2. *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”.

4.2.5 Service information

| | |
|------------------------------------|--|
| Service information | |
| Full system information page | 1 |
| Advanced ethernet information page | 2 |
| System returned: | <div style="display: flex; align-items: center;"> 3 <input type="button" value="Ok"/> </div> |

1. *Full system information page* – provides full system information summary in a separate browser tab;
2. *Advanced ethernet information page* – provides advanced Ethernet information in a separate browser tab;

(!) Note that Advanced Ethernet information page resets all counters and gathers Ethernet information. Please wait until information is gathered and displayed..

4.3 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:

4.3.1 Ethernet management port IP configuration

| Ethernet management port IP configuration | | |
|---|----------|---|
| IP Address | 1 | <input type="text" value="192.168.205.11"/> |
| IP Mask | 2 | <input type="text" value="255.255.255.0"/> |
| IP Default gateway | 3 | <input type="text" value="255.255.255.255"/> |
| Ethernet MAC address | 4 | 00.04.A6.80.C0.04 (4) |
| Remote IP Address | 5 | <input type="text" value="192.168.205.10"/> |
| | 6 | Rollback on <input type="checkbox"/> <input type="button" value="Execute configuration"/> |

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1. *IP Address* – allows specifying IP address of FODU Wi700 you are currently logged in. Default IP address is 192.168.205.10 or 192.168.205.11 – depending on which side the specific FODU Wi700 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 FODU Wi700 IP addresses need to be in the same subnet.

2. *IP Mask* – allows specifying IP mask of FODU Wi700 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>**);
3. *IP Default gateway* – allows specifying gateway of FODU Wi700 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>**);
4. *Ethernet MAC address* – shows the MAC address of FODU Wi700 you are currently logged in (command line – **net mac**);
5. *Remote IP Address* – shows IP address of remote (far-end) FODU Wi700 to ensure communication between link sides (command line – **net ip remaddr <remaddr>**);
6. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied.

4.3.2 IP Services

| IP services | | |
|--------------|----------|---|
| FTP service | 1 | <input type="button" value="Start FTP"/> |
| TFTP service | 2 | <input type="button" value="Start TFTP"/> |

1. *FTP service* – starts FTP service for file access and software update of your FODU Wi700. By default FTP service is not running (command line – **net start ftp**);
2. *TFTP service* – starts TFTP service for file transfer between both FODU Wi700 link sides. By default TFTP service is not running (command line – **net start tftp**).

4.3.3 Static Route Configuration

(!) Do not make any changes to default route; otherwise, management connection to FODU will be lost.

| Static route configuration | |
|---|---|
| Static routes | 1 <input type="text" value="192.168.205.0/255.255.255.0/192.168.205.10"/> |
| Network Address | 2 <input type="text" value="192.168.205.0"/> |
| Network Mask | 3 <input type="text" value="255.255.255.0"/> |
| Gateway | 4 <input type="text" value="192.168.205.10"/> |
| Routes flags | 5 SL..... |
| Rollback on <input type="checkbox"/> <input type="button" value="Add"/> <input type="button" value="Change"/> <input type="button" value="Delete"/> | |
| 6 <input type="button" value="Write to config file"/> | |
| FODU returned: | 7 Ok |

1. *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**);
2. *Network address* – allows specifying network address for the route changing/adding (command line – **net route add/delete <dest addr> [MASK <mask>] <gateway>**);
3. *Network mask* - allows specifying network mask for changing/adding the route (command line – **net route add/delete <dest addr> [MASK <mask>] <gateway>**);
4. *Gateway* - allows specifying gateway for the route changing/adding (command line – **net route add/delete <dest addr> [MASK <mask>] <gateway>**);
5. After entering addresses or selecting a specific route, buttons “Add”, “Change” and “Delete” allow you to modify FODU Wi700 routes. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied.
6. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
7. *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. |
| 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 FODU and 10.0.10.10 for the local side FODU, 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:

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 |
| Rollback on <input type="checkbox"/> Execute configuration | |

(!) “Rollback on” should not be selected!

Press “Execute configuration”.

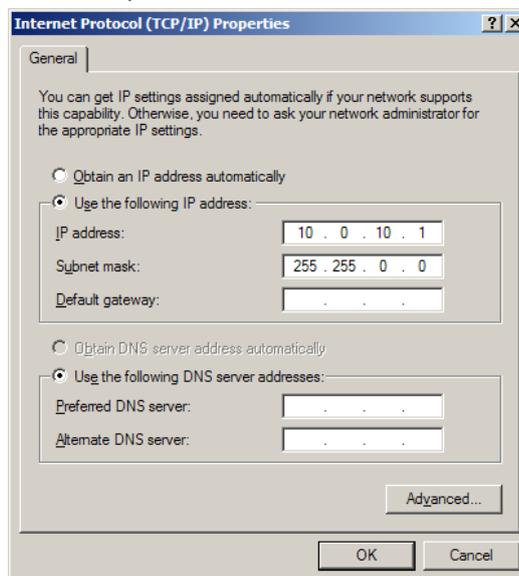
2) Enter the local side (close-end) Web GUI and go to **“IP configuration”**. The configuration will look in the following way:

| 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 |
| Rollback on <input type="checkbox"/> Execute configuration | |

(!) “Rollback on” should not be selected!

Press “Execute configuration”.

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 2.2.3**. Configuration of LAN Ethernet port must be as follows:



- 4) Go to the remote side Web GUI, choose “Tools → Configuration file” and press “Cfg write”.
- 5) Repeat step 4) for the local side Web GUI.

4.4 Ethernet Configuration

The Ethernet configuration window provides the speed settings for all four LAN ports of Ethernet switch as well as shows the current status of all four LAN ports (command line – **ethernet stat**).

Explanation of customization fields:

| Ethernet configuration | | | | | |
|------------------------|--------------|--------------|--------------|--------------|--------------------------------------|
| Ethernet status | | | | | |
| | Port 1 (LAN) | Port 2 (LAN) | Port 3 (LAN) | Port 4 (LAN) | Port 5 (WAN) |
| Link | Off | Off | Off | Off | 1000 Mbps |
| Duplex (actual) | Full | Full | Full | Full | Full |
| Rx flow | Off | Off | Off | Off | Off |
| Tx flow | Off | Off | Off | Off | Off |
| Rx state | On | On | On | On | On |
| Tx state | On | On | On | On | On |
| Speed (set) | auto | auto | auto | auto | |
| | | | | | Rollback on <input type="checkbox"/> |
| | | | | | Execute configuration |
| | | | | | Write to config file |
| FODU returned: | | | | | |

1. Represents all four LAN (Local Area Network) ports of the FODU Wi700 switch;
2. *Link* – shows operation status of each port;
3. *Duplex (actual)* – shows if port is currently operating in full or half duplex mode;
4. *Rx flow* – shows if ‘flow control’ is enabled or disabled for regress traffic;
5. *Tx flow* – shows if ‘flow control’ is enabled or disabled for egress traffic;
6. *Rx* – shows if regress activity is allowed;
7. *Tx* – shows if egress activity is allowed;
8. *Speed (set)* – shows current operation mode of each port;
9. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied;
10. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
11. *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”.

4.5 VLAN Configuration

The VLAN configuration window provides configuration of port-based Ethernet Virtual Local Area Networks (VLANs), allowing using up to 4093 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).

| VLAN configuration | | | | | | | |
|------------------------------|----------|--|---|---|---|--------------------------------|---|
| 802.1Q VLAN | 1 | <input checked="" type="radio"/> Enabled | <input type="radio"/> Disabled | | | | |
| 802.1Q Double Tagging | 2 | <input type="radio"/> Enabled | <input checked="" type="radio"/> Disabled | | | | |
| Drop invalid VLAN | 3 | <input type="radio"/> Enabled | <input checked="" type="radio"/> Disabled | | | | |
| VLAN configuration table | | | | | | | |
| VLAN Nr.\Port | 4 | P1 | P2 | P3 | P4 | WAN | Management |
| Default VLAN | 5 | <input type="text" value="0"/> | <input type="text" value="0"/> | <input type="text" value="0"/> | <input type="text" value="0"/> | <input type="text" value="0"/> | <input type="text" value="0"/> |
| 14 | 6 | <input type="checkbox"/> Trunk | <input type="checkbox"/> Trunk | <input checked="" type="checkbox"/> Trunk | <input checked="" type="checkbox"/> Trunk | <input type="checkbox"/> Trunk | <input type="checkbox"/> Access <input type="button" value="Del"/> |
| 22 | | <input type="checkbox"/> Trunk | <input type="checkbox"/> Trunk | <input checked="" type="checkbox"/> Trunk | <input type="checkbox"/> Trunk | <input type="checkbox"/> Trunk | <input checked="" type="checkbox"/> Access <input type="button" value="Del"/> |
| Select/Deselect all VLAN(-s) | 7 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | | | | | | 8 | Rollback on <input type="checkbox"/> <input type="button" value="Execute configuration"/> |
| Add new VLAN | | | | | | | |
| Nr.: | 9 | <input type="text"/> | <input type="checkbox"/> Trunk | <input type="checkbox"/> Trunk | <input type="checkbox"/> Trunk | <input type="checkbox"/> Trunk | <input type="checkbox"/> Trunk <input type="checkbox"/> Access <input type="button" value="Add"/> |
| | | | | | | 10 | <input type="button" value="Reset VLAN(-s)"/> |
| | | | | | | 11 | <input type="button" value="Write to config file"/> |
| Execution status: | | | | | | 12 | Ok |

Figure 4.5. VLAN configuration

1. **802.1Q VLAN** – enables support of 802.1Q VLAN (command line – **ethernet vlan** [enable | disable]);
2. **802.1Q Double Tagging** – enables double tagging feature, which is useful for ISP applications. When the ISP aggregates incoming traffic from each individual customer, the extra tag (double tag) can provide an additional layer of tagging to the existing IEEE 802.1Q VLAN. The ISP tag (extra tag) is a way of separating individual customers from other customers. Using the IEEE 802.1Q VLAN tag, a user can separate the individual customer’s traffic;
3. **Drop invalid VLAN** – frames with no corresponding entry in VLAN table are being dropped;
4. **VLAN Nr. /Port** – displays all 6 ports of the switch;
5. **Default VLAN** – specifies default VID for nonIEEE 802.1Q frames;
6. **VLAN table** displays the list of set VLAN IDs and appropriate VLAN types on all available switch ports;
7. **Select/Deselect all VLAN(-s)** – Allows selecting or deselecting all VLANs of the corresponding column;
8. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied;
9. Adding new VLANs is done by entering preferable VID, enabling appropriate port, choosing VLAN type and pressing “Add” button;
10. **Reset VLAN(-s)** – resets the whole VLAN configuration (command line – **ethernet vlan reset**);
11. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
12. **Execution status** - 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.

4.5.1 Ethernet Switch Port Status and Settings

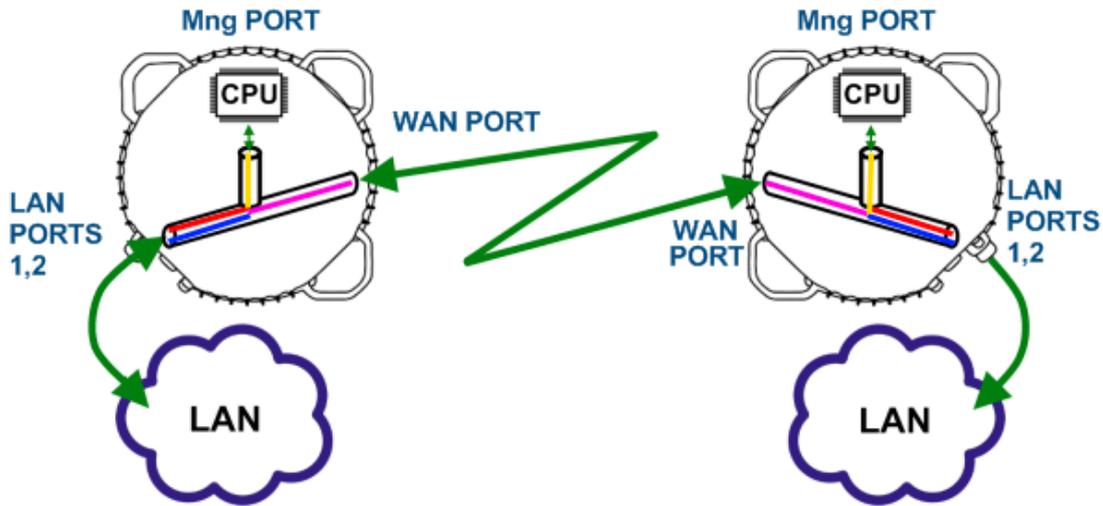


Figure 4.6.

Switch LAN ports 1 and 2 are connected to LAN interface.
Switch WAN port is connected to WAN interface, modem and radio part.
Switch Mng port is connected to LAN Management CPU.

4.5.2 Ethernet Switch VLAN Status and Settings

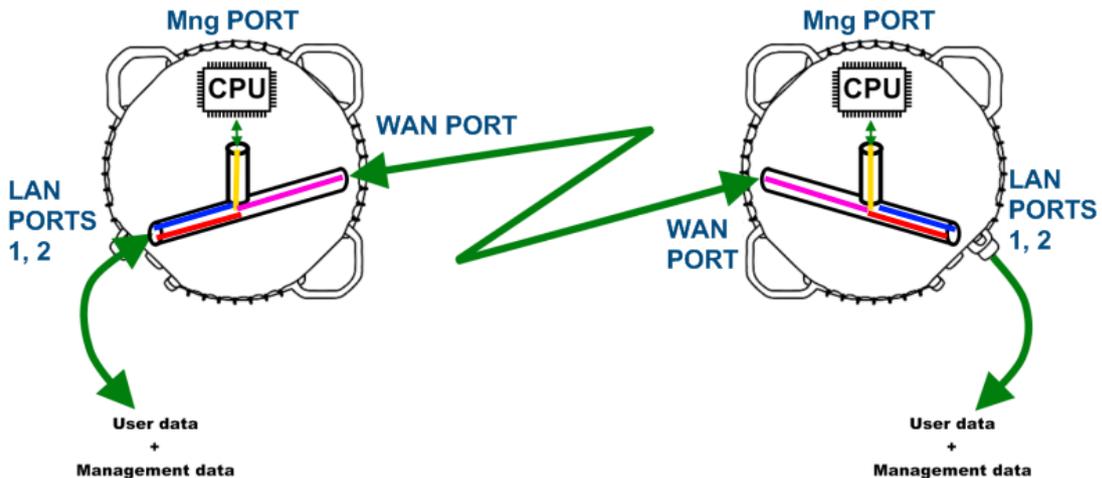


Figure 4.7. System without VLANs

When VLANs are not used (**Figure 4.7**), user data and management data are not separated either logically, or physically.

When using VLANs (**Figure 4.8**), 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.

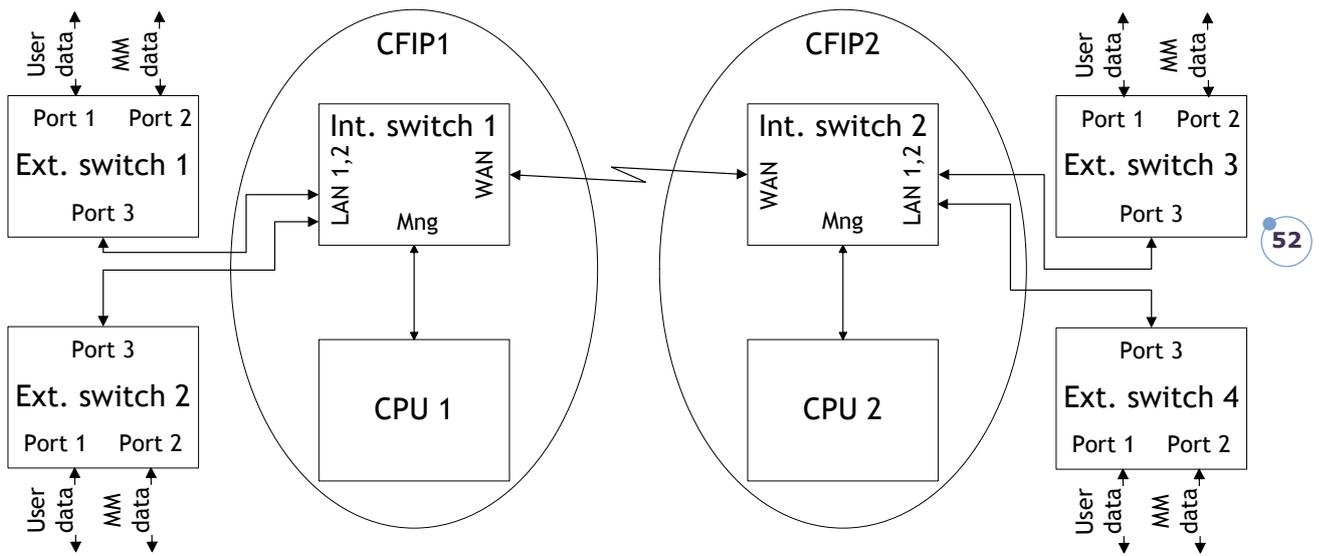


Figure 4.8. System with VLANs

System with two separate VLANs – A and B. **Figure 4.9.** represents ports membership to VLANs.

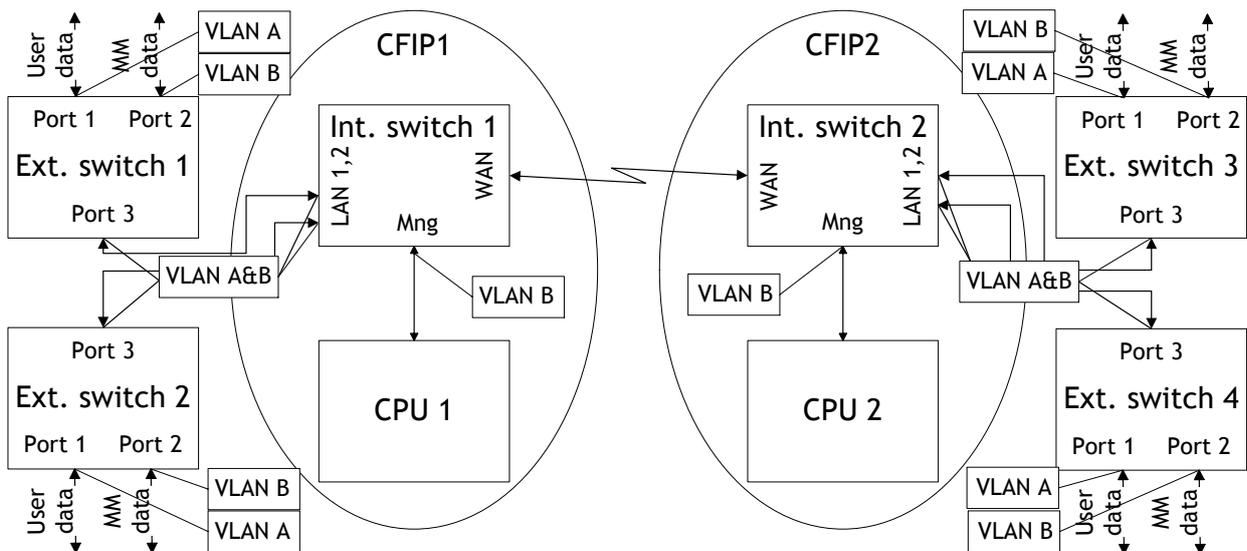


Figure 4.9. VLANs and ports membership

LAN and WAN ports of Int. switch 1 and switch 2 are sending data according to VLAN ID and destination address, and adding VLAN tags for packets outgoing from Mng port. Additionally, VLAN tag is removed at Mng port of Switch 1 and Switch 2.

VLAN A is the Trunk type VLAN with LAN & WAN port membership.

VLAN B is the Management type VLAN with LAN & WAN & Mng membership.

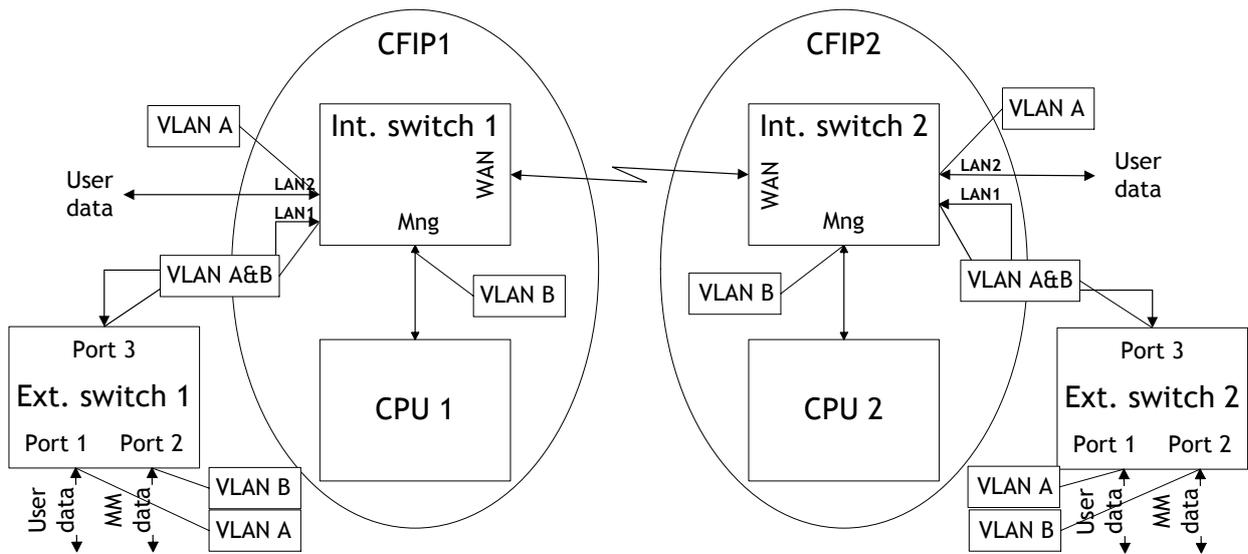


Figure 4.10. Configuration with management access from one side of the link

For both switches:

VLAN A is configured as:

- Trunk type VLAN with LAN1 & WAN membership;
- Access type VLAN with LAN2 & WAN membership with removing and inserting VLAN tags while packet is being transmitted to LAN2 and WAN, respectively.

VLAN B is configured as:

- Management type VLAN with LAN1, WAN and Mng ports membership when removing VLAN tags while packet is being sent to Mng port and inserting tag while packet is transmitting to LAN&WAN ports.

Limitations and rules on using VLAN:

- Supports up to 4093 full range VLAN IDs.
- 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 on one LAN port is not allowed.
- After the VLAN table initialization is completed, 802.1Q VLAN mode must be enabled by using the command “**Ethernet VLAN enable**”.
- Note that Access VLAN Type cannot be configured together with Management VLAN.
- In order to pass untagged packets through the link, “**Ethernet vlan 0 traffic**” should be added.

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 FODU Wi700 Web management;

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

- 3) Set preferable VLAN configuration in “VLAN configuration” of local link side FODU Wi700 Web management.

Examples of VLAN usage:

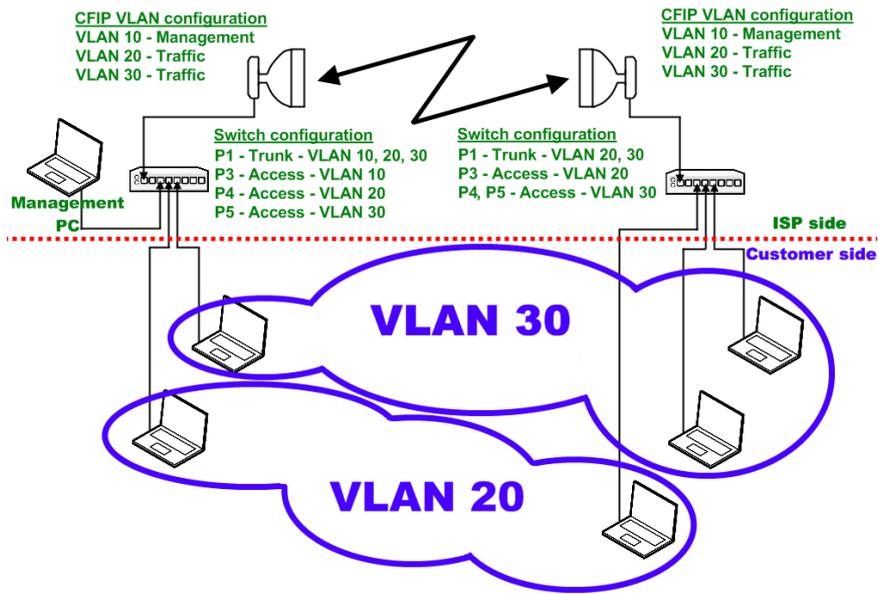


Figure 4.11. VLAN configuration with VLAN tag encapsulation on the ISP side

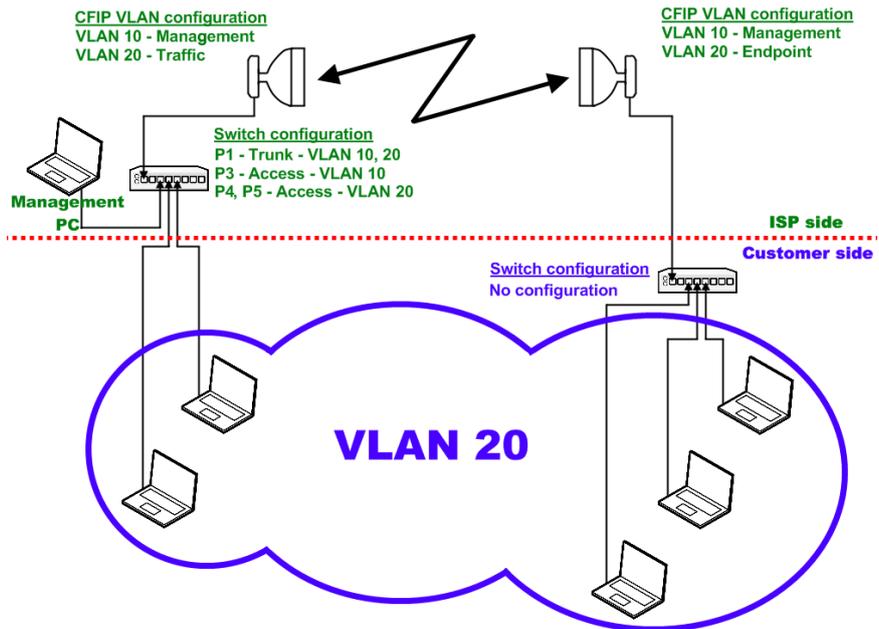


Figure 4.12. VLAN configuration with 'Access' VLAN

4.6 QoS

4.6.1 General Configuration

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 general configuration | | | | | | | |
|--------------------------------------|----------------------------|---|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------|
| QoS general status | | | | | | | |
| Name | P1 | P2 | P3 | P4 | WAN | Mng | |
| QoS 802.1p | 1 <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Enable/Disable all |
| DiffServ | 2 <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Enable/Disable all |
| Port based priority | 3 1 | 1 | 1 | 1 | 1 | 1 | |
| Rollback on <input type="checkbox"/> | | | | | | | Execute configuration |
| QoS general queuing | | | | | | | |
| Queuing priority selection | 4 | 802.1p | | | | | |
| Queuing type | 5 | <input type="radio"/> Fixed <input checked="" type="radio"/> Weighted | | | | | |
| Name | Q1 | Q2 | Q3 | Q4 | | | |
| Weights (0 < Q1 < Q2 < Q3 < Q4 < 50) | 6 1 | 2 | 4 | 8 | | | |
| Rollback on <input type="checkbox"/> | | | | | | | Execute configuration |
| 8 | | | | | | | Write to config file |
| Execution status: | | | | | | | 9 Ok |

1. *QoS 802.1p* – enables or disables 802.1p priorities for any available switch port – LAN1/2/3/4, WAN or Mng (command line – **ethernet QoS 802.1p** *{[enable | disable <Port>] | [map]}*);
2. *DiffServ* – enables or disables DiffServ (DSCP) priorities for any available switch port – LAN1/2/3/4, WAN or Mng (command line – **ethernet QoS DSCP** *[enable | disable <port>] | map*);
3. *Port based priority* – allows passing packets from available ports 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>*);
4. *Queuing priority selection* – allows to select primary QoS method, upon which queueing decision shall be made;
5. *Queuing type* – allows choosing fixed priority queuing mode or weighted queuing mode;
6. *Weights (0<Q1<Q2<Q3<Q4<50)* – allows specifying correlation of all four queues. Queue values should correspond to limitations. Default correlation is 1:2:4:8.
7. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied;
8. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
9. *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”.

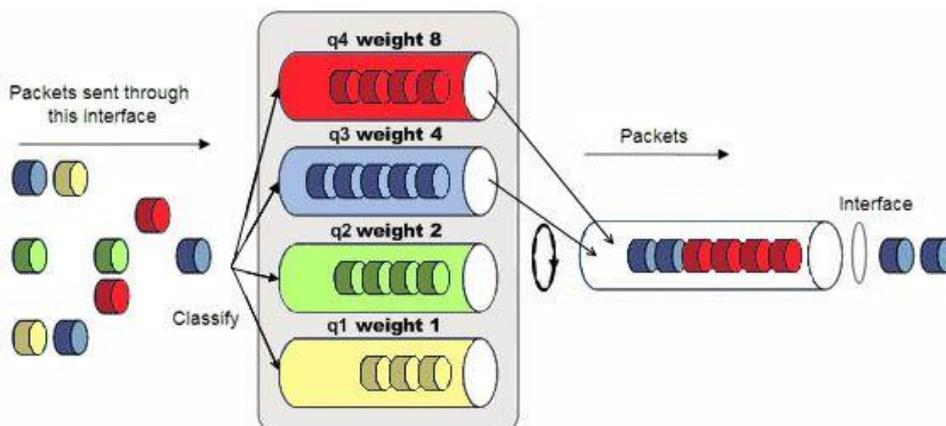


Figure 4.13. Weighted priority queuing mode

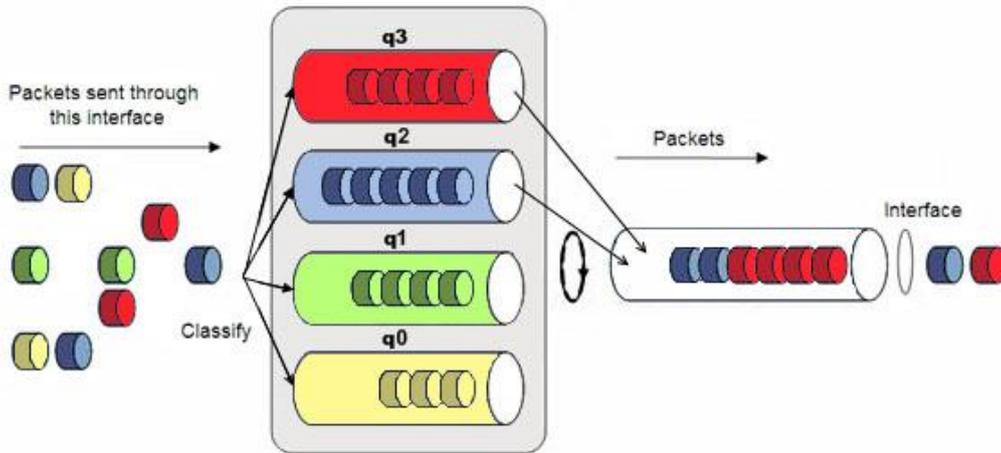


Figure 4.14. Fixed priority queuing mode

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.

4.6.2 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 | 1 Queue value |
| 0 | 1 |
| 1 | 1 |
| 2 | 2 |
| 3 | 2 |
| 4 | 3 |
| 5 | 3 |
| 6 | 4 |
| 7 | 4 |

2 Rollback on Execute configuration
3 Write to config file
4 FODU returned: Ok

1. QoS 802.1p priority mapping – allows assigning queue values to specific 802.1p values.
2. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied;
3. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);

4. *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”.

4.6.3 DSCP Configuration

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

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| QoS DSCP configuration | | | | | | | |
|------------------------|-------|------|-------|------|-------|------|-------|
| DSCP mapping 1 | | | | | | | |
| 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 |

2 Rollback on **Execute configuration**

3 **Write to config file**

4 FODU returned: Ok

1. *DSCP mapping* – allows assigning queues for different DSCP classes. You may have up to 64 different traffic DSCP classes;
2. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied;
3. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
4. *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”.

4.7 Spanning Tree Configuration

Implementation of 802.1D-1998 STP (Spanning Tree Protocol) is compatible with Rapid STP and Multiple STP, as well as having additional capability for automatic WAN port Path Cost calculation and non-standard mode for faster network convergence.

4.7.1 Spanning Tree Config

| Spanning tree configuration | |
|------------------------------|-------------------|
| Bridge settings | |
| STP state | Enabled |
| Address | 00.04.A6.80.B2.00 |
| Priority (0..65535) | 32768 |
| Max Age (6..40) | 20 s |
| Hello Time (1..100) | 2 s |
| Forward Delay (4..30) | 15 s |
| Fast Mode | Disabled |
| Port 1 LAN | |
| State | Forwarding |
| Priority (0..65535) | 128 |
| Path Cost (1..200000000) | 200000 |
| Port 2 LAN | |
| State | Disabled |
| Priority (0..65535) | 128 |
| Path Cost (1..200000000) | 200000 |
| Port 3 LAN | |
| State | Forwarding |
| Priority (0..65535) | 128 |
| Path Cost (1..200000000) | 200000 |
| Port 4 LAN | |
| State | Blocking |
| Priority (0..65535) | 128 |
| Path Cost (1..200000000) | 200000 |
| Port 5 WAN | |
| State | Forwarding |
| Priority (0..65535) | 128 |
| Path Cost Selection | Manual |
| Path Cost (1..200000000) | 200000 |
| Path Cost Mode | Long |
| Path Cost Offset (0..200000) | 0 |
| Execute configuration | |
| Write to config file | |
| Command execution status | Ok |

1. *Bridge settings* - Values 5-9 take effect if a given Bridge is Root;
2. *STP state* – allows enabling or disabling STP support. In “Disabled” mode the switch passes through BPDUs (Bridge Protocol Data Unit) packets;
3. *Address* – the MAC address of the unit;
4. *Priority (0..65535)* – this parameter and MAC address determine whether a given Bridge is Root Bridge. Advantage is given to the combination of *Priority* and *Address*, which is numerically smaller;
5. *Max Age (6..40)* – this parameter determines time period, during which the received BPDUs packets’ information is stored for a separate port;
6. *Hello Time (1..100)* – time gap, between which the BPDUs packets are being sent;
7. *Forward Delay (4..30)* – time period that determines time a separate port stays in *Listening* and *Learning* conditions;
8. *Fast Mode* – allows to enable or disable “Fast Mode”, in which STP operates ten times faster but is not compatible with other standardized STP devices;
9. *Port 1 LAN* – STP parameters of LAN 1 port;
10. *State* – port condition. Can be one of the following: *Disabled*, *Blocking*, *Listening*, *Learning*, *Forwarding* or *Broken*;
11. *Priority (0..65535)* – Port Priority. Combination of Priority, Port number and Path Cost determines whether the port will be selected as Root port or will be blocked on the occasion of loop, etc;
12. *Path cost (1..200000000)* – this parameter setting depends on the capacity of a separate port;
13. *Port 3 LAN* – STP parameters of LAN 3 port;

14. *Port 2 LAN* – STP parameters of LAN 2 port;
15. *Port 4 LAN* – STP parameters of LAN 4 port;
16. *Port 5 WAN* – STP parameters of WAN port;
17. *State* – port condition. Can be one of the following: *Disabled, Blocking, Listening, Learning, Forwarding* or *Broken*;
18. *Priority (0..65535)* – Port Priority. Combination of Priority, Port number and Path Cost determines whether the port will be selected as Root port or will be blocked on the occasion of loop, etc;
19. *Path cost selection* – path cost for WAN port can be set manually (default) or calculated automatically with “byACM” option enabled, which operates according to ACM swiching;
20. *Path cost* – this parameter setting depends on the capacity of a separate port; setting is disabled when automatic “Path cost selection” is enabled;
21. *Path cost mode* - automatic Path Cost mode of WAN port. Can be Short or Long;
22. *Path cost offset* - offset of the WAN port automatic Path Cost;
23. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied;
24. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
25. *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”.

4.7.2 Spanning Tree Status

Spanning tree status shows current STP status at all available ports. Description of parameters is in Chapter 4.7.1. Besides information about currently elected Root port is being shown.

| Spanning tree status | | | |
|----------------------------|-------------------|---------------------|-------------------|
| Bridge information | | Root information | |
| STP status | Enabled | Port | N/A |
| Fast Mode | Enabled | Root Path Cost | 0 |
| Address | 00.04.A6.80.B2.00 | Address | 00.04.A6.80.B2.00 |
| Priority | 32768 | Priority | 32768 |
| Max Age | 20e-1 s | Max Age | 20e-1 s |
| Hello Time | 2e-1 s | Hello Time | 2e-1 s |
| Forward Delay | 15e-1 s | Forward Delay | 15e-1 s |
| Number of Topology Changes | 3 | | |
| Time Since Topology Change | 168317e-1 s | | |
| Port 1 LAN | | Port 2 LAN | |
| State | Forwarding | State | Disabled |
| Forward Transitions | 1 | Forward Transitions | 0 |
| Priority | 128 | Priority | 128 |
| Path Cost | 200000 | Path Cost | 200000 |
| Port 3 LAN | | Port 4 LAN | |
| State | Forwarding | State | Blocking |
| Forward Transitions | 1 | Forward Transitions | 0 |
| Priority | 128 | Priority | 128 |
| Path Cost | 200000 | Path Cost | 200000 |
| Port 5 WAN | | | |
| State | Forwarding | | |
| Forward Transitions | 1 | | |
| Priority | 128 | | |
| Path Cost | 200000 | | |
| Path Cost Mode | Long | | |
| Path Cost Offset | 0 | | |

4.8 SNMP Configuration

The SNMP configuration window provides the configuration of SNMP communities, host and trap addresses. SAF NMS system will work only when SNMP is properly configured.

Explanation of customization fields:

4.8.1 SNMP community configuration

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| SNMP community configuration | |
|-----------------------------------|---|
| Read (Max length: 31 characters) | 1 saf-public |
| Write (Max length: 31 characters) | 2 saf-private |
| SNMP trap address | 3 255.255.255.255 |
| | 4 Rollback on <input type="checkbox"/> Execute configuration |

1. *Read* - Specifies the SNMP community name of the agent to enable parameters to be read (not configured). The default read community name is *saf-public* (command line – **snmp community read** <communityname>);
2. *Write* – Specifies the community name of the agent to enable parameters to be written (configured). The default community name for writing parameters is *saf-private* (command line – **snmp community write** <communityname>);
3. *SNMP trap address* – Sets the IP address of the management terminal with the installed Trap Manager software, based on SNMP platform. The FODU Wi700 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>);
4. Pressing “Execute configuration” applies changes made to the corresponding section only for the local side FODU Wi700. If “Rollback on” is selected, configuration will be reverted in case of erroneous configuration changes applied.

4.8.2 SNMP Allowed Hosts Configuration

| SNMP allowed hosts configuration | |
|----------------------------------|---|
| SNMP host list | 1 192.168.205.5 |
| | Rollback on <input type="checkbox"/> Add Delete |
| | 2 Write to config file |
| FODU returned: | 3 Ok |

1. *SNMP host list* – shows the list of available SNMP hosts; adds or deletes the host IP address to the FODU SNMP host table. If the SNMP host connected to the FODU is not added to the FODU SNMP host table, the FODU 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>);
2. Writes to configuration file all the changes made on the whole page (command line – **cfg write**);
3. *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”.

5 Performance and Alarm Management

5.1 Alarm Management

5.1.1 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.

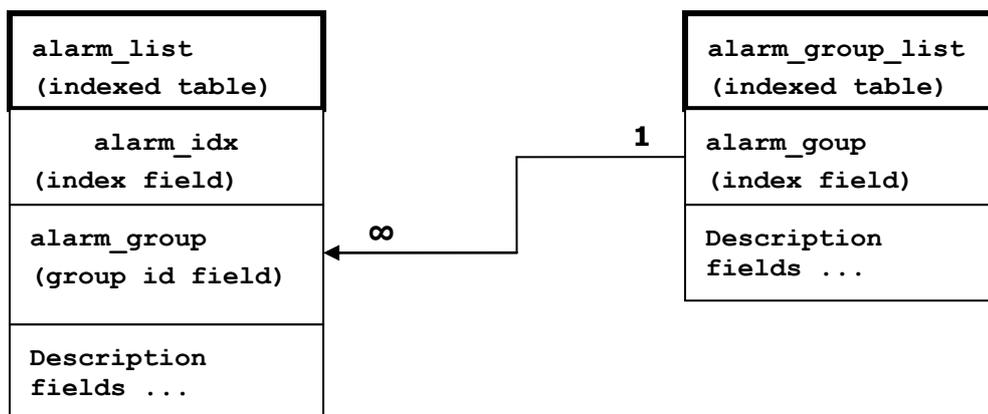


Figure 5.1. Alarm and group table relation

5.1.2 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 | No data from temperature sensor |

| | | | |
|----|----|---------------------------------------|---|
| | | temperature sensor | connected via I2C interface |
| 12 | 12 | System temperature fault | Temperature is out of defined range |
| 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] |
| 42 | 35 | PM log flash write error | Error while writing pm log to flash |
| 43 | 36 | Event of command execution starting | Message about command execution from particular interface |
| 44 | 37 | Event of string message | Informative message |
| 46 | 39 | Ethernet interface | No connection to Ethernet LAN port |

5.1.3 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 5.2.5**.

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

Figure 5.2. Alarm status window

5.1.4 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 5.3.**) 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 log

```

1736: 2011-11-28 22:04:15 - 043 - Command from interface - WEB> system reset
1737: 2011-11-28 22:04:15 - 010 - System CPU restart ==> - Set
1738: 2011-11-28 22:04:49 - 001 - ==> System Start - Set
1739: 2011-11-28 22:04:49 - 035 - ACM profile was changed - [256QAM]
1740: 2011-11-28 22:11:21 - 043 - Command from interface - WEB> modem set 56000 256QAM 256QAM WeakFEC 0
1741: 2011-11-28 22:11:31 - 043 - Command from interface - WEB> modem set 30000 QPSK QPSK StrongFEC 0
1742: 2011-11-28 22:11:34 - 031 - Acquire status alarm - [ACQUIRE_IN_PROGRESS]-> Set
1743: 2011-11-28 22:11:34 - 032 - Last acquire error status - [ACQUIRE_ERR_FREQ_SWEEP]-> Set
1744: 2011-11-28 22:11:34 - 035 - ACM profile was changed - [QPSK]
1745: 2011-11-28 22:11:47 - 043 - Command from interface - WEB> modem set 30000 qpsk 256QAM WeakFEC 0
1746: 2011-11-28 22:11:50 - 035 - ACM profile was changed - [QPSK]
1747: 2011-11-28 22:11:59 - 043 - Command from interface - WEB> modem set 30000 qpsk 256QAM StrongFEC 0
1748: 2011-11-28 22:12:02 - 035 - ACM profile was changed - [QPSK]
1749: 2011-11-28 22:12:11 - 043 - Command from interface - WEB> modem set 30000 256QAM 256QAM StrongFEC 0
1750: 2011-11-28 22:12:14 - 035 - ACM profile was changed - [256QAM]
1751: 2011-11-28 22:12:20 - 043 - Command from interface - WEB> modem set 30000 256QAM 256QAM WeakFEC 0
1752: 2011-11-28 22:12:22 - 035 - ACM profile was changed - [256QAM]
1753: 2011-11-28 22:12:34 - 043 - Command from interface - WEB> modem set 56000 qpsk 256QAM WeakFEC 0
1754: 2011-11-28 22:12:36 - 031 - Acquire status alarm - [ACQUIRE_LOCKED]-> Reset
1755: 2011-11-28 22:12:36 - 032 - Last acquire error status - [ACQUIRE_SUCCESS]-> Reset
1756: 2011-11-28 22:12:36 - 035 - ACM profile was changed - [QPSK]
End

```

Filter:

> Alarm-event log file <

Figure 5.3. Alarm log window

5.1.5 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"/> |
| | | | <input type="button" value="Execute configuration"/> |
| | | | <input type="button" value="Write to config file"/> |
| FODU returned: | Ok | | |

Figure 5.4. 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 | | | | | | |
|-------------------------------|-----------------------------|-----------|------------|-------------|--|--------------------|
| Alarm ID | Alarm name | Low value | High value | Delta value | Alarm value | |
| 4 | License will soon expire | 1296000 s | | | | Value = 80352000 s |
| 12 | System temperature fault | -33.0 C | 85.0 C | 1.0 C | | Value = 33.5 C |
| 14 | Main supply voltage failure | 36.00 V | 57.00 V | 1.00 V | | Value = 46.70 V |
| 15 | Main supply current failure | 0.000 A | 0.840 A | 0.010 A | | Value = 0.542 A |
| 16 | Main supply power failure | 0.00 W | 30.00 W | 0.50 W | | Value = 25.33 W |
| 18 | 1,2V failure | 1.15 V | 1.32 V | 0.03 V | | Value = 1.22 V |
| 19 | 1,5V failure | 1.43 V | 1.57 V | 0.03 V | | Value = 1.49 V |
| 20 | 3,3V failure | 3.15 V | 3.60 V | 0.03 V | | Value = 3.39 V |
| 21 | 5,0V failure | 4.50 V | 5.50 V | 0.03 V | | Value = 5.02 V |
| 22 | Permanent 7,5V failure | 6.75 V | 8.25 V | 0.05 V | | Value = 7.61 V |
| 23 | Switchable 7,5V failure | 6.75 V | 8.25 V | 0.05 V | | Value = 7.58 V |
| 24 | 12,0V failure | 10.80 V | 13.20 V | 0.05 V | | Value = 11.90 V |
| 25 | -5,0V failure | -5.50 V | -4.50 V | 0.03 V | | Value = -5.00 V |
| 27 | Rx level alarm | -71 dBm | -30 dBm | 1 dBm | Def: <input checked="" type="checkbox"/> | Value = -57 dBm |
| 33 | Radial MSE | | -21.9 dB | 1.0 dB | Def: <input checked="" type="checkbox"/> | Value = -31.4 dB |
| 34 | LDPC decoder stress | | 5.0e-03 | | Def: <input checked="" type="checkbox"/> | Value = 0.0e+00 |
| 36 | RX carrier offset | -700 kHz | 700 kHz | 10 kHz | | Value = -11 kHz |
| 38 | Modem temperature fault | -33.0 C | 95.0 C | 1.0 C | | Value = 49.0 C |

Execute configuration

Write to config file

System returned: Ok

Figure 5.5. Alarm threshold configuration window

5.1.6 Alarm Management Commands

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

| Alarm management commands | |
|--------------------------------------|---|
| 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. |

Alarm management commands

| Command | Description |
|---|---|
| Alarm cfg <group ID> [<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. |

5.2 Performance Management

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

5.2.1 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 5.6**).

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.

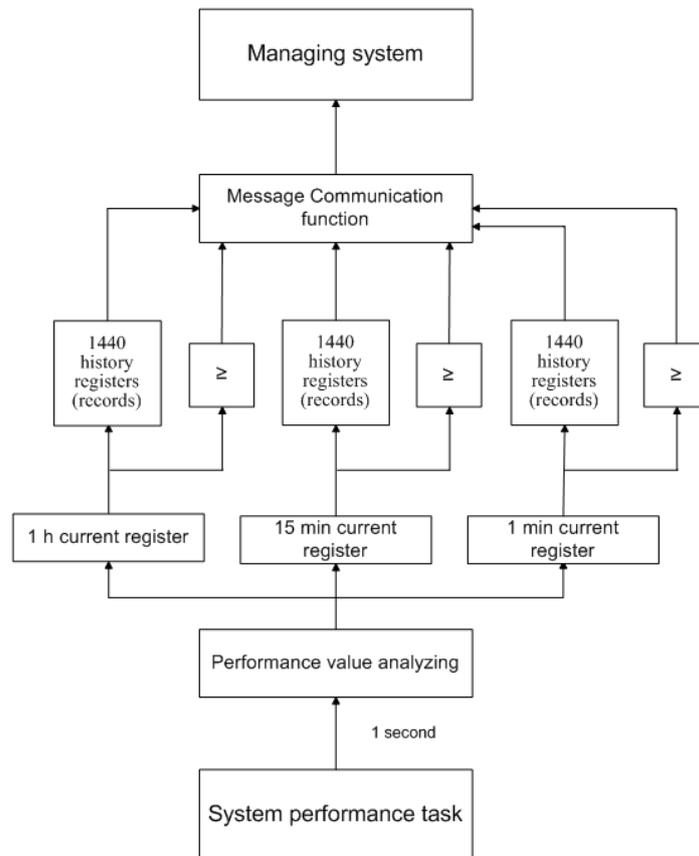


Figure 5.6. Functional architecture for data collection, history and thresholding treatment

5.2.2 Performance Values

5.2.3 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.

5.2.4 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.

5.2.5 Performance Management in Web GUI

The main performance management tool in the FODU Wi700 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 5.7**.

Performance log field selection

Select objects to display

- ALL
- Uptime
- Rx level
- Tx level
- System temperature
- Radial MSE
- LDPC decoder stress

Figure 5.7 Selecting performance log parameters

Performance log

| Nr | Date | Time | Radio | | | | | | System | | | | Modem | | | | | |
|------|----------|-------|----------|-----|----|----------|-----|----|--------|----------------|------|----|------------|-------|----|---------------------|---------|----|
| | | | Rx level | | | Tx level | | | Uptime | System temp, C | | | Radial MSE | | | LDPC decoder stress | | |
| | | | Min | Max | TS | Min | Max | TS | Val | Min | Max | TS | Min | Max | TS | Min | Max | TS |
| 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 | -29.6 | 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

Figure 5.8 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 5.2.1. and 5.2.2. for further details on threshold seconds.

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

Figure 5.9 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.

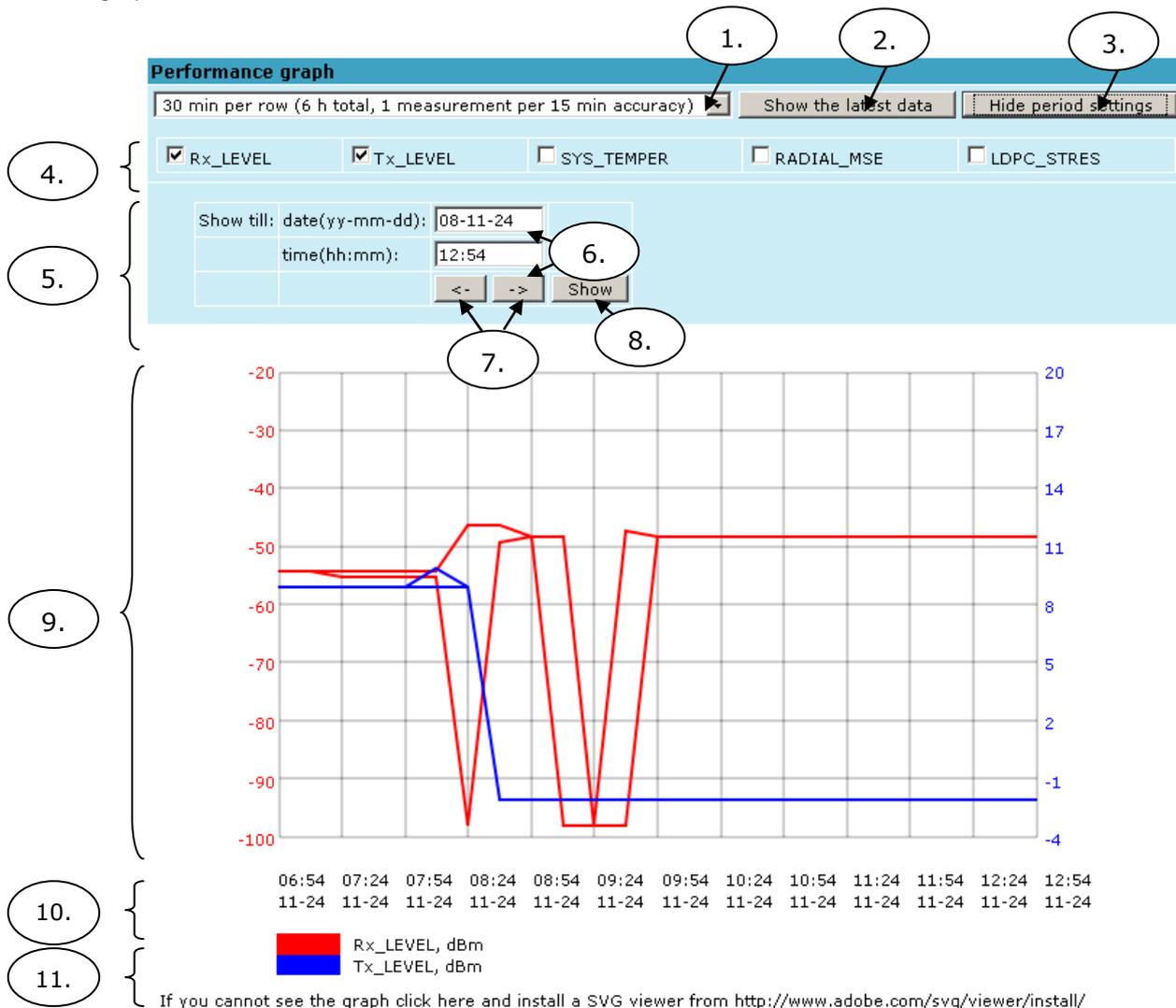


Figure 5.10 Performance graph showing system temperature and Rx level in period of last 6 hours

1. 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)
2. Updates the performance graph; the newest data is shown
3. Shows / hides period settings (point 5)
4. Performance data selector. Two and only two performance parameters can be selected at a time
5. Period settings. Allows the user to specify time period for the graph
6. Date and time fields. The date format is “yy-mm-dd”, the time format is “hh:mm”
7. Sets date and time fields (point 6) one screen back / forth
8. Shows / updates the performance graph using the period settings (point 5)
9. 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
10. 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
11. 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).

5.2.6 Constellation Diagram

A constellation diagram is a representation of a signal modulated by the digital modulation schemes 256QAM, 128QAM, 64QAM, 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:

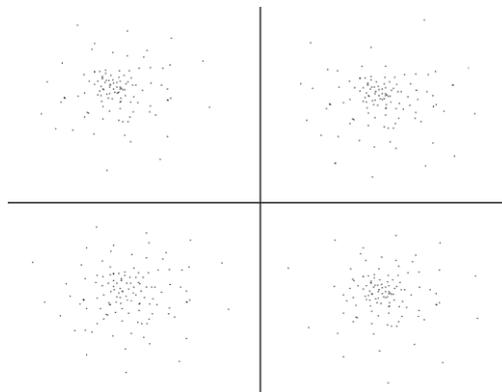


Figure 5.11. Gaussian noise (QPSK)

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

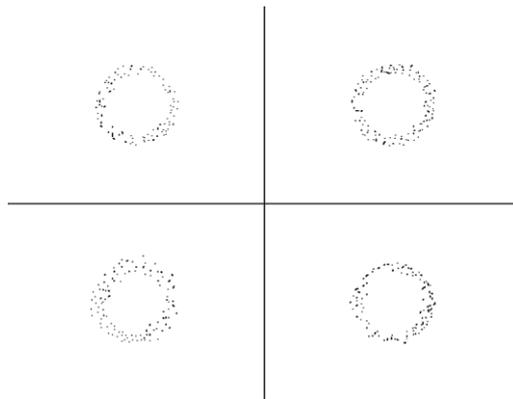


Figure 5.12. Non-coherent single frequency interference (QPSK)

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

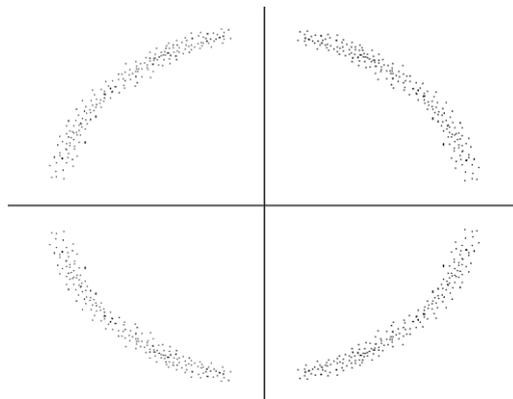


Figure 5.13. Phase noise (QPSK)

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

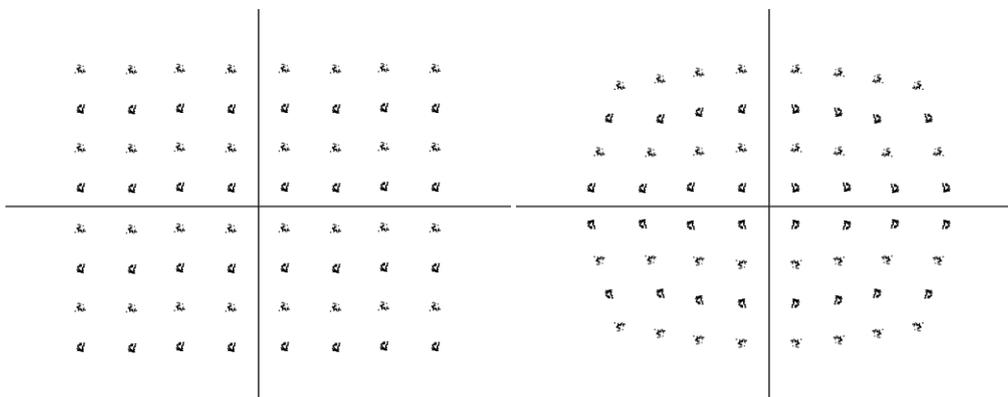


Figure 5.14. Amplitude compression (64QAM)

Examples of FODU constellation diagrams under excellent conditions are shown below:

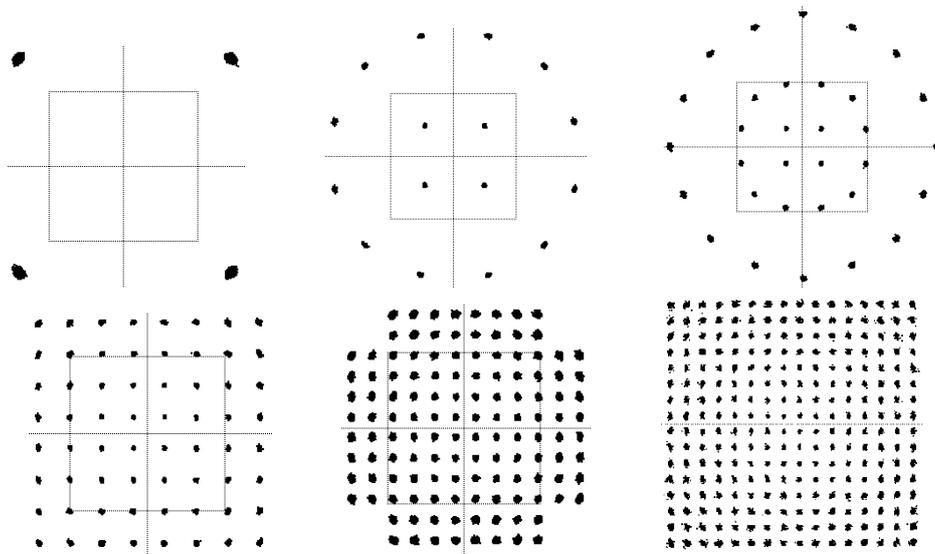
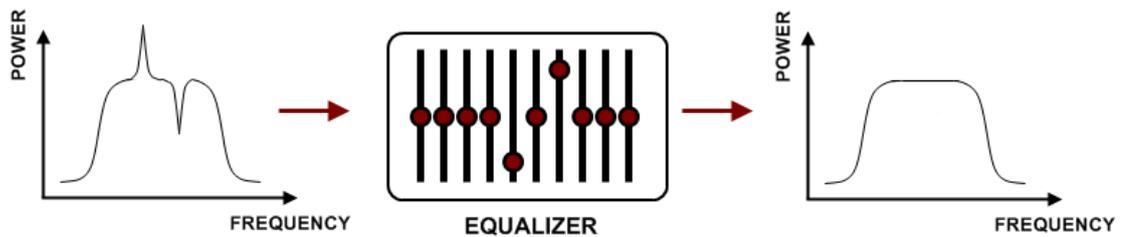


Figure 5.15. Constellation diagram – QPSK, 16APSK, 32APSK, 64QAM, 128QAM, 256QAM

5.2.7 Adaptive Equalizer

FODU Wi700 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.

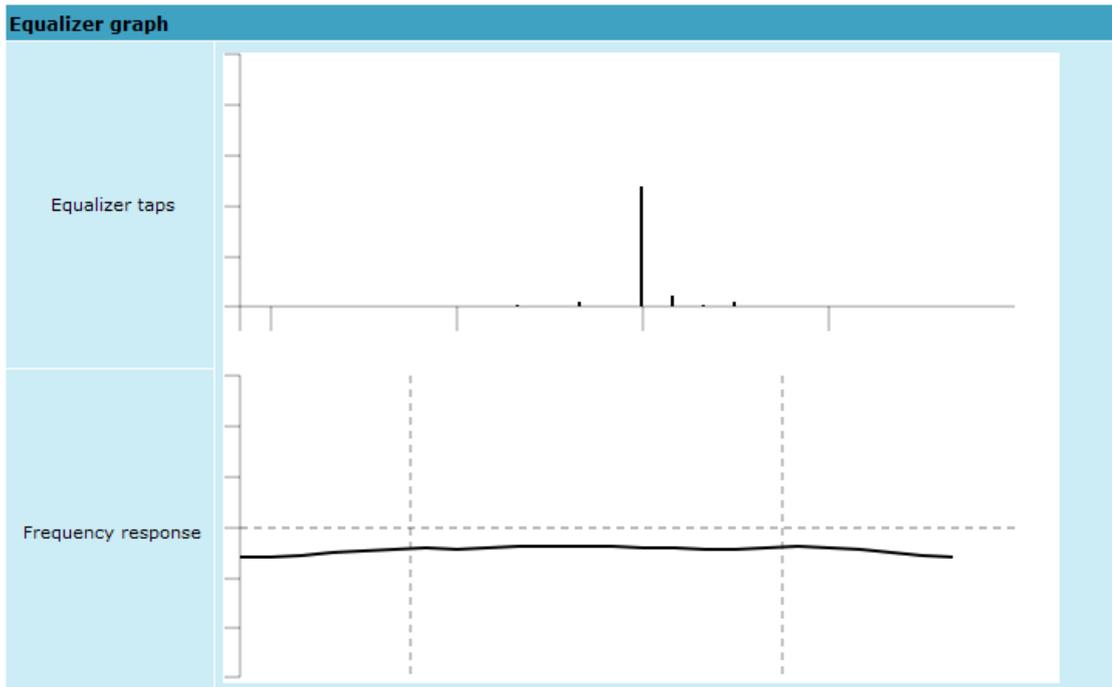
In current FODU device an adaptive equalizer is realized as complex-arithmetic 24-taps digital FIR (Finite Impulse Response) filter. In other words, equalizer is a selective frequency amplifier and attenuator, a device, which application to IF (Intermediate Frequency) band-limited signal is schematically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



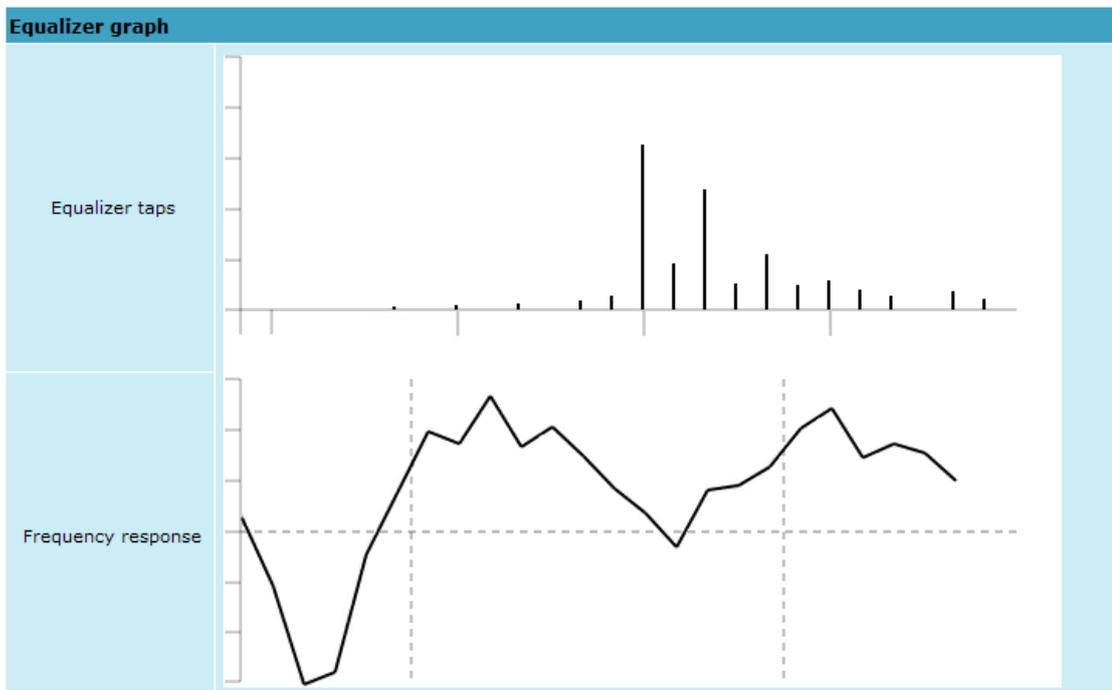
Equalizer graph

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.



5.2.8 Performance Management Commands

It is also possible to view performance log in command prompt.

The list of available commands is the following:

| Additional performance management 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. |

5.3 Ethernet modem statistics

Ethernet statistics window shows the full Ethernet and framing statistics of FODU modem since unit start or statistics reset. All statistics are also accessible using command prompt command **ethernet statistics**.

Explanation of fields:

| Ethernet statistics | | | |
|-------------------------------|----------------------|---------------------|--|
| Statistics for 1 day 22:40:03 | | 1 | |
| Modem state | | Ok | 2 |
| | | | 3 <input type="button" value="Clear statistics"/> |
| Name | Rx | Name | Tx |
| Truncated frames | 4 0 | Vlan tags | 26 0 |
| Log events | 5 0 | Backpres. events | 27 0 |
| Vlan tags detected | 6 0 | Pause frames | 28 0 |
| Unsup. opcodes | 7 0 | Control frames | 29 0 |
| Pause frames | 8 0 | Wire byte counter | 30 3357985167 |
| Control frames | 9 0 | Underruns | 31 0 |
| Dribble nibbles | 10 0 | Giants | 32 0 |
| Broadcasts | 11 11036 | Late collisions | 33 0 |
| Multicasts | 12 11054 | Max collisions | 34 0 |
| Dones | 13 21245712 | Excessive defers | 35 0 |
| Out of range errors | 14 0 | Non-exc. defers | 36 0 |
| Length check errors | 15 0 | Broadcasts | 37 21383 |
| CRC errors | 16 0 | Multicasts | 38 21437 |
| Code errors | 17 0 | Dones | 39 21282030 |
| False carrier errors | 18 0 | Length check errors | 40 0 |
| Rx Dv event | 19 0 | CRC errors | 41 0 |
| Prev. pkt dropped | 20 0 | Collisions | 42 0 |
| Byte counter | 21 3364556166 | Byte counter | 43 3357985167 |
| Name | GFP | Name | QoS |
| FCS errors | 22 0 | Rx Q1 frames | 44 21245712 |
| CHEC errors | 23 10758 | Rx Q1 dropped | 45 0 |
| Dropped frames | 24 0 | Rx Q2 frames | 46 0 |
| Delineation errors | 25 10758 | Rx Q2 dropped | 47 0 |
| | | Tx frames | 48 21282031 |
| | | Tx dropped | 49 0 |

- Shows 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;

14. *Out of range errors* – frame Type/Length field larger than 1518 (Type Field) bytes;
15. *Length check errors* – frame length field in the packet does not match the actual data byte length and is not a Type Field;
16. *CRC errors* – frame CRC do not match the internally generated CRC;
17. *Code errors* – one or more nibbles are signalled as errors during reception of the packet;
18. *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;
19. *Rx Dv event* – indicates that the last receive event seen is too short to be a valid packet;
20. *Prev. pkt dropped* – indicates that since the last RSV, a packet is dropped (i.e. interframe gap too small);
21. *Byte counter* – total number of bytes received on the wire, not counting collided bytes;
22. *FCS errors* – number of generic framing procedure (GFP) frames with CRC errors received by the de-encapsulation block;
23. *CHEC errors* – number of generic framing procedure (GFP) frames with CHEC errors received by the de-encapsulation block;
24. *Dropped frames* – number of generic framing procedure (GFP) frames that were dropped in the de-encapsulation block;
25. *Delineation errors* – number of 'lost of synchronization' events;
26. *Vlan tags* – number of VLAN tagged packets, 32-bit counter;
27. *Backpres. events* – carrier-sense-method backpressure was previously applied;
28. *Pause frames* – frames transmitted are control frames with a valid PAUSE opcodes;
29. *Control frames* – frames transmitted are control frames;
30. *Wire byte counter* – total number of bytes transmitted on the wire, including all bytes from collided attempts;
31. *Underruns* – underruns occur during frame transmission;
32. *Giants* – frames having byte count greater than the MAXIMUM FRAME SIZE parameter (1516, 1536 or 1916 bytes);
33. *Late collisions* – Collisions occurred beyond the collision window (512 bit times);
34. *Max collisions* – packets aborted after number of collisions exceeded the RETRANSMISSION MAXIMUM parameter;
35. *Excessive defers* – packets deferred in excess of 6,071 nibble times in 100 Mbps mode, or 24,287 bit-times in 10 Mbps mode;
36. *Non-exc. defers* – packets deferred for at least one attempt, but less than an excessive defer;
37. *Broadcasts* – packets, which destination address contained broadcast address;
38. *Multicasts* – packets, which destination address contained multicast address;
39. *Dones* – transmission of packets successfully completed;
40. *Length check errors* – frame length field in the packet does not match the actual data byte length and is not a Type Field;
41. *CRC errors* – frame CRC do not match the internally generated CRC;
42. *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;

43. *Byte counter* – total count of bytes transmitted on the wire not including collided bytes;
44. *Rx Q1 frames* – number of frames received on Q1;
45. *Rx Q1 dropped* – number of frames dropped on Q1;
46. *Rx Q2 frames* – number of frames received on Q2;
47. *Rx Q2 dropped* – number of frames dropped on Q2;
48. *Tx frames* – number of frames passed through TX FIFO;
49. *Tx dropped* – number of frames dropped in TX FIFO.

6 Miscellaneous Controls in Web Graphic User Interface

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

6.1 Configuration File

This section allows working with FODU configuration script.

The management module has RAM and EEPROM chips onboard. When FODU 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 FODU 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.

(!) Note! The parameters that are not specified in the configuration script will have their default values when the FODU is restarted.

Explanation of customization fields:

The screenshot shows a web interface for managing the configuration file. It includes a text area for the script, a 'Delete' button, and several control buttons like 'Cfg write', 'Cfg run', 'Cfg backup', 'Cfg restore', 'Cfg add', and 'Cfg factory'. A link at the bottom says 'To save cfg file on your computer click here.' Red numbers 1 through 9 are placed on the screenshot to indicate specific features: 1 points to the script content, 2 to the delete button, 3 to 'Cfg write', 4 to 'Cfg run', 5 to 'Cfg backup', 6 to 'Cfg restore', 7 to 'Cfg add', 8 to 'Cfg factory', and 9 to the save link.

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

2. *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' button (command line – **cfg delete <line>**);
3. *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**);
4. *Execute current configuration* – executes commands present in configuration script (command line – **cfg run**);
5. *Input file name to backup cfg in FODU memory* – allows choosing file name under which current configuration script will be saved in the FODU flash memory (command line – **cfg backup <file>**);
6. *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';
7. *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>**);
8. *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**);
9. *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 | |
|--|--|
| 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. |

6.2 License Management

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

FODU without licensing option will operate with full functionality, but FODU with licensing option but without activated licenses will operate with minimum functionality (14MHz channel bandwidth, QPSK modulation, no ACM). Functionality may be expanded using appropriate license key.

Explanation of fields:

| License management | |
|--|--|
| Active license status | |
| <input type="button" value="Show active license"/> | |
| License status | 1 Ok |
| Left time | 2 Unlimited |
| Key | 3 IA55F-3NNEF-Y2TQ2-TPMOB |
| Time | 4 Unlimited |
| | |
| Bandwidth | Maximal modulation |
| 20000 KHz | 256QAM |
| 28000 KHz | 256QAM |
| 30000 KHz | 256QAM |
| 40000 KHz | 256QAM |
| 50000 KHz | 256QAM |
| 56000 KHz | 256QAM |
| ACM | 11 Enabled |
| License management | |
| Available licenses | 12 IA55F-3NNEF-Y2TQ2-TPMOB/Active / Unlimited time <input type="button" value="^"/> <input type="button" value="v"/> |
| License key | 13 <input type="text"/> <input type="button" value="Add"/> |
| System returned: | 14 Ok |

1. *License status* – shows if management CPU was able to read license data;
2. *Left time* – shows the amount of time left for the active license;
3. *Key* – displays currently active license;
4. *Time* – shows the overall time for the active license;
5. *20000 KHz* – shows the maximum modulation that can be used together with 20 MHz channel bandwidth;
6. *28000 KHz* – shows the maximum modulation that can be used together with 28 MHz channel bandwidth;
7. *30000 KHz* – shows the maximum modulation that can be used together with 30 MHz channel bandwidth;
8. *40000 KHz* – shows the maximum modulation that can be used together with 40 MHz channel bandwidth;
9. *50000 KHz* – shows the maximum modulation that can be used together with 50 MHz channel bandwidth;
10. *56000 KHz* – shows the maximum modulation that can be used together with 56 MHz channel bandwidth;
11. *ACM* – shows if adaptive coding and modulation (ACM) is allowed for the active license;
12. *Available licenses* – shows the list of entered licenses. To activate any license, select it. “Add” button will transform into “Activate”, which should be pressed;
13. *License key* – allows entering a license key. Entering a license key twice, activates it;

14. *System 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”.

6.3 Command Line

In the command line you are able to execute all the commands to manage the FODU Wi700 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.

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Command management

Valid commands:

```
status radio atpc modem loopback ethernet system diagnostics cfg tfs net
license alarm log pm web snmp access cls ver help
```

Enter Command

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

6.4 File System

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

Firmware and boot configuration files

The following files are required for the FODU 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 **Chapter 7**.

- Firmware file, - this file is the main firmware executable for the appropriate FODU model. The file name can be freely changed, but its default name will contain the version and FODU model, e.g., ‘FODUI000.elf.ezip’. 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 **Chapter 7**; configuration backup files are created by FODU 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 FODU 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 **Chapter 7** 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 FODU is restarted. To save it in EEPROM use '*write*' command.

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

Working with files

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

| | |
|-----------------|---|
| 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,</p> <p style="padding-left: 40px;"><i>edit boot.ini,Be</i></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> |
|--------------------|--|

6.5 Security Commands

General tips

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.

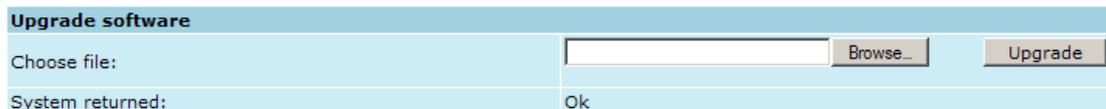
(!) “Guest” account is unable to change its access password.

(!) 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 FODU.

7 Updating Software

To simplify the software update process, SAF Tehnika 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 SAF Tehnika 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 (e.g. FODUI000.elf.ezip) 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 FODU management software by uploading the appropriate firmware file to the FODU Wi700 flash disk and further editing boot configuration file if necessary. The file upload can be performed:

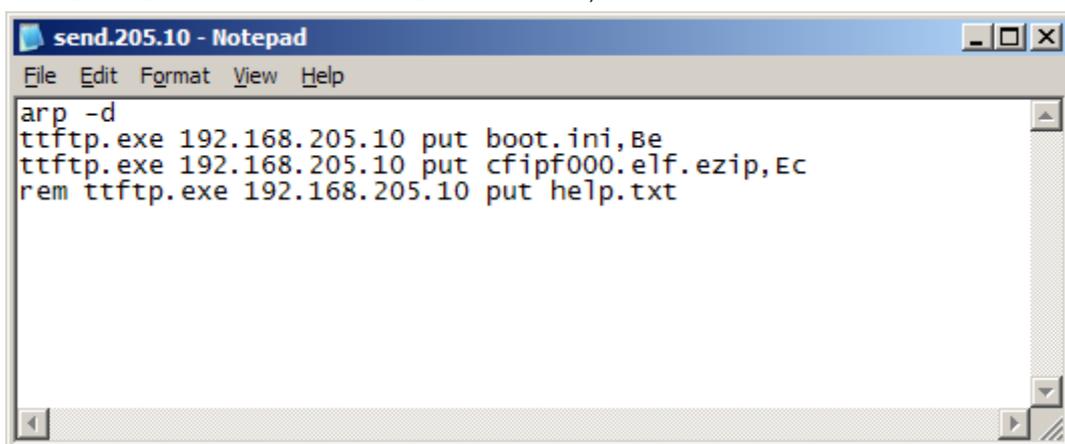
- via Ethernet management port using update package,
- via Ethernet management port using FTP,
- via Ethernet management port using TFTP, or
- via RS232 serial port using Xmodem protocol.

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

7.1 Update Software with Update Pack

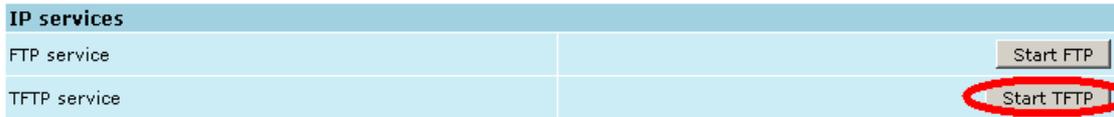
To update FODU software by using the update pack, proceed as follows:

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

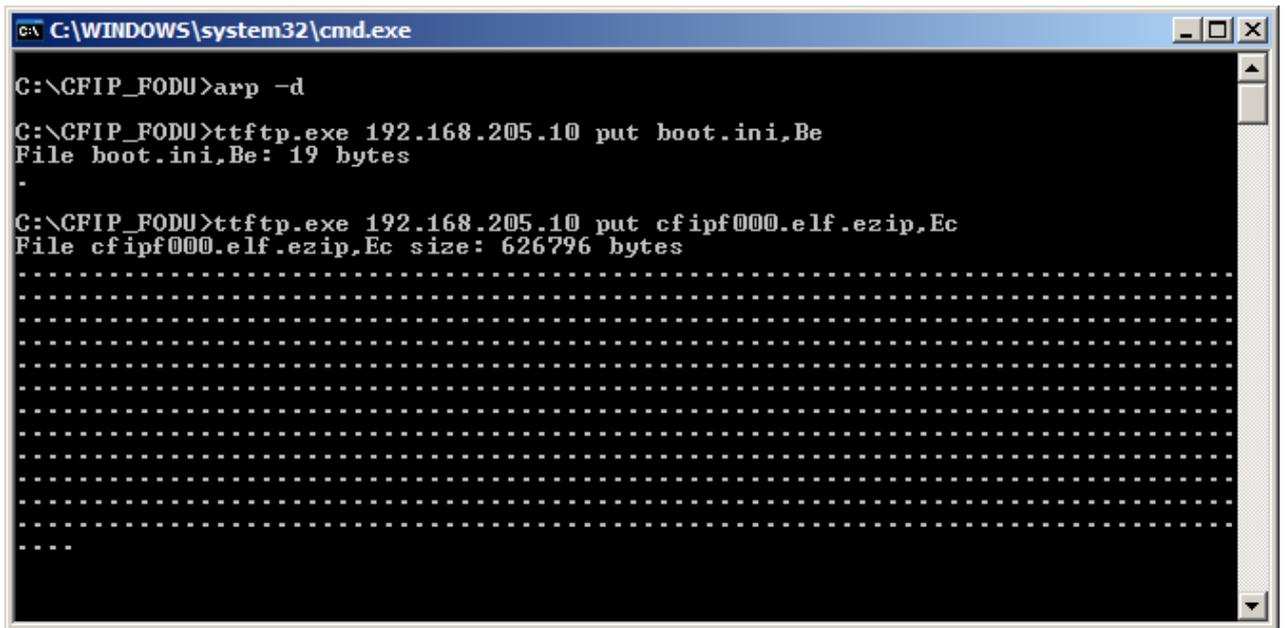


- **arp -d ip_addr [if_addr]** deletes the host specified by ip_addr. If another host with a duplicate IP address exists on the network, the ARP cache may have had the MAC address for the other computer placed in it. **arp -d** is used to delete an entry that may be incorrect. By default no host is specified.
- **rem tftp.exe 192.168.205.10 put help.txt** prefix ignores command execution
- **tftp.exe 192.168.205.10 put FODUI000.elf.ezip,Ec** uploads firmware file named ‘FODUI000.elf.ezip’ with attribute flags ‘E’ and ‘c’ to host FODU with IP address 192.168.205.10.

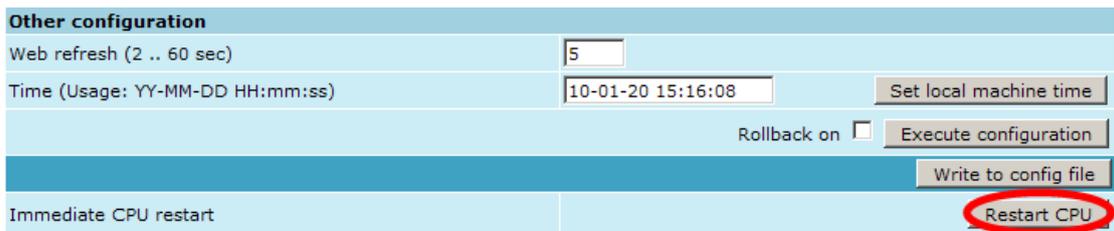
- Start TFTP on both link sides in 'Configuration → IP configuration':



- run 'send.205.xx.cmd' to perform update, where „xx” represents last number of actual FODU 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 FODU Flash disk. Update process screen is shown below:



- To activate new firmware, firstly restart the management CPU of the remote link side FODU Wi700 and then the local side FODU Wi700 (traffic flow won't be interrupted) in 'Configuration → System configuration':



7.2 Uploading File via Ethernet Management Port (TFTP)

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

1. Connect the FODU to network or directly to PC;
2. Make sure TFTP is running on FODU (by default, the TFTP is switched off); to run the TFTP on FODU, connect to FODU with Telnet client and enter the following command: 'start tftp';
3. Run the program that enables to use TFTP service, for example command interpreter (cmd.exe) if using Windows, see **Figure 7.1**;
4. For example, to upload the firmware file 'FODU000.elf.ezip' with attribute flags 'E' and 'c', enter command:

tftp -i 192.168.205.11 put C:\files\FODUI000.elf.ezip FODUI001.elf.ezip,Ec

where:

- '-i' – key which specifies that file must be transferred in binary image transfer mode;
- '192.168.205.11' – FODU Ethernet management port IP address (host);
- 'C:\files\FODUI000.elf.ezip' – firmware file (source);
- 'FODUI001.elf.ezip' –file name in the FODU 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;

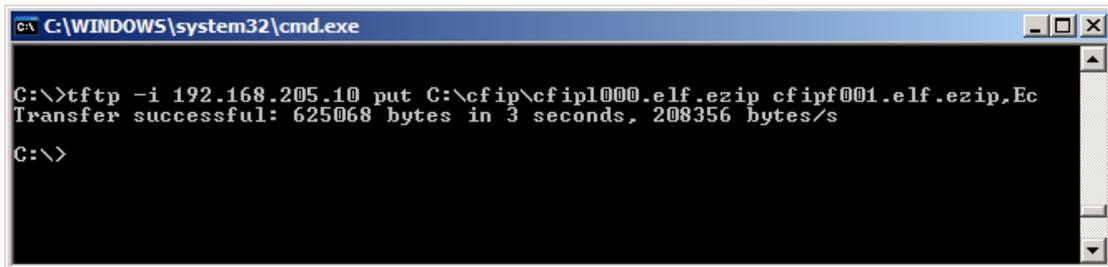


Figure 7.1.

5. If uploaded file is large (like firmware file), it is recommended to defragment Flash disk. Use `'fs clean'` command from Telnet or ASCII terminal to perform defragmentation.
6. If the uploaded file is the firmware file which should be used by FODU, 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* in **Chapter 6.4**.

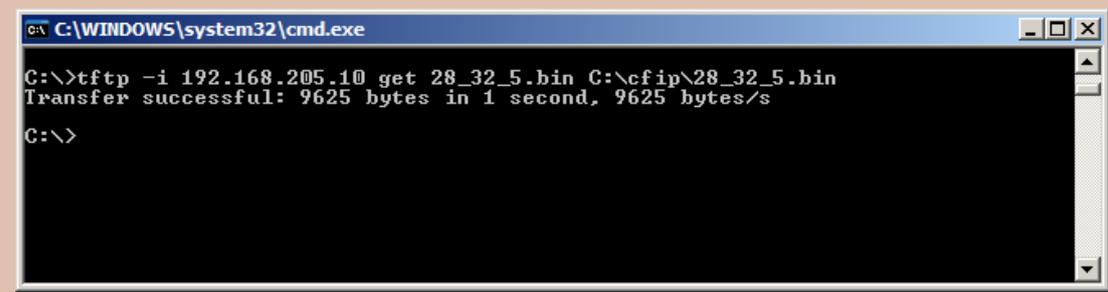
(!) To copy file from FODU Flash disk to PC hard disk via TFTP, use the following command:

tftp -i 192.168.205.11 get filename destination_filename

where

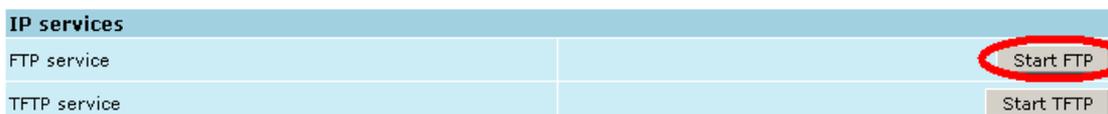
'192.168.205.11' – FODU port IP address (host);

'filename' – file to be copied from FODU to PC; 'destination_filename' – destination path where the file will be saved on PC hard disk.



7.3 Uploading File via Ethernet Management Port (FTP)

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



1. Open command window.
2. Start FTP client by entering “**ftp**” command (“*ftp>*” prompt will appear).
3. Connect to FODU FTP server using command “**open** <FODU_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 FODU 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 FODU flash disk.

Use command “**delete** <filename>” to delete the file from the FODU Flash disk.

6. Proceed with steps 5. and 6. in **Chapter 7.1**.

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

7.4 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 FODU management system is not available, or does not start normally.

1. Connect the ASCII console to the FODU 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 **Chapter 2.3.1** for information how to make a connection.
2. Type ‘restartcpu’ and, while FODU is booting, press any key when ‘boot.ini?’ prompt appears. This will stop executing script in ‘boot.ini’ file and the FODU 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 FODU name (default ‘SAF>’).

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

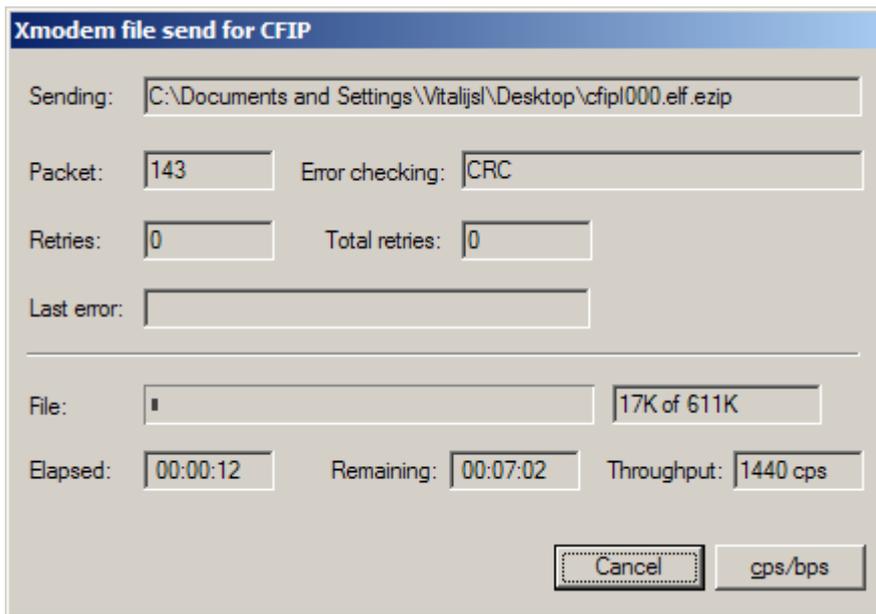
‘**Ec**’ – file flags, in case the file is firmware file - ‘E’ and ‘c’ flags must be used; if the file is boot configuration file (boot.ini), the flags must be ‘**Be**’ (‘B’ and ‘e’); the flags for configuration backup files may not be specified, in that case the command will be

```
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 FODU 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 (**Figure 7.2.**):

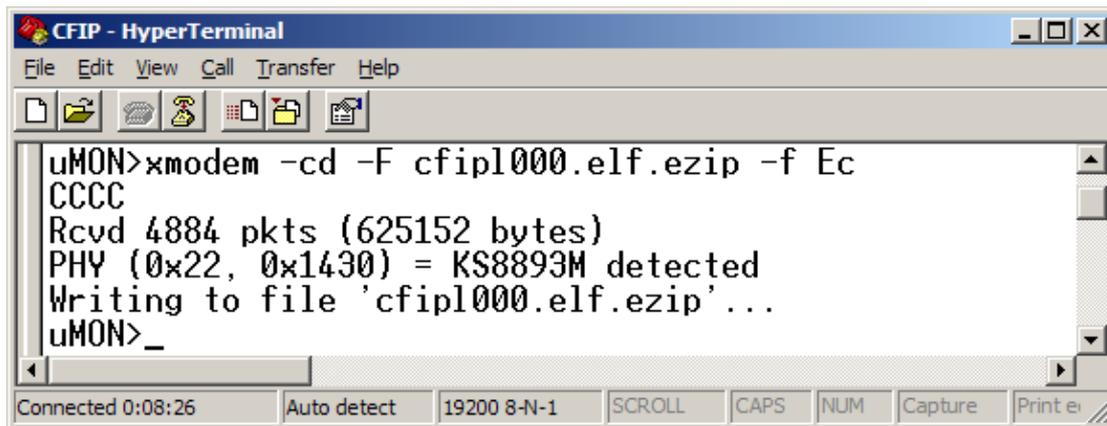


Figure 7.2.

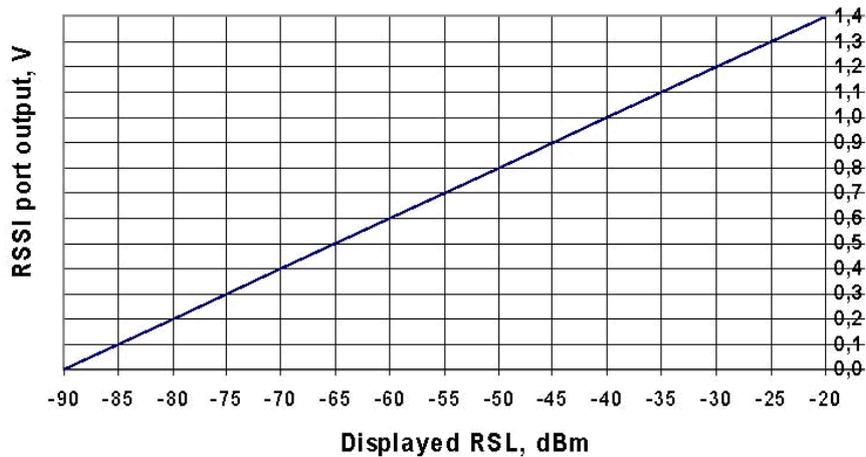
5. Enter '*reset*' command to exit from MicroMonitor mode and restart the FODU.
6. Proceed with steps 5. and 6. in **Chapter 7.1.**

8 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 FODU 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 |

9 Pinouts

9.1 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.

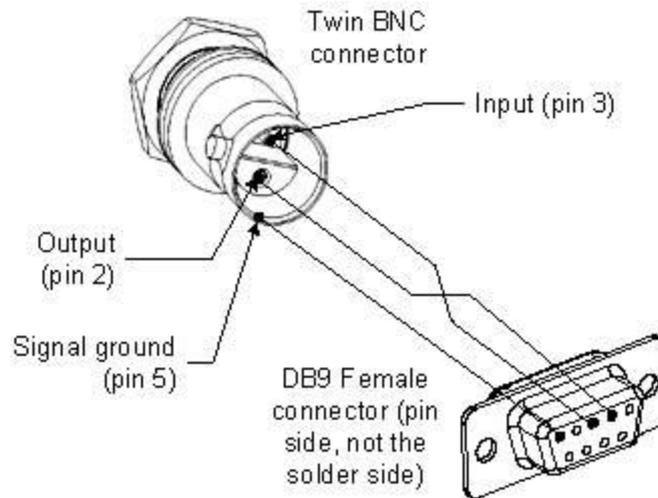
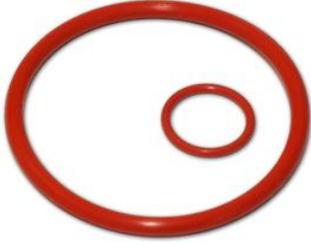
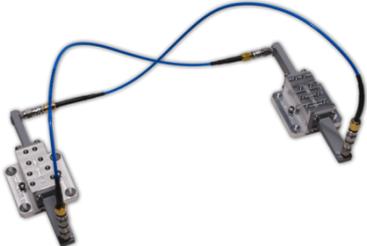
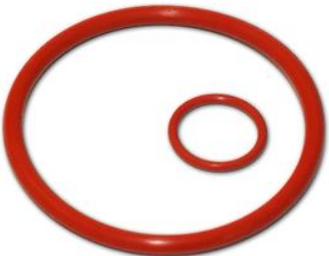
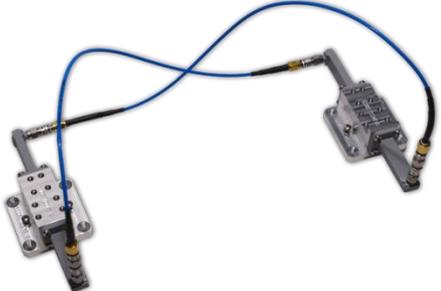


Figure 9.1. RS-232 port pinouts, pin numbers refer to DB9 female connector

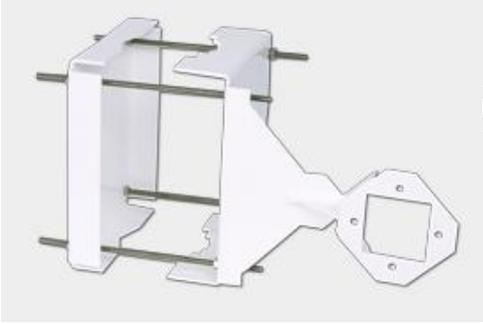
Figure 9.2. RJ-45 socket pin numbering

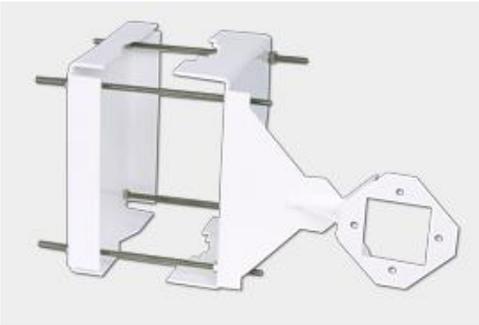
10 Available Accessories

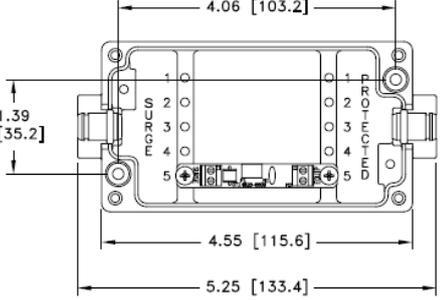
| | |
|---|---|
|  |  |
| <p>FODU RJ-45 connector 8P shield solid P/N FOACNR02</p> | <p>13/15GHz Flexible Waveguide 60cm UBR-PBR P/N C15WF201</p> |
|  |  |
| <p>18/23GHz Flexible Waveguide 2ft/6 P/N C22WF201</p> | <p>O-ring - rubber gasket to be fitted between 0.25m antenna and FODU CLAOR001</p> |
|  |  |
| <p>Test equipment (See the list of available test equipment below)</p> | <p>Test kit for 24GHz C24TST02</p> |
|  |  |
| <p>Coaxial attenuator 40 dB P/N CLA40A01</p> | <p>SAF adapted OMT for Comhat 0.3/0.6/1.2m antenna for dual-polarization C07OMT01</p> |

| | |
|---|--|
|  |  |
| <p>FODU RJ-45 connector 8P shield solid P/N FOACNR02</p> | <p>13/15GHz Flexible Waveguide 60cm UBR-PBR P/N C15WF201</p> |
|  |  |
| <p>18/23GHz Flexible Waveguide 2ft/6 P/N C22WF201</p> | <p>O-ring - rubber gasket to be fitted between 0.25m antenna and FODU CLAOR001</p> |
|  |  |
| <p>Test equipment (See the list of available test equipment below)</p> | <p>Test kit for 24GHz C24TST02</p> |
|  |  |

| | |
|--|--|
| <p>Coaxial attenuator 40 dB P/N CLA40A01</p> | <p>SAF adapted OMT for Comhat 0.3/0.6/1.2m antenna for dual- polarization C07OMT01</p> |
|--|--|

| | |
|---|--|
|  |  |
| <p>RSSI cable for ODU align 1m BNC – 2 plug-in P/N CLGCRS01</p> | <p>FODU FODU Mounting Bracket (for 1xFODU P/N: CLGRFB05; for 2xFODU P/N: CLGRFB06)</p> |

| | |
|---|---|
|  |  |
| <p>RSSI cable for ODU align 1m BNC – 2 plug-in P/N CLGCRS01</p> | <p>FODU FODU Mounting Bracket (for 1xFODU P/N: CLGRFB05; for 2xFODU P/N: CLGRFB06)</p> |
|  |  |
| <p>ODU twin BNC RG108A connector for RS-232 console port for FODUs P/N FOACNT01</p> | <p>SFP 850nm MM Transceiver 1000Base-SX 3.3V P/N: I0AMOM01 SFP 1310nm SM Transceiver 1000Base-LX 3.3V P/N: I0AOM001</p> |

| | | | | | | | |
|---|--|---------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
|  |  | | | | | | |
| <p>AC/DC Power supply 40-50V/1,5-1,2A P/N: I0AB4806 (ETSI); I0AB4805 (FCC)</p> | <p>Hermetic connector for power cable P/N: I0ACNP01</p> | | | | | | |
|  |  | | | | | | |
| <p>Surge protection for FODU-GE 48VDC cable, 2A P/N I0ASP201</p> | <p>FODU Wi700 LC-ODC cable</p> <table border="1" data-bbox="858 1025 1356 1137"> <tr> <td>3m SM P/N: I0ACO001</td> <td>3m MM P/N: I0ACM001</td> </tr> <tr> <td>10m SM P/N: I0ACO002</td> <td>10m MM P/N: I0ACM002</td> </tr> <tr> <td>50m SM P/N: I0ACO003</td> <td>50m MM P/N: I0ACM003</td> </tr> </table> | 3m SM P/N: I0ACO001 | 3m MM P/N: I0ACM001 | 10m SM P/N: I0ACO002 | 10m MM P/N: I0ACM002 | 50m SM P/N: I0ACO003 | 50m MM P/N: I0ACM003 |
| 3m SM P/N: I0ACO001 | 3m MM P/N: I0ACM001 | | | | | | |
| 10m SM P/N: I0ACO002 | 10m MM P/N: I0ACM002 | | | | | | |
| 50m SM P/N: I0ACO003 | 50m MM P/N: I0ACM003 | | | | | | |
|  |  | | | | | | |
| <p>FODU cable TWIN BNC - DB9 (2m). P/N FOACTW01</p> | <p>FODU-GE RJ-45 cable connector case P/N I0ACNR01</p> | | | | | | |

10.1 Other Available Accessories

- Power cable 2x0,75mm, CU, outdoor (P/N I0ACGE01)

FODU Test Equipment

| | | |
|--------------------------|---------------|--|
| Test equipment 10/11 GHz | P/N: C11TST02 | Test equipment 10/11 GHz |
| Test equipment 13/15 GHz | P/N: C15TST02 | 13/15GHz test suite, contains two waveguide-to-coaxial adapters, two attenuators, 40 dB, coaxial cable, 40 cm long |
| Test equipment 18/23GHz | P/N: C22TST02 | 18/23GHz test suite, contains two waveguide-to-coaxial adapters, two attenuators, 40 dB, coaxial cable, 40 cm long |

| | | |
|------------------------|---------------|--|
| Test equipment 26GHz | P/N: C26TST02 | 26 GHz test suite, contains flexible waveguide, waveguide attenuators (60dB) |
| Test equipment 38GHz | P/N: C38TST02 | 38 GHz test suite, contains flexible waveguide, waveguide attenuators (60dB) |
| Test equipment 7/8 GHz | P/N: C08TST02 | 7/8GHz test suite, contains two waveguide-to-coaxial adapters, two attenuators, 40 dB, coaxial cable, 40 cm long |
| Test kit 24 GHz | P/N: C24TST02 | Test kit 24 GHz |

11 List of Abbreviations

- 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
- FO** – Fiber Optics
- 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
- 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
STP – Spanning Tree Protocol
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

12 Product specifications for coaxial CFIP ODU

12.1 Wi700 CFIP ODU Technical Specification



Wi700 CFIP ODU Ports
- N-type (data + power)
- BNC (RSSI)

| Radio & Modem | | |
|-------------------------|---|--|
| Product name | CFIP Wi 700 Split Mount | CFIP Wi 700 M Split Mount |
| Frequency Bands | 6, 7, 8, 10, 11, 13, 15, 18, 23, 26, 38 GHz | |
| Capacity | IDU: up to 363 Mbps ODU Unified Band: up to 363 Mbps | IDU: up to 348 Mbps, up to 63E1, up to 2xSTM-1 per every 1+0 link ODU Unified Band: up to 348 Mbps |
| Channel bandwidth | IDU: 3.5/7/14/28/40/56 MHz ODU Unified Band: 3.5/7/14/28/40/56 MHz | IDU: 7/14/28/40/56 MHz ODU Unified Band: 7/14/28/40/56 MHz |
| Modulation | 4QAM, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM | |
| Protection Switching | 1+0, 1+1 (HSB, SD, FD), Ring/Mesh (with RSTP/MSTP), 2+0, 3+0, 4+0 (Ethernet Aggregation) | 1+0, 1+1 (HSB, SD, FD), Ring/Mesh (with RSTP/MSTP), E1 ring protection, STM-1 Add/Drop, 2+0, 3+0, 4+0 (Ethernet Aggregation) |
| Aggregation | 2+0, 3+0, 4+0 (Ethernet Aggregation) | 2+0, 3+0, 4+0 (Ethernet Aggregation), 2+0 aggregation between single MAC, 2+2 protected aggregation |
| ACM switching | Hitless | |
| Management | | |
| Management ports | RJ-45, DB-9 | 2xRJ-45, DB-15 |
| Management | In-band | |
| SNMP | SNMP traps, MIB, SNMP v1/v2c | SNMP traps, MIB, SNMP v1/v2/v3 |
| EMS | Web based HTTP, Telnet, FTP, Terminal | |
| Performance graphs | Uptime, Rx level, Tx level, System temperature, Radial MSE, LDPC decoder stress, constellation diagram, equalizer graph | Rx level, Tx level, System temperature, Signal/Noise (SNR) level, System performance, constellation diagram, equalizer graph |
| Ethernet performance | Per port Ethernet counters, Enhanced radio Ethernet statistics | Ethernet switch statistics |
| Loopbacks | E1, modem, IF | Modem, radio, E1 (local, remote) |
| Ethernet | | |
| Switch Type | Managed Gigabit Ethernet Layer 2 | |
| Max frame size | 9728 bytes | |
| MAC table | 4K entries; automatic learning and aging | |
| Flow Control | 802.3x | |
| QinQ (Double Tagging) | Yes | |
| QoS | 64 level DiffServ (DSCP) or 8 level 802.1p mapped in 4 prioritization queues with VLAN support | 64 level Diffserv (DSCP) or 802.1Q VLAN Tag Priority, IPv4 TOS priority, Port priority |
| QoS queuing | Fixed or weighted (configurable ratio) | Weighted |
| VLAN support | 802.1Q (up to 4K VLAN entries) | |
| Spanning Tree Protocol | 802.1D-2004 RSTP, 802.1Q-2005 MSTP | 802.1D-1998 STP, 802.1D-2004 RSTP |
| MEF | MEF 9, MEF 14 | |
| Mechanical & Electrical | | |
| Power consumption | IDU: 20 - 30W / ODU: 16-27 W(SP); 32-39W(HP) | IDU: 30 - 40W / ODU: 13 - 18W |
| Weight | IDU: 3.1 kg / ODU: 3.5kg | IDU: 3.4 kg / ODU: 3.5kg |
| Temperature Range | IDU: -5°C to +45°C / ODU: -33°C to +55°C | IDU: -5°C to +55°C / ODU: -33°C to +55°C |
| Dimensions: HxWxD, mm | IDU: 1U rack (45x430x240) ODU: 288x288x80 | IDU: 1U rack (44.5x445x238.5) ODU: 288x288x80 |
| Operational use | ODU: EN 300 019 Class 4.1, IP65; IDU: 300 019 Class 3.1E | |

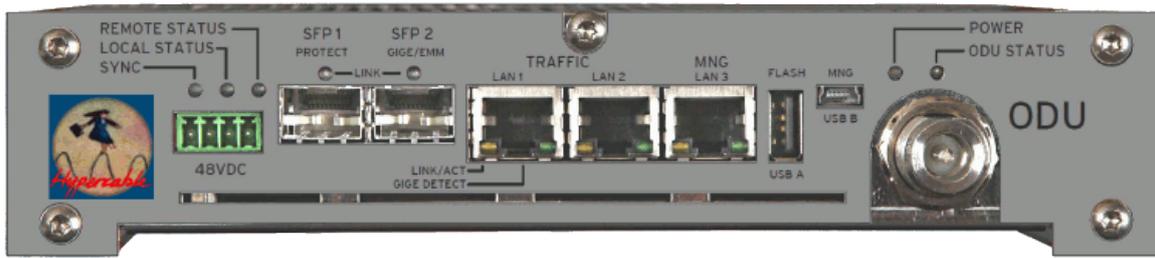
| | Channel bandwidths (MHz) | | | | | | | | | | |
|--------|--------------------------|-------|-------|---------|---------|---------|----|----|-----------|-----|-----------|
| | 3,5 | 7 | 14 | 28 | 40 | 56 | 7 | 14 | 28 | 40 | 56 |
| 4QAM | 3 | 8 | 17 | 35 | 49 | 71 | 8 | 17 | 36 | 52 | 74 |
| 16QAM | 7 | 17 | 34 | 69 | 98 | 135 | 16 | 36 | 74 | 108 | 144 - 152 |
| 32QAM | 9 | 21 | 45 | 88 | 127 | 182 | 21 | 46 | 94 | 132 | 192 |
| 64QAM | 13 | 28 | 57 | 115 | 163 | 240 | ** | 55 | 112 | 164 | 232 |
| 128QAM | - | 34-36 | 68 | 138 | 196 | 287 | - | ** | 128 - 136 | 188 | 264 |
| 256QAM | - | - | 79-86 | 161-174 | 229-245 | 335-363 | - | - | 144 - 160 | - | 312 - 348 |

* Capacities are subject to change ** Under development

12.2 Modulation mode & output power

| Modulation | Standard/High Tx Power, dBm | | | | | |
|---------------|-----------------------------|--------------------|-----------|----------------|-----------|--------|
| | 6, 7, 8 GHz | 10, 11, 13, 15 GHz | 17 GHz | 18, 23, 26 GHz | 24 GHz | 38 GHz |
| 4QAM | +19 / +27 | +19 / +25 | +5 | +19 | -20 to 0 | +17 |
| 16QAM | +18 / +26 | +18 / +24 | -25 to +4 | +18 | -20 to -1 | +16 |
| 32QAM | +17 / +25 | +17 / +23 | -25 to +3 | +17 | -20 to -2 | +15 |
| 64QAM | +15 / +23 | +15 / +21 | -25 to +1 | +15 | -20 to -4 | +13 |
| 128QAM | +15 / +23 | +15 / +21 | -25 to +1 | +15 | -20 to -4 | +13 |
| 256QAM | +12 / +20 | +12 / +18 | -25 to -2 | +12 | -20 to -7 | +10 |

12.3 IDU for CFIP ODU Technical Specification



100

| | |
|--------------------------------------|--|
| Modem | |
| Channel Bandwidths | ETSI: 7, 14, 28, 40, 56 MHz ANSI: 10, 20, 30, 40, 50, 60 MHz |
| Modulations | QPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM |
| Capacity | 10 – 360 Mbps |
| Supported ODUs | CFIP Phoenix ODU, CFIP Phoenix R ODU |
| ATPC feature | Yes |
| ACM feature | Hitless Oms |
| Applications | |
| Configuration | 1+0, 1+1 (HSB, SD, FD), 2+0 (built-in Ethernet aggregation) |
| Protection switching | Hot Stand-by (<50ms), Space/Frequency diversity (hitless, errorless) |
| Ports | |
| Ethernet traffic | 2x 100/1000Base-T, RJ-45 (max 3 ports) 2x SFP (1000BseSX/LX) – also works as Extension/Protection ports |
| Ethernet Management Access | 1x 100/1000Base-T, RJ-45 |
| Extension/protection port | 2x SFP (1000BseSX/LX) – also as Traffic port |
| Serial port for configuration | USB B (alternative IP port) |
| Flash memory port | USB A |
| ODU port | N-Type Female |
| DC power port | Single block 4 pole |
| Ethernet | |
| Switch type | Managed Gigabit Ethernet Layer 2 |
| Max frame size | 10K |
| MAC table | 8192 entries; automatic learning and aging |
| Packet buffer | 125KB , non-blocking store&forward |
| Flow Control | 802.3x |
| VLAN support | 802.1Q (up to 4K VLAN entries) |
| QinQ (Double Tagging) | Yes |
| QoS | 64 level DiffServ (DSCP) or 8 level 802.1p mapped in 4 prioritization queues with VLAN support, IPv6 Traffic Class |
| Synchronization | SyncE, PTP 1588v2 |
| Encryption | Yes, AES 128 |

| Management features | |
|---------------------------------|--|
| Protocols | via WEB GUI (HTTP/HTTPS), CLI (Telnet/SSH), NMS (SNMP v1/v2c/v3), Serial interface (USB IP port) |
| Access | In-band (via VLAN) Out-of-band (128 kbps) |
| SNMP | Yes, SNMP traps, MIB, SNMP v1/v2c |
| Element Management System (EMS) | Web based, HTTP/HTTPS |
| Mechanical & Electrical | |
| Temperature Range / Humidity | -5°C to +45°C / 5% to 95% |
| Dimensions: HxWxD | ½ width 1U (45 x 210 x 240 mm) |
| Weight | 2 kg |
| Max. power consumption | IDU: <22 W (full port connection) IDU+ODU: <90W |
| IDU-ODU connection | Belden 9914/RG-8 cable (300 m), RG213 cable (200 m), N-Type connectors |
| DC port | -20V to -60V DC (conforms to ETSI EN 300 132-2) Max IDU current up to 1.5 ADC |
| IDU compliance | |
| Operation | ETSI EN 300 019, Part 1-3, Class 3.2 |
| Storage | ETSI EN 300 019, Part 1-1, Class 1.2 |
| Transportation | ETSI EN 300 019, Part 1-2, Class 2.3 |
| Power | EN 300 132-2 |
| Radio frequency IDU+ODU | EN 302 217-2-2 |
| EMC | EN 301 489-1, EN 301 489-3 |
| Safety | IEC 60950-1/EN 60950-1 |

12.3.1 IDU modem modes

ETSI bandwidths

| Modulation | 7 | 14 | 28 | 40 | 56 |
|------------|----|----|-----|-----|-----|
| QPSK | 10 | 21 | 44 | 62 | 85 |
| 8PSK | 16 | 32 | 65 | 91 | 128 |
| 16QAM | 21 | 43 | 88 | 123 | 171 |
| 32QAM | 26 | 53 | 109 | 152 | 217 |
| 64QAM | 33 | 66 | 136 | 186 | 266 |
| 128QAM | 38 | 78 | 159 | 220 | 314 |
| 256QAM | 44 | 89 | 182 | 253 | 362 |

12.3.2 IDU external module CFIP -16E1/T1-EXT



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| | |
|---|---|
| CFIP-16E1/T1-EXT | |
| EAGMEX16 | 16E1/T1 external module for C IDU, 16xRJ-45, 2xSFP ports |
| 16xE1/T1 | G.703-E1 balanced 120ohm for E1 mode G.703-E1 unbalanced 75 ohm for E1 mode T1.102-T1/100 ohm for T1 mode |
| Scalability | Cascading up to four external modules |
| Ports | |
| IDU connection | 1x SFP port 1000Base-SX (proprietary GigE protocol) |
| Connection to next External module | 1x SFP port 1000Base-SX (proprietary GigE protocol) |
| E1 ports | 16x RJ-45 |
| DC port | Industrial power connector |
| Mechanical & Electrical | |
| Dimensions: HxWxD | ½ width 1U (45 x 210 x 240 mm) |
| Weight | 1.3 kg |
| Max. power consumption | IDU: <9 W |
| DC port | -20V to -60V DC |

12.3.3 IDU external module CFIP -ASI-EXT



| | |
|---|---|
| CFIP-ASI-EXT | |
| EAGMEXA4 | External ASI module IDU, 4x BNC, 2x SFP ports |
| ASI | Unbalanced, 75 ohm |
| Scalability | Cascading up to four external modules |
| Ports | |
| IDU connection | 1x SFP port 1000Base-SX (proprietary GigE protocol) |
| Connection to next External module | 1x SFP port 1000Base-SX (proprietary GigE protocol) |
| E1 ports | 4x BNC |
| DC port | Industrial power connector |
| Mechanical & Electrical | |
| Dimensions: HxWxD | ½ width 1U (45 x 210 x 240 mm) |
| Weight | 1.3 kg |
| Max. power consumption | IDU: <9 W |
| DC port | -20V to -60V DC |

13 Hypercable contact



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