User manual

Integra-X
Integra-X2
Integra-FIDU
Integra-FIDU+

VER 2.12

FW 3.24.23

Proprietary notice

The information presented in this guide is the property of SAF Tehnika, JSC. No part of this document may be reproduced or transmitted without proper permission from SAF Tehnika, JSC.

The specifications or information contained in this document are subject to change without notice due to the continuing introduction of design improvements. If there is any conflict between this document and compliance statements, the latter will supersede this document.

SAF Tehnika, JSC has no liability for typing errors in this document or damages of any kind that result from the use of this document.

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

Radio unit does not contain serviceable parts. Warranty will not be applicable in the event Radio unit has been hermetically unsealed.

SAF Tehnika, JSC is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. The operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, according to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used following the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from the one connected to the receiver.

Consult the dealer or an experienced radio/TV technician for help.

This device complies with Industry Canada licence-exempt RSS standard(s). The operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Chapter 1 OVERVIEW

Labeling

Each FODU unit has 2 identical labels: 1) on the front and 2) on the back of the unit casing. Each FIDU/FIDU+ unit has one label on the back of the unit.

The label contains the following information - see a sample in *Figure 1-1*.

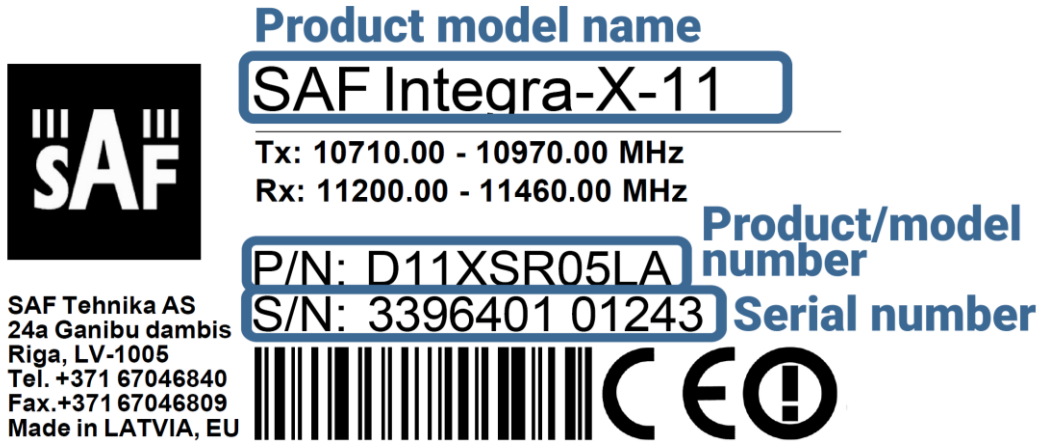


Figure 1-1 Integra-X FODU label

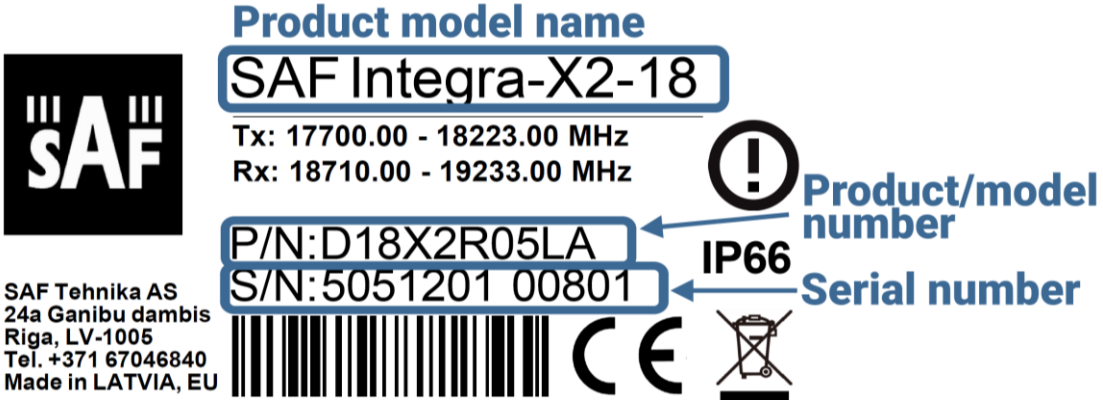


Figure 1-2 Integra-X2 FODU label

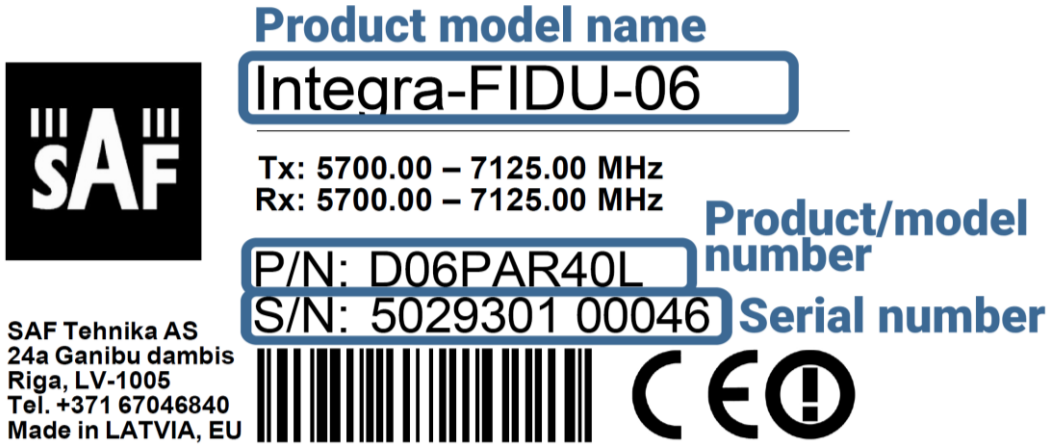


Figure 1-3 Integra-FIDU+ label

Product model name - "SAF Integra-X-11" for FODU and "Integra-FIDU-06" for FIDU. The number, in the end, indicates the frequency band supported by the device; in the example above it is 11 GHz Integra-X and 6 GHz Integra-FIDU.

Frequency range - Note that the frequency range on the label is defined for the whole supported range of the diplexer. The first supported central frequency of a channel can be calculated by adding one-half of the channel bandwidth to the left edge. The last supported central frequency of a channel can be calculated by subtracting one-half of the channel bandwidth from the right edge.

The frequency range of subband A low side Integra-X 11 GHz FODU:

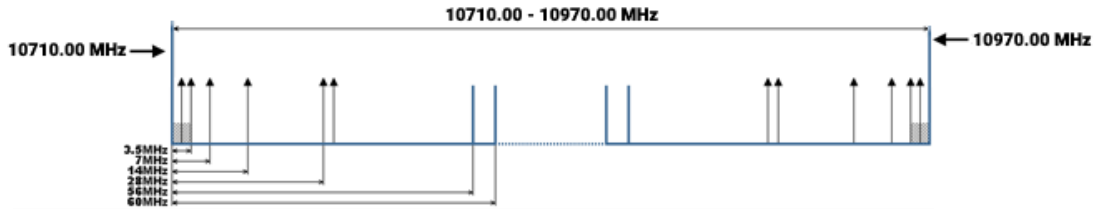


Figure 1-4 Tuneable center frequency range for 11GHz high side Integra-X/-X2/-FIDU/-FIDU+ device (with diplexer)

For example, the supported central frequency range for 28 MHz channel bandwidth in this case is (10710+14) – (10970-14) MHz or 10724 – 10956 MHz.

Product Number / Model Number (P/N or M/N) (FODU: D11XSR05LA, FIDU: D06PAR40L): product/model number contains various information about the unit. See the translation below for Integra FODU (D11XSR05LA) version:

"**D11X**" - designates Integra-X 11 GHz product;

- "**S**" - designates Integra-X without an integrated antenna;
- "**2**" - designates Integra-X2 product (different HW version supporting AES-256 encryption).

"**R**" – XPIC full license allowing unlimited 2.2 Gbps capacity (112MHz/4096QAM) [1];

- "**K**" - XPIC 1 Gbps license;
- "**L**" - XPIC 500 Mbps license.

"**05**" - designates the version number of the radio.

"**L**" - designates low side radio;

- "**A**" - high side radio.

"**A**" - designates radio diapason subband.

- "**B**" - B subband radio;
- "**C**" - C subband radio.

Translation for Integra-FIDU/FIDU+ (D06F1R40L) version:

"**D06P**" - designates Integra-FIDU+ 6 GHz product;

"**1**" - designates Integra- FIDU+ 1+0 option;

- "**2**" - designates Integra-FIDU/FIDU+ 2+0 option
- "**A**" - designates Integra-FIDU/FIDU+ 1+0 AES-ready option
- "**B**" - designates Integra-FIDU/FIDU+ 2+0 AES-ready option

"**R**" – XPIC full license allowing unlimited 2.2 Gbps capacity (112MHz/4096QAM);

- "**K**" - XPIC 1 Gbps license;
- "**L**" - XPIC 500 Mbps license.

[1] Contact SAF representatives for detailed license information.

"40L" - designates Integra-FIDU/FIDU+ radio without diplexer.

"01" - designates the version number of the radio with diplexer.

"H" - designates high side radio (for the radio with diplexer);

- "L" - low side radio.

"A" - designates radio diapason subband (for the radio with diplexer).

- "B" - B subband radio;
- "C" - C subband radio.

Serial Number (502930100046): the serial number uniquely identifies the unit.

Microwave Radiation

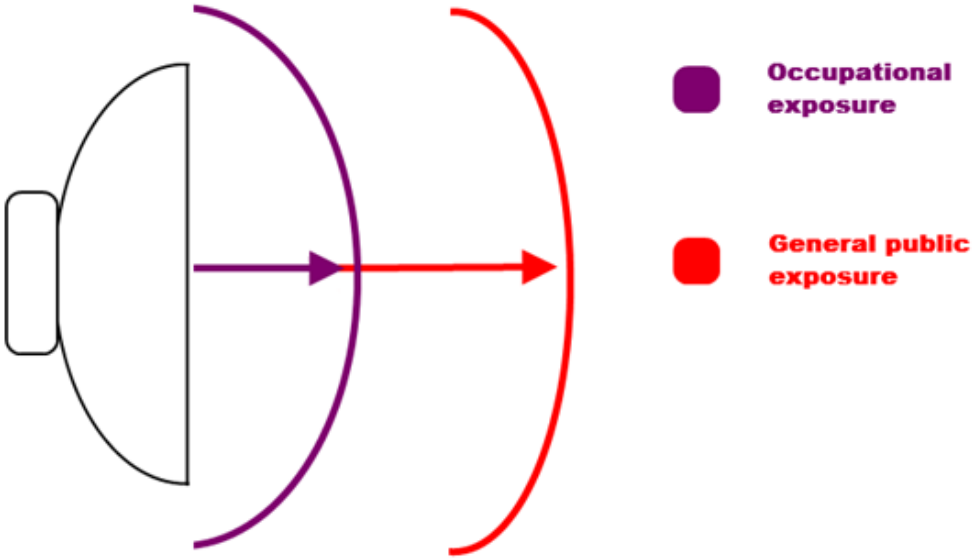


Figure 1-5 Microwave radiation exposure diagram

Integra radio conforms to both occupational and general public exposure limit guidelines and restrictions to time-varying electric, magnetic and electromagnetic fields which are specified or referred in the documents below:

- 1999/519/EC: Council Recommendation of July 12, 1999, on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz);

- WHO: Environmental Health Criteria 137: ´Electromagnetic Fields (300 Hz to 300 GHz);

- ANSI/IEEE C95.1, 1999:

´IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz;

- BRD, Bundesimmissionsschutzgesetz, 26. BImSchV Verordnung über elektromagnetische Felder;

- Bundesamt für Umwelt, Wald und Landwirtschaft (BUWAL), Bern/Schweiz

Schriftenreihe Umwelt Nr. 164, Luft, Mai 1992

´Messung nichtionisierender elektromagnetischer Strahlung, 1. Teil: Frequenzbereich 100 kHz bis 300 GHz;

- DIN VDE 0848-2, Entwurf, Oktober 1991:

´Sicherheit in elektrischen, magnetischen und elektromagnetischen Feldern, ´Teil 2: Schutz von Personen im Frequenzbereich von 30 kHz bis 300 GHz;

- ENV 50166-2, January 1995 (withdrew in December 1999 by CENELEC)

´Human Exposure to Electromagnetic Fields (10 kHz – 300 GHz)

Chapter 2 INSTALLATION

Please find *Figure 2-1* and *Table 2-1* below with the Integra-X and Integra-X2 FODU radio package contents.

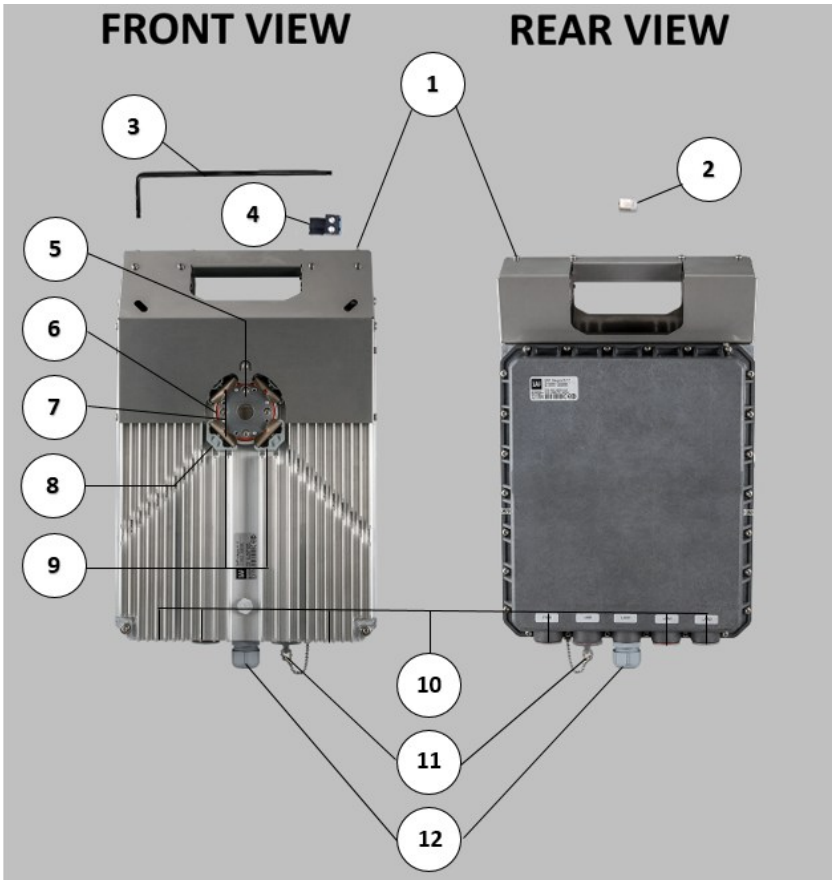


Figure 2-1 Integra-X and Integra-X2 FODU radio package contents

Table 2-1 Integra-X/-X2 and Integra-FIDU/FIDU+ package content

Products and accessories	Qty
1. D11XS***** Integra-X, 11GHz	1
2. XSPR_2148 RJ45 CAT5 connector 4P	1
3. D0ALK003 Locking key for Integra-X	1
4. XSPR_184 2-pin RIA pluggable terminal block	1
Parts attached to Integra-X and Integra-X2 FODU product	
5. Diplexer flange, frequency specific	1
6. MEBG_2893 O-ring AS-568-140	1
7. D0KBS001.003 Integra-X/-X2 tensioner	4
8. D0KBS001.004 Socket Head screw M6x16	4
9. D0KBSL01.006 Integra-X/-X2 fixator, ABS	4
10. D0APC001 Port cap	3
11. D0APCS01 Service cork assembly	1
12. D0ACGL01 Cable gland	1

Parts attached to Integra-FIDU/FIDU+ product	
S0KRIM02.016 Universal mounting bracket for 19-inch rack installation	2
MESK_3491 M3x10 DIN965 Torx Steel Zinc plated screws	10
I0ACPP11 GE patch cable, S/FTP, Cat6, with RJ-45, 2m long	1
XSPR_2933 2-pin power supply pluggable terminal block	1

If any further assistance is required, please contact techsupport@saftehnika.com

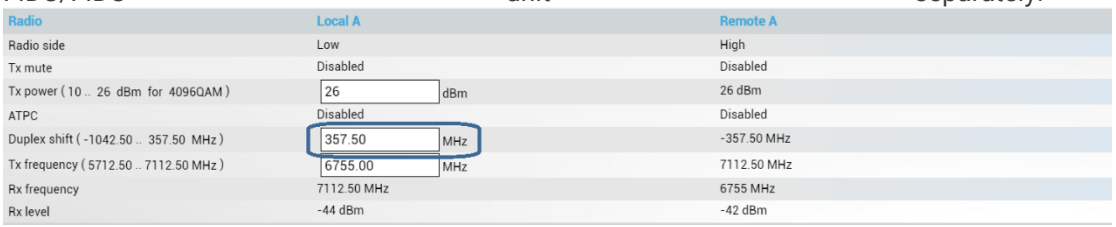
Initial setup in an indoor environment upon delivery ("bench test")

Before Integra FODU and FIDU/FIDU+ installation, it is highly recommended to check the delivered package contents in an indoor environment.

We also recommend performing an initial setup and operational verification test ("bench test"). For detailed instructions, please check the video on SAF Tehnika Youtube channel: *Integra Configuration and Installation video series - EPISODE 1 of 2*.

For Integra-FIDU/FIDU+ without a diplexer the following steps must be done before performing the initial configuration:

1) Access Integra-FIDU/FIDU+ web GUI using the default IP address 192.168.205.10.
2) On the Main page, press the MODIFY button and specify Duplex shift for each Integra-FIDU/FIDU+ unit separately:



The Duplex shift must be set according to the frequency license, respecting the Tx and Rx frequencies of each side of the link. For Low side radio, the Duplex shift must be a positive value; for High side radio, the Duplex shift must be a negative value. The Duplex shift configuration can be done only on one (local) radio, the "Execute for both" option will not work for Duplex shift change.

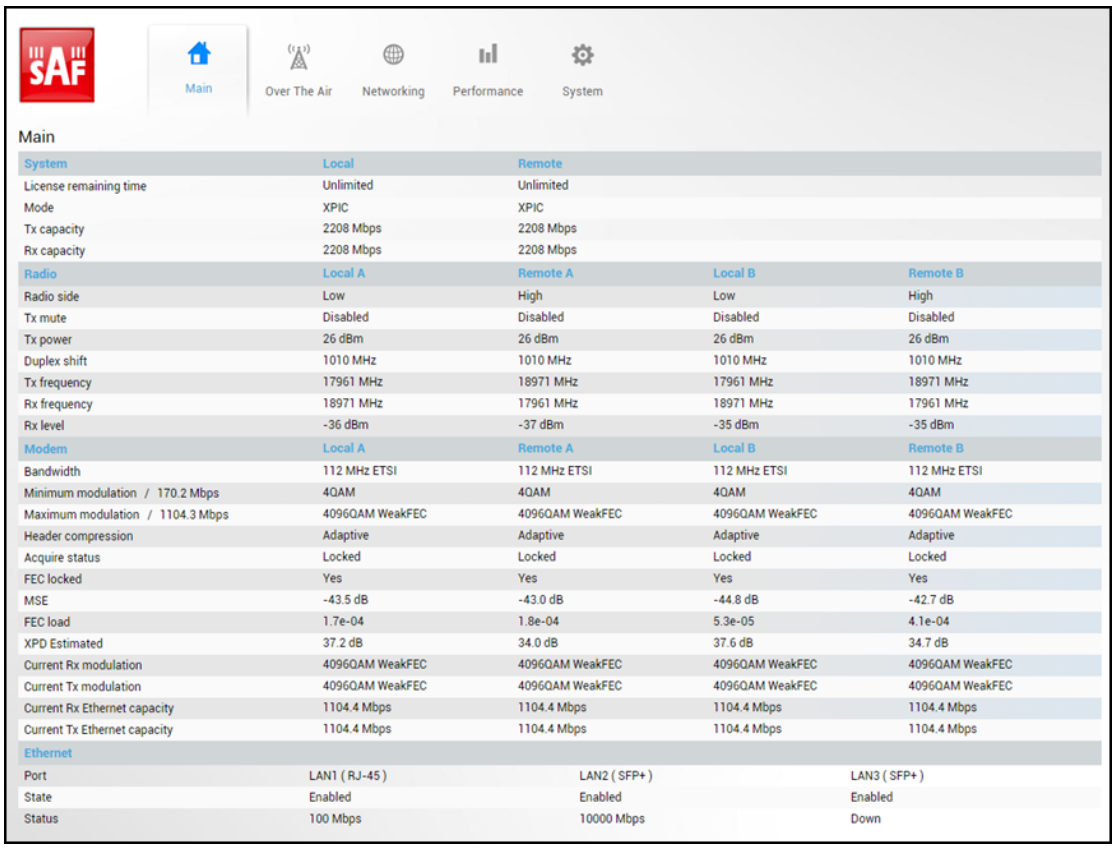
3) After configuring the Duplex shift, set the Tx frequency on each radio. The Rx frequency will be automatically calculated and set by the unit, respecting the configured Duplex shift value on each radio.
4) As the Integra-FIDUs without a diplexer have only one option for default management IP address, the next step is to set different management IP addresses for both Integra-FIDU/FIDU+ devices. For IP address configuration, refer to *System → Configuration → IP configuration* section.

During indoor bench tests, use office paper packs (see below *Figure 2-2*). Adjust the number of paper packs and Tx power value until the Rx level is between -40…-30 dBm. Note that it is recommended to start with the minimum possible Tx power value and increase if necessary. As this is only a rough device general operation test with no antennas attached, Integra radios might indicate low "XPD Estimated" parameter values and corresponding alarms. The "XPD" Estimated" parameter can be improved in such conditions to recommended values (>25 dB) by moving paper packs and Integra radios to obtain better alignment between the devices.

As Integra radios emit high-power microwave radiation, it is recommended that devices be powered on only when paper packs are placed between them. Also, keep yourself at a safe distance while radios are operational (>1m).

Note that Integra radios testing with office paper packs should be done only for short operational verifications, but not for long-lasting link operation inspections, as over time, paper heats up, and thus its attenuation increases, which causes link operation degradation and instability.

Figure 2-2 Example of Integra FODU link bench test with office paper packs



Main

System	Local	Remote		
License remaining time	Unlimited	Unlimited		
Mode	XPIC	XPIC		
Tx capacity	2208 Mbps	2208 Mbps		
Rx capacity	2208 Mbps	2208 Mbps		
Radio	**Local A**	**Remote A**	**Local B**	**Remote B**
Radio side	Low	High	Low	High
Tx mute	Disabled	Disabled	Disabled	Disabled
Tx power	26 dBm	26 dBm	26 dBm	26 dBm
Duplex shift	1010 MHz	1010 MHz	1010 MHz	1010 MHz
Tx frequency	17961 MHz	18971 MHz	17961 MHz	18971 MHz
Rx frequency	18971 MHz	17961 MHz	18971 MHz	17961 MHz
Rx level	-36 dBm	-37 dBm	-35 dBm	-35 dBm
Modem	**Local A**	**Remote A**	**Local B**	**Remote B**
Bandwidth	112 MHz ETSI	112 MHz ETSI	112 MHz ETSI	112 MHz ETSI
Minimum modulation / 170.2 Mbps	4QAM	4QAM	4QAM	4QAM
Maximum modulation / 1104.3 Mbps	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Header compression	Adaptive	Adaptive	Adaptive	Adaptive
Acquire status	Locked	Locked	Locked	Locked
FEC locked	Yes	Yes	Yes	Yes
MSE	-43.5 dB	-43.0 dB	-44.8 dB	-42.7 dB
FEC load	1.7e-04	1.8e-04	5.3e-05	4.1e-04
XPD Estimated	37.2 dB	34.0 dB	37.6 dB	34.7 dB
Current Rx modulation	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Current Tx modulation	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Current Rx Ethernet capacity	1104.4 Mbps	1104.4 Mbps	1104.4 Mbps	1104.4 Mbps
Current Tx Ethernet capacity	1104.4 Mbps	1104.4 Mbps	1104.4 Mbps	1104.4 Mbps

Ethernet			
Port	LAN1 (RJ-45)	LAN2 (SFP+)	LAN3 (SFP+)
State	Enabled	Enabled	Enabled
Status	100 Mbps	10000 Mbps	Down

Figure 2-3 Recommended settings for Integra radio link bench test with office paper packs

Integra-X/-X2 FODU and Integra-FIDU/FIDU+ installation overview

Integra-X and Integra-X2 FODU installation

Integra-X/-X2 FODU must always be installed in a vertical position with the handle up and cable ports down.

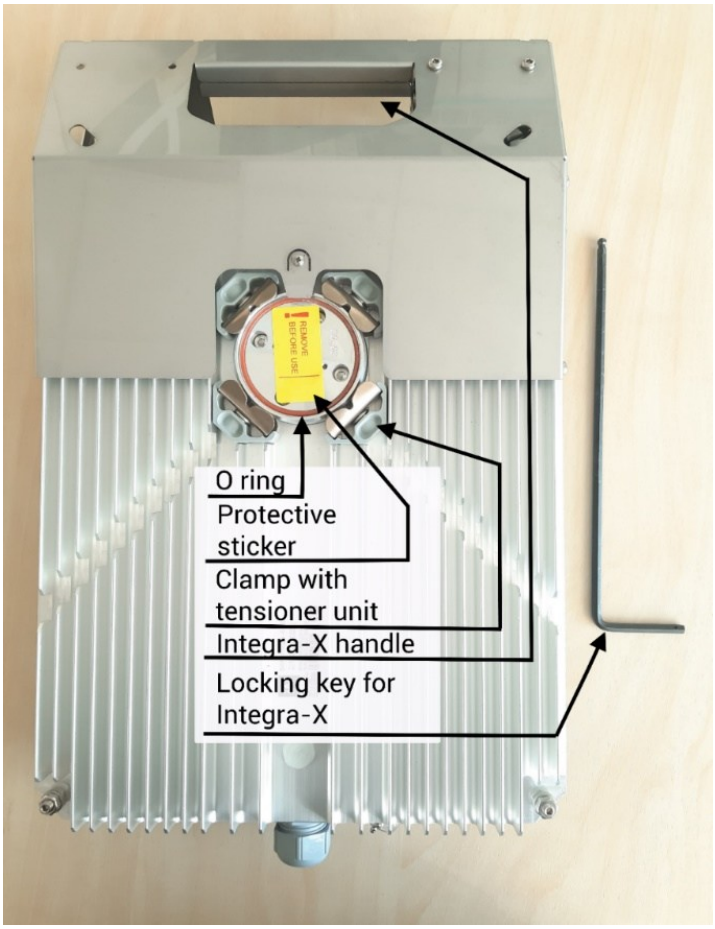


Figure 2-4 Integra FODU common view from the antenna side

Figure 2-5 Tools for antenna attachment

Tools required for FODU mounting: Level (not supplied, optional), locking key for Integra-X/-X2 (size 5 Allen wrench, 240mm, supplied, position 4 in *Table* 2-1 Integra-X/-X2 and Integra-FIDU/FIDU+ package *content*).

Integra-FIDU/FIDU+ installation

Integra-FIDU/FIDU+ must be installed indoors. Use universal mounting brackets and screws included in the package for installation of the radio into a 19" rack.

SAF Tehnika provides two types of Integra-FIDU/-FIDU+:

1) Integra-FIDU/FIDU+ with built-in diplexer – the radio can be attached to the antenna using a waveguide.

Integra-FIDU/FIDU+ with diplexer supports 1+0 configuration only.

2) Integra-FIDU/FIDU+ without built-in diplexer – the radio has two Tx and two Rx ports for connecting to the external branching unit or SAF Indoor Branching unit (IBU) for 2+0 XPIC operation. The branching unit can be attached to the antenna using waveguides, see the *Figure* 2-6.

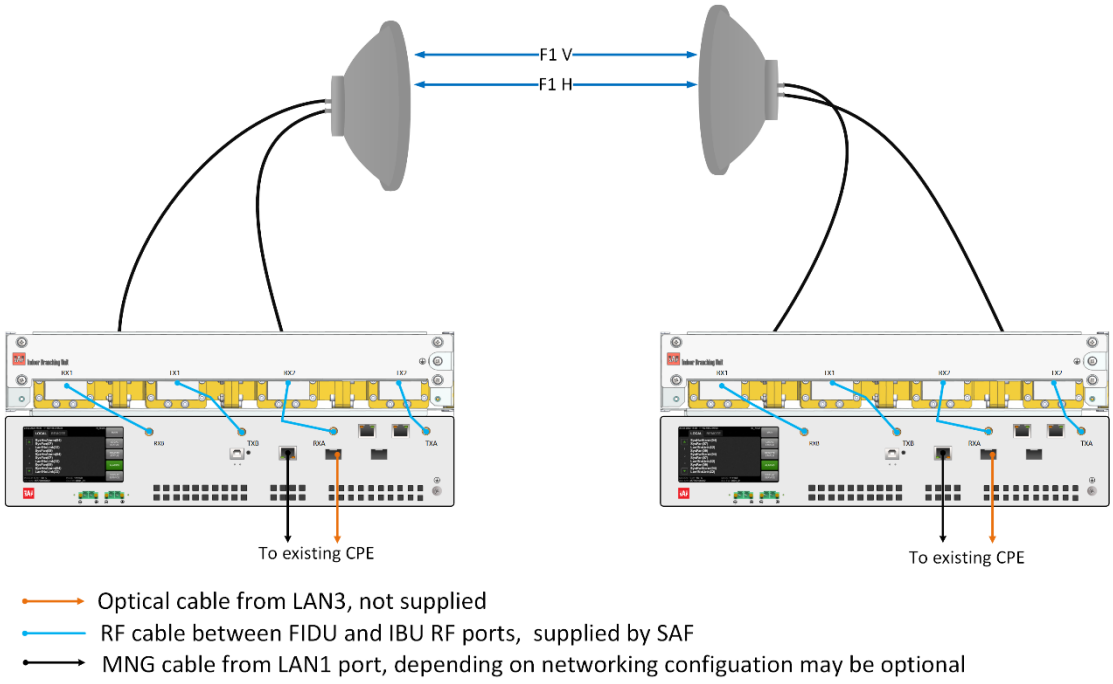


Figure 2-6 Integra- FIDU/FIDU+ 2+0 XPIC with IBU

Please pay attention to the frequency assignments for the FIDU channels. RF interconnections between the FIDU and IBU should be done according to the frequencies stated on the IBU.

Figure 2-7 Frequency assignment stickers on passive IBU

Figure 2-8 Frequency assignment stickers on active IBU

Stickers labeled 1), 2), 3), and 4) on the IBU indicate the available frequencies and bandwidths.

Please refer to https://support.saftehnika.com/files/downloads/41dcee58-601a-ea11-9fbe-0050569a8c0f/Phoenix_G2_IBU_filter_assembly_manual_V_1_5.pdf. For further questions please contact Techsupport@saftehnika.com.

Setting link polarization

For Integra-X and Integra-X2 there are both polarizations in use in XPIC mode, and it is not possible to change polarization by mechanical changes. For Integra-FIDU/FIDU+ without a diplexer, both polarizations in XPIC mode can be used – polarizations can be determined by the waveguide connection between the branching unit and antenna. Integra-FIDU/FIDU+ with built-in diplexer supports single flange, and the polarization can be determined by the waveguide between the FIDU/FIDU+ and antenna. For using Integra radios in one polarization configuration, see *Set system operational mode*.

Attaching FODU to the antenna

The antenna must be assembled according to the instructions from the antenna manufacturer, supplied with the antenna.

All Integra-X and Integra-X2 FODUs have a SAF2 interface with a circular flange. It is compatible only with antennas that have radio adapters with a SAF2 interface (see example in *Figure 2-9)*. The only exception is 4(U) GHz band radio, having two N-type female RF ports (see *Figure 2-11)*.

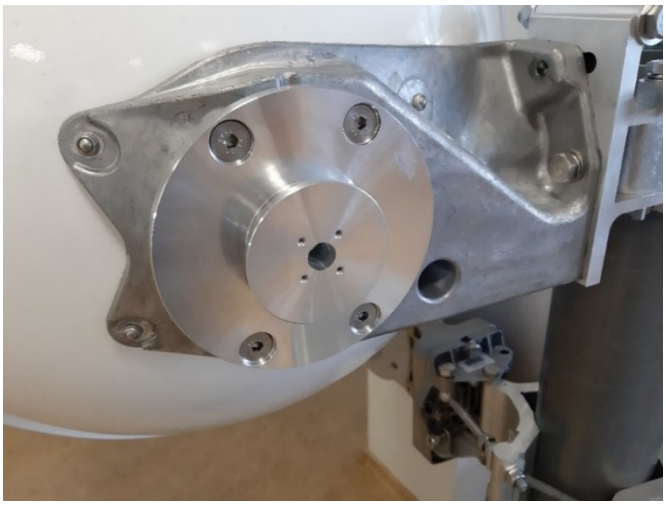


Figure 2-9 Radio adapter with SAF2 interface COMPATIBLE with Integra-X and Integra-X2

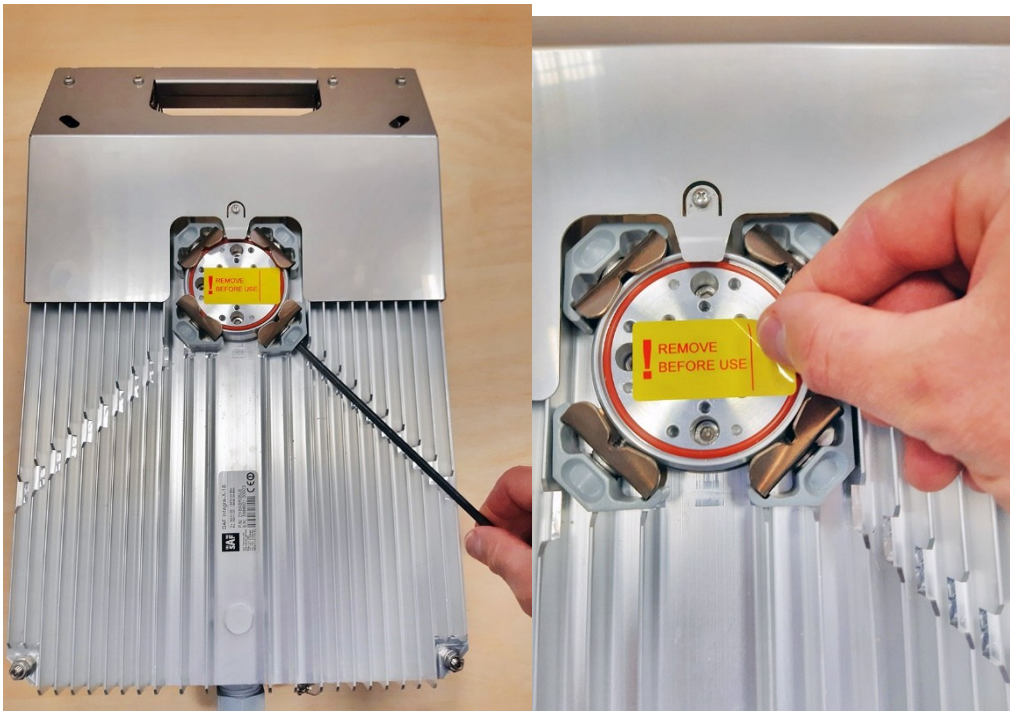
Please note that Integra-X and Integra-X2 are not compatible with antennas that have radio adapters with SAF2R interface with rectangular waveguide (see example in *Figure 2-10)*. Such antennas can only be used with other SAF radios: 6 – 13 GHz Integra-S/GS/WS, PhoeniX G2 VHP.

Figure 2-10 Radio adapter with SAF2R interface INCOMPATIBLE with Integra-X and Integra-X2

Figure 2-11 Integra-X/-X2 radio interface with two N-type female connectors

To attach Integra-X and Integra-X2 to an antenna with SAF2 adaptation, please follow the steps shown in *Figure 2-12*.

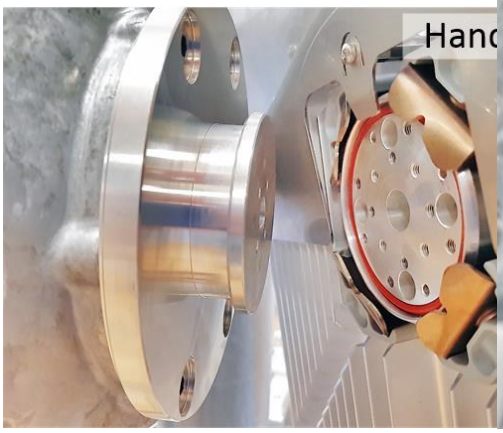
In the case of 4(U) GHz band radio, a FODU must be connected to a dual-polarization antenna presenting two N-type ports using the mast mounting bracket (SAF P/N S0SPKS06) and two coaxial cables[2]. Each of the cables must be connected to the antenna port of the corresponding polarization.

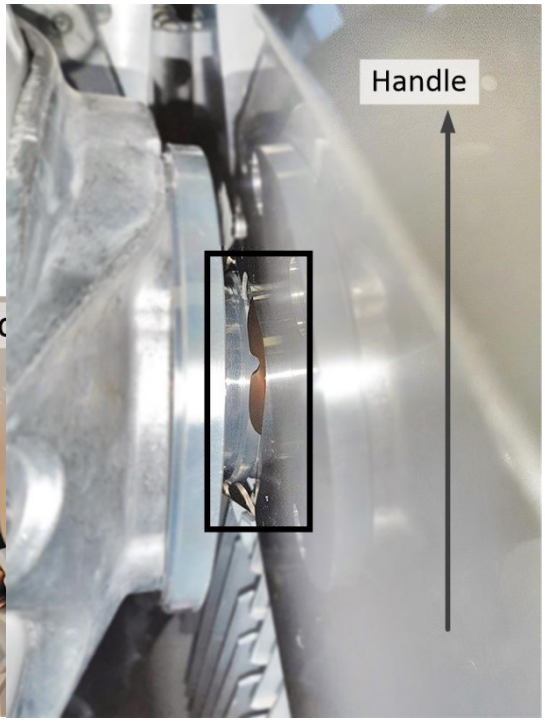


[2] Please inquire SAF representatives for SAF P/N

1 Use the locking key. Screw in clamp tensioner bolts but don't tighten, then loosen the upper 2 bolts on the handle side by 2 turns, and 2 on the bottom side by 4 turns.

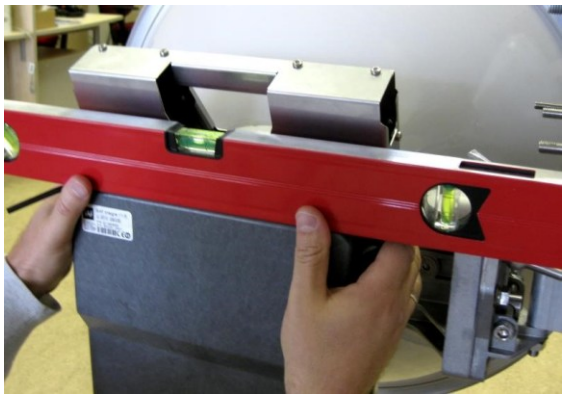
2 Remove the protective sticker from the FODU diplexer flange, check also SAF2 flange on the antenna for a sticker, if it is not a permanent one, remove it.





3 Make sure that the O-ring is in place. Holding Integra-X/-X2 FODU by handle attach it to SAF2 flange by hanging on upper tensioners, see right picture 4.

4 Hung Integra-X/-X2 FODU on upper tensioners on SAF2 flange, then push the lower part until lower clamps hit on flange, make sure that all 4 clamps are in the proper position - “hang” the flange so that FODU diplexer presses to SAF2 flange.



5 Tighten flange clamps so you can adjust FODU leveling by rotating FODU on the SAF2 flange.

6 Use the air level to verify that FODU is properly leveled. Tighten all 4 clamp bolts with 3Nm/2.2 foot lbs force.

7 Assembled Integra-X/-X2 view.

Figure 2-12 Attaching Integra-X and Integra-X2 to the antenna

Attaching FIDU/FIDU+ to the waveguide (antenna)

Interconnection of Integra-FIDU/FIDU+ with the antenna must be done with a waveguide. The Integra-FIDU/FIDU+ with diplexer has standard waveguide flange: UDR70 for 6GHz, UBR84 for 7/8GHz, UBR100 for 11 GHz, and UBR140 for 13 GHz frequency. These are compatible with waveguide standard flanges.

In the case of Integra-FIDU/FIDU+ without a diplexer, an external branching unit or SAF IBU must be used along with the FIDU. This type of FIDU/FIDU+ has four SMA connectors (2xTx/2xRx ports) for interconnection with SAF IBU. The SAF IBU has a standard waveguide flange for connection to the waveguide.

Connecting Integra-FIDU/FIDU+ without a diplexer to SAF IBU

The interconnection between Integra-FIDU/FIDU+ and the IBU can be done with coaxial cables, which are included in the IBU package. The Tx/Rx ports on the Integra-FIDU/FIDU+ and the IBU are SMA-type connectors. The Tx ports of the Integra-FIDU/FIDU+ must be connected to the Tx ports of the IBU, and the Rx ports of the Integra-FIDU/FIDU+ must be interconnected with the Rx ports on the IBU. For more detailed information about SAF IBUs, refer to the *IBU installation guide*.

Passive IBU has 2 SMA Tx inputs coupled with a circulator. Active IBU has 2 switchable SMA Tx inputs, thus providing lower attenuation compared to a passive one. The Integra-FIDU/FIDU+ with outputs for switch operation is necessary. Please contact techsupport@saftehnika.com for further information.

Grounding connection

Always provide a good connection from the Integra-X/-X2 and Integra-FIDU/FIDU+ grounding screw to the tower/mast/building grounding circuit. See *Grounding connection* section.

Power connections

For Integra-X/-X2 and Integra-FIDU/FIDU+ power connection diagrams, please look to *Powering Integra-X/-X2 devices*.

For cable diameter considerations, please see the subsections *RJ-45 port* and *2-wire DC power port* of this document.

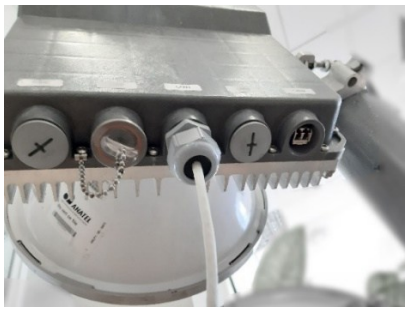
Note on antenna and XPIC alignment

1) SAF Tehnika recommends performing antenna alignment in Channel A (single polarization) mode. See *Single polarization mode* for further details.
2) Use RSSI Channel A for the multi-meter signal on FODU when aligning the antenna. See *RSSI/audio port* section. If you use WEB GUI for alignment, be aware that the status is updated with a certain delay. For RSSI voltage readings vs calculated dBm, see *Figure 8-11*.
3) For general antenna adjustment considerations, please refer to *Antenna alignment whitepaper*.
4) Switch the system to XPIC mode and check if Rx signals are within the 2dB margin for both polarizations against the calculated value. XPD estimated (see *XPIC mode* section) should be 25...40 dB. If the XPD estimated is not in the 25...40dB range, slightly loosen all 4 FODU clamp bolts (¾..1 turn) and rotate Integra-X/-X2 on SAF2 antenna adapter, while aiming to achieve XPD Estimated value between 25 dB to 40 dB. Fix FODU in this position by tightening all 4 FODU clamp bolts with 3Nm/2.2 lbs-ft torque.

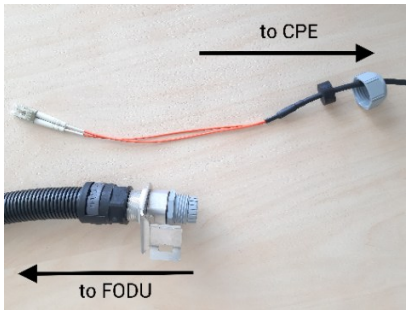
If any further assistance is required, please contact techsupport@saftehnika.com.

Connecting Integra-X/-X2 FO interface using a fiber conduit kit

1 Fiber conduit kit.



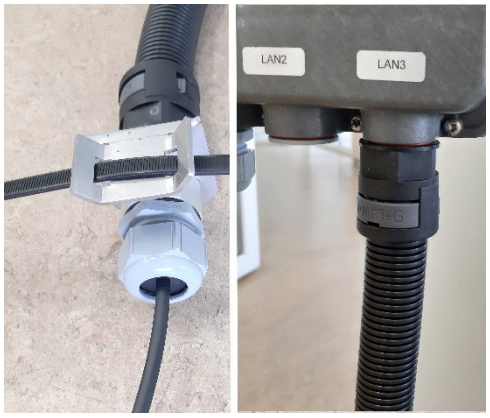
2 Unscrew the cap of the SFP port (LAN2 or LAN3) that will be used and install an SFP module.



3 Disassemble the conduit kit and put its parts in the correct sequence on the cable.

4 Push FO cable with LC connector through the conduit. Use protective covers for the LC connector optics.

5 Remove protective covers from the LC connector and connect the connector to the SFP module.



6 Tighten parts on both ends of the conduit to weatherproof the assembly. Do not break the cable.

7 Fasten the other end of the fiber conduit to the pole using the included tie-wrap.

8 Assembled view of the Integra-X/-X2 with optical cable conduit. Cables must always be at the bottom of the Integra-X/-X2.

Figure 2-13 Optical cable conduit assembly

Chapter 3 WEB GUI

Initial configuration

Powering Integra-X/-X2 devices and connecting to PC

There are three options for powering Integra-X/-X2 devices as shown in *Figure* 3-1.

Option #1: *power supply via PoE connection from SAF Tehnika PoE injectors to LAN1 port.*

If necessary, along with the power, this connection can also provide a Gigabit Ethernet data connection to LAN1. For this power connection, we recommend using SAF Tehnika-supplied PoE injector **I0ATPI43** as it is tailor-made for operation with Integra-X/-X2 devices and can provide the necessary power level to the device. The accepted input voltage for SAF Tehnika PoE injectors is 10…57 V DC. The PoE output voltage is stabilized to 57 V DC. SAF Tehnika injectors should be switched with DIP switches on their back to **mode "B"** when used with Integra-X/-X2. In the case of the need for third-party injector use, please inquire SAF representatives about compatibility with the Integra-X/-X2 device. For details on suitable Ethernet cable lengths for power-only PoE connections, see Table 8-2.

For details on SAF Tehnika PoE injectors, their connection scheme, settings, specifications, and more, see: *Description of SAF produced PoE injectors* .

Option #2: *2-wire DC power supply to 2-wire DC power port*

As all the power supply circuits are internally isolated inside the device, then DC power supply with any polarity (+38…+57V or -38…-57V) and any grounding configuration (positive, negative, or floating) can be used in connection to Integra 2-wire DC power port described in subsection *2-wire DC power port*. However, the recommended DC power supply is **-48VDC with the positive or floating ground**. Use a 2-pin pluggable terminal block (P/N XSPR_184 for Integra-X/Integra-X2, P/N XSPR_2933 for Integra-FIDU/-FIDU+) to connect the cable to Integra radio. To power on Integra devices, there should be a minimum +38V or -38V voltage level provided on the power cable terminal end which is connected to the device's 2-wire DC port. For the 48V power supply source, please check *Table 8-3* to find a suitable cable diameter and length to have a sufficient power level on the DC power connection.

Use 5-10 A rated type B circuit breaker in the chain between the power supply and the PoE injector for isolating each radio powered by the same PSU in case of a surge.

In the case of Integra-FIDU/-FIDU+, only option #2 can be used (dedicated DC port).

Option #3: *use at the same time both power connections with PoE injector and DC power supply and thus having power source redundancy.*

For uninterrupted and hitless power supply failover operation on the Integra radio, there is only 1 possible power connection configuration: SAF Tehnika **I0ATPI43** PoE injector is used as the main power source (note that it should be used only in PoE 120W mode), but DC power supply as the standby power source.

Option #4: *using 2 independent DC power supplies with a floating ground.*
For uninterrupted and hitless power supply failover operation on the Integra radio, there is posibbilty to feed radio on DC port by one 48V DC power supply with isolated poles, and with another independent 48V DC power supply on LAN1 by using power adapter cable D0ACPW01.

For more details and best connection practices of hitless redundancy for Integra radio see: *Integra-X/X2 radio power connection redundancy*.

Please note that the LAN1 port has a lower overvoltage protection rating compared to the DC input. To enhance protection, an external overvoltage protection device may be installed.

Connecting Integra radio power supply

Example below shows Integra-X/Integra-X2 power supply options. The same options apply also to Integra-FIDU/-FIDU+.

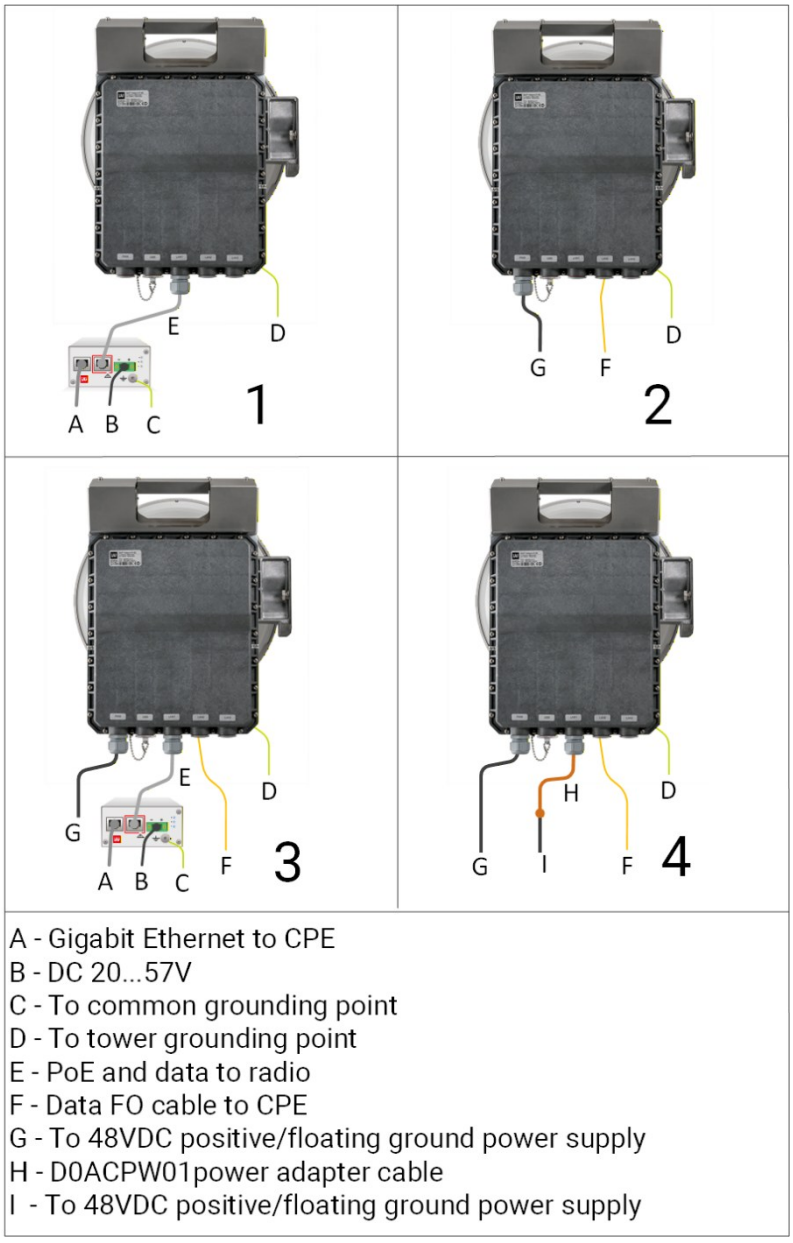


Figure 3-1 Four options for the power supply of Integra-X/Integra-X2

For Ethernet cables longer than 30 meters it is recommended to make grounding points each 20...30 meters.

System requirements

To access the Integra Web GUI you will need a PC with one of the following Web browsers:

Google Chrome;
Mozilla Firefox;
Internet Explorer 8 (or above)

The minimum supported horizontal resolution is 1366px.

Ethernet management connection configuration

Before proceeding with the initial link setup in the Web GUI, you must adjust the IPv4 settings of your LAN adapter to 192.168.205.0 subnet (see for example). The IP address should be something other than the default low/high side IP addresses (192.168.205.10/192.168.205.11).

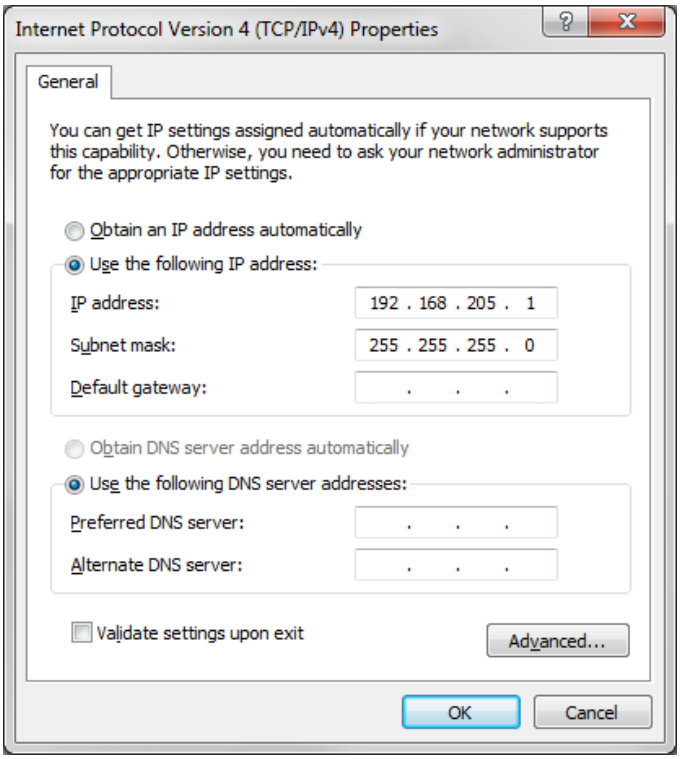


Figure 3-2 LAN adapter setup

After applying these settings, you are ready to connect to the Web GUI or establish an SSH/Telnet connection. Refer to *Chapter 4 COMMAND LINE INTERFACE* for the details on how to connect to other CLI interfaces (serial, SSH, Telnet).

Accessing Web GUI

1) Launch your browser and in the address field, enter the IP address of a radio. Default IP addresses are as follows:

- 192.168.205.10 for low side Integra radio (example P/N D**XS***L*)
- 192.168.205.11 for high side Integra radio (example P/N D**XS***H*)

Figure 3-3 Browser's address field

For a secure connection, use *https://* prefix.

2) Press the "Enter" key.

3) The login screen will appear:

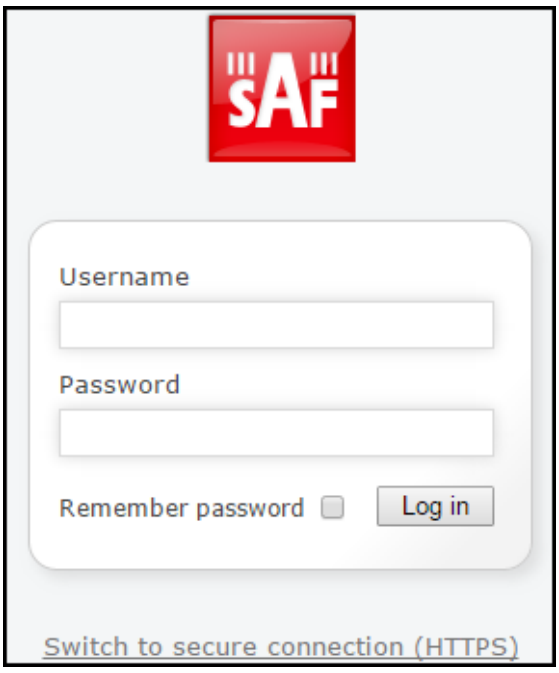


Figure 3-4 Login screen

4) Enter the username and password. The default credentials are as follows:
Username: **admin**
Password: **changeme**

5) Select "Remember password" if you want the browser to remember entered login credentials.

6) Press the "Log in" button.

"Switch to secure connection (HTTPS)" indicates that the HTTP protocol is being used. Press on the link and you will be redirected to a secure HTTPS URL.

The minimum supported horizontal resolution is 1366px.

Main page

After logging in, you will be automatically redirected to the "*Main page*" of the Web GUI.

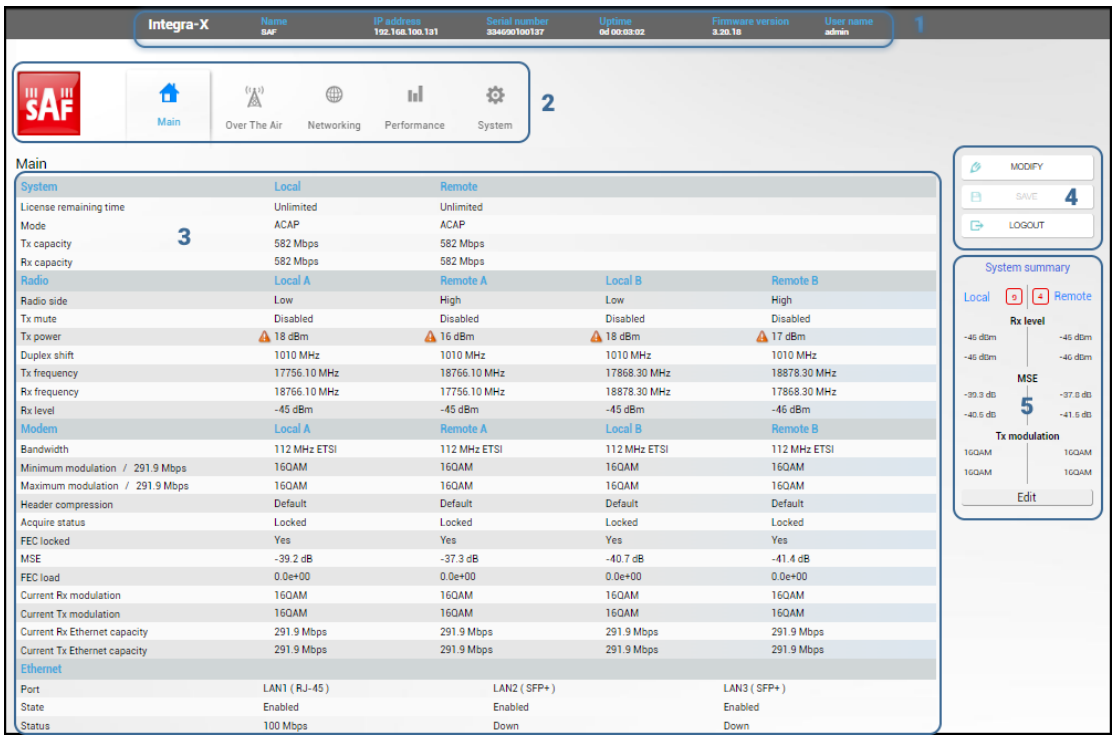


Figure 3-5 Main page

Web GUI is divided into 5 sections:

1) *Top panel* – Shows information about the Integra radio you are connected to:
   - Model name
   - System name
   - IP address
   - Serial number
   - Uptime
   - Firmware version
   - User name
2) *Menu panel* - Allows navigating between the Main page ("Main") and subpages of 4 sections:
   - Main
   - Over the air (Radio/modem configuration)
   - Networking (Ethernet configuration)
   - Performance
   - System
3) *Main WEB GUI window* - by default, the main page ("Main") is shown. Contents will change according to the menu panel selection and the chosen system operational mode.

Values appear in red color in case of exceeding alarm threshold values (*Performance → Alarm → Alarm threshold configuration*) or in case of a warning (e.g., if loopback is active).

Values appear in orange color in case alarm threshold values were exceeded during the last 15 seconds.

Values with ⚠ are modified by enabled automation (e.g., ATPC, LSP, or Backup-link configuration and status). Move the mouse over the sign for further details.

4) *MODIFY/SAVE/LOGOUT* - This allows modifying parameters in the window. If none can be modified, the MODIFY button appears inactive. After modification, the SAVE button becomes active and indicates the number of unsaved changes as well as their type (when moving the cursor over the button). Pressing the LOGOUT button will log out of the current session. This panel is visible on all pages.

⚠ If you do not save the configuration after modification, it will be lost after the radio restart.

5) *System Summary* – This panel is visible on all pages. During normal operation, there are two green rounded rectangles near "Local" and "Remote". In case of active alarms on the device, the rectangle will become red and indicate the number of current alarms. It is possible to check active alarms on the local device in detail by clicking on the local side rectangle which will open *Performance → Alarm → Alarm status* with a list of all current alarms on the local side device.
The section below alarm rectangles shows one to four (default value – three) selected sensor parameters for the Local and Remote devices:

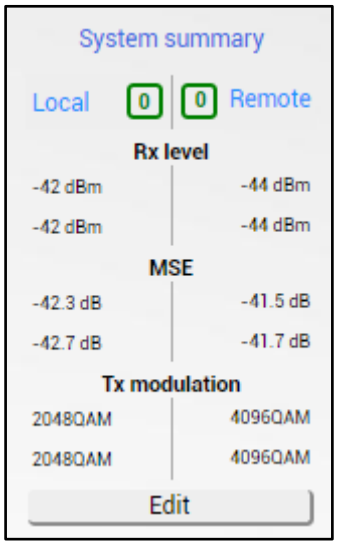


Figure 3-6 System summary section of Integra WEB GUI

It is possible to change the "System summary" sensor view by pressing the EDIT button, see *Figure 3-7* below.

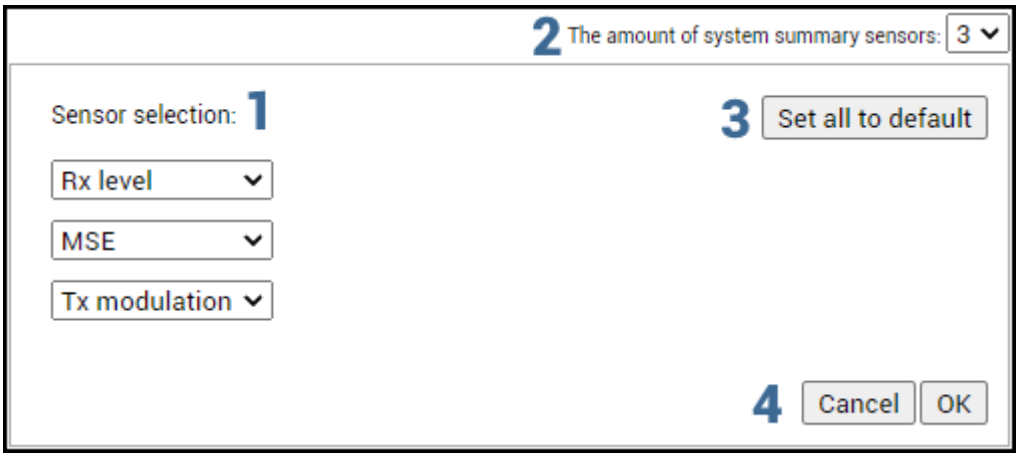


Figure 3-7 System Summary edit

1) Choose from the sensors shown in the System Summary panel.
2) Choose up to 4 sensors for display (by default, 3 sensors are selected).
3) Reset settings to the default number and type of sensors.
4) Apply (OK) or cancel the selected configuration.

Modifying basic system parameters

Modify the system parameters from the main page by pressing the MODIFY button. From here, you can do the initial link configuration and set the system operational mode.

Set system operational mode

Initially, the XPIC mode is enabled. Press the MODIFY button, and entry fields will appear for changing values. It is possible to change device operational modes between:

1) Single channel configuration (use Channel A for single vertical polarization and Channel B for single horizontal polarization):

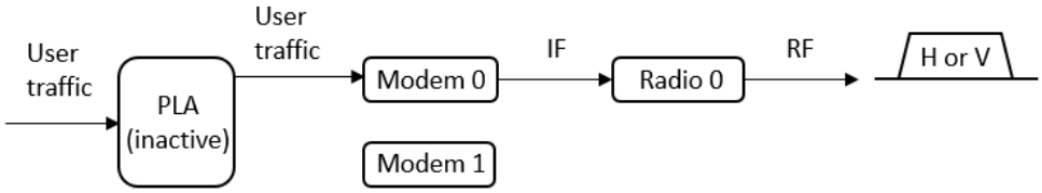


Figure 3-8 Flowchart for single channel operational mode

2) XPIC:

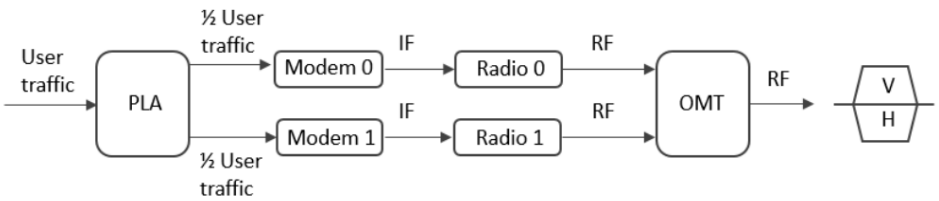


Figure 3-9 Flowchart for XPIC operational mode

3) ACAP (Adjacent Channel Adjacent Polarization mode with 2 channels each using different polarization and different channel):

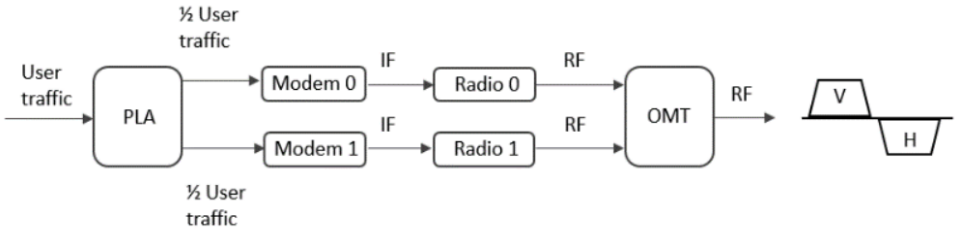


Figure 3-10 Flowchart for ACAP operational mode

Additionally, for Integra-FIDU/FIDU+ without diplexer (with IBU connected), the ACAP mode will also allow operating in ACCP mode, where the polarization can be determined by how the waveguides from the IBU are connected to antennas.

4) ACCP (Adjacent Channel Co-Polarized mode with 2 channels each using different frequency channels and the same polarization):

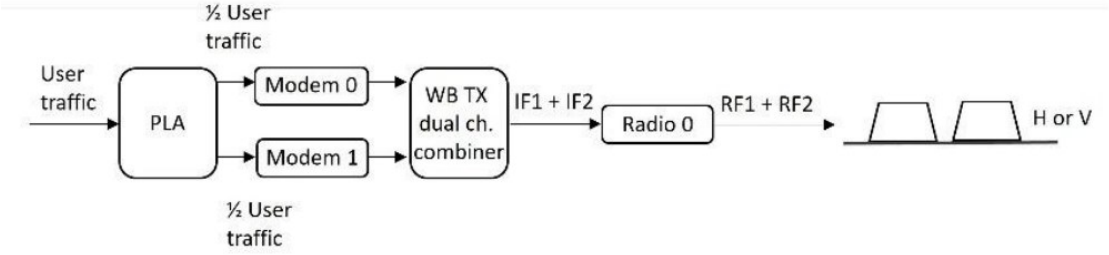


Figure 3-11 Flowchart for ACCP operational mode

ACCP mode is available only in Integra-X and Integra-X2 30 GHz radios.

5) SD (1+1 Space Diversity):

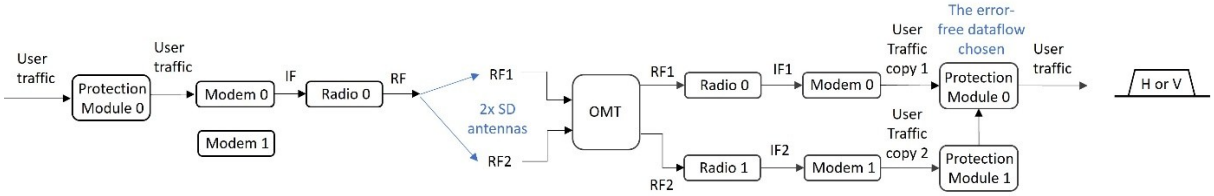


Figure 3-12 Flowchart for 1+1 SD operational mode with Integra-X/-X2

6) HSB (1+1 Hot Standby):

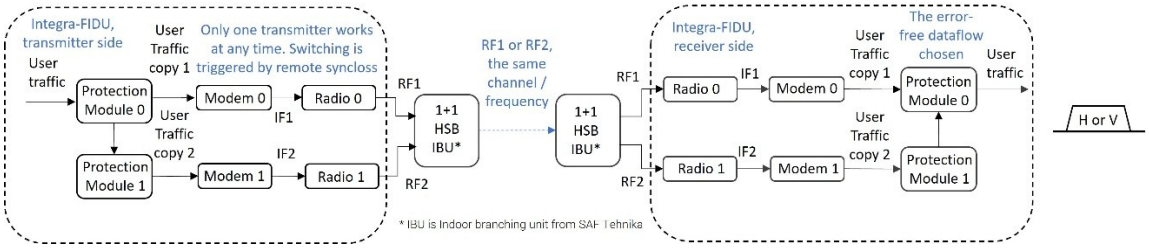


Figure 3-13 Flowchart for 1+1 HSB operational mode with Integra-FIDU/-FIDU+

7) FD (1+1 Frequency Diversity):

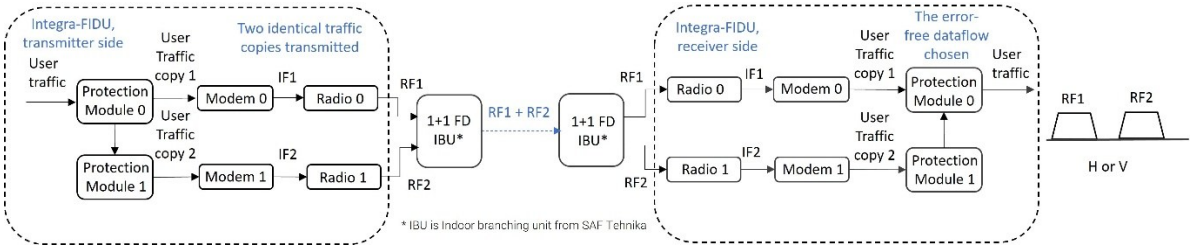


Figure 3-14 Flowchart for 1+1 FD operational mode with Integra- FIDU/-FIDU+

Operational mode selection from the Main menu can be seen in *Figure* 3-15 below:

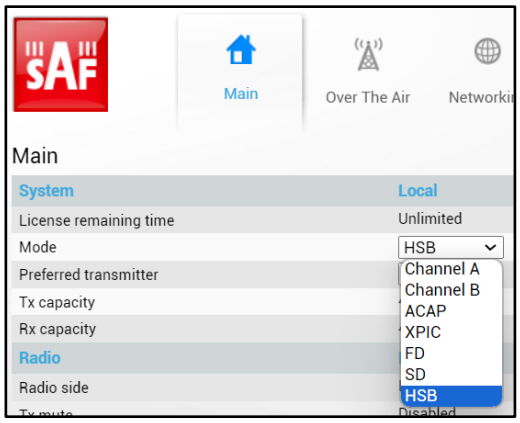


Figure 3-15 Changing system operational mode

XPIC mode

Choose XPIC in System configuration, see *Figure* 3-15.

XPIC – status mode

Main

System	Local	Remote		
License remaining time	1 Unlimited	Unlimited		
Mode	2 XPIC	XPIC		
Tx capacity	3 2208 Mbps	2208 Mbps		
Rx capacity	4 2208 Mbps	2208 Mbps		
Radio	**Local A**	**Remote A**	**Local B**	**Remote B**
Radio side	5 Low	High	Low	High
Tx mute	6 Disabled	Disabled	Disabled	Disabled
Tx power	7 26 dBm	26 dBm	26 dBm	26 dBm
ATPC	8 Disabled	Disabled	Disabled	Disabled
Duplex shift	9 1560 MHz	1560 MHz	1560 MHz	1560 MHz
Tx frequency	10 17920 MHz	19480 MHz	17920 MHz	19480 MHz
Rx frequency	11 19480 MHz	17920 MHz	19480 MHz	17920 MHz
Rx level	12 -41 dBm	-40 dBm	-38 dBm	-37 dBm
Modem	**Local A**	**Remote A**	**Local B**	**Remote B**
Bandwidth	13 112 MHz ETSI	112 MHz ETSI	112 MHz ETSI	112 MHz ETSI
Minimum modulation / 170.2 Mbps	14 4QAM	4QAM	4QAM	4QAM
Maximum modulation / 1104.3 Mbps	15 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Header compression	16 Disabled	Disabled	Disabled	Disabled
Acquire status	17 Locked	Locked	Locked	Locked
FEC locked	18 Yes	Yes	Yes	Yes
MSE	19 -42.7 dB	-43.7 dB	-43.4 dB	-43.6 dB
FEC load	20 9.8e-04	1.5e-04	5.3e-04	1.5e-04
XPD Estimated	21 41.9 dB	35.0 dB	46.4 dB	36.9 dB
Current Rx modulation	22 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Current Tx modulation	23 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Current Rx Ethernet capacity	24 1104.4 Mbps	1104.4 Mbps	1104.4 Mbps	1104.4 Mbps
Current Tx Ethernet capacity	25 1104.4 Mbps	1104.4 Mbps	1104.4 Mbps	1104.4 Mbps
Ethernet				
Port	26 LAN1 (RJ-45)	LAN2 (SFP+)	LAN3 (SFP+)	
State	27 Enabled	Disabled	Disabled	
Status	28 1000 Mbps	Down	Down	

Figure 3-16 XPIC – modify mode

The Local and Remote sides of the link are represented. For XPIC four columns are shown – Local A&B channels and Remote A&B channels. In the case of Single Channel (polarization) mode, only two columns will be shown for the corresponding channel – Local and Remote.

1) ***License remaining time*** – time left until the capacity of the system will be limited to the minimum (2Mbps). If the time limitation is not active, "Unlimited" will be shown. Refer to chapter *System → Tools → License management* for more details.
2) ***Mode*** – system operational mode - XPIC, ACAP, or single polarization.
3) ***Tx capacity*** – maximum available Tx capacity according to the configured modulation scheme, bandwidth, and system operational mode.
4) ***Rx capacity*** - maximum link available Rx capacity with configured maximal modulation schema, current bandwidth, and system configuration.
5) ***Radio side*** – "Low" or "High" side, depends on working frequencies of the link, not modifiable and factory hardware preset value, which is also indicated on the device label.
6) ***Tx mute*** – Tx mute status, configurable in Over The Air page. Allows turning the transmitter power off. It may be effective when diagnosing interference existence – when the transmitter power of one side is off, you should not observe significant RSL on the other side. Synchronization is lost on the Tx channel while the transmitter is muted.
7) ***Tx power*** – currently configured Tx power.
8) ***ATCP*** – ATPC status, configurable in Over The Air page.
9) ***Duplex shift*** – radio duplex shift, the difference between Tx and Rx frequencies, not modifiable, and factory hardware preset value.
10) ***Tx frequency*** – currently selected Tx frequency for the local radio.
11) ***Rx frequency*** – receiving frequency for the local radio. Determined by the Tx frequency and duplex shift.
12) ***Rx level*** – current signal Rx level for the corresponding polarization. Value updates with the browser refresh frequency. The Rx level needs to be according to the link budget calculation within a ±2dB margin.
13) ***Bandwidth*** – currently configured bandwidth.
14) ***Minimum modulation*** – configured minimum modulation. Data capacity, which can be obtained with minimum modulation, is shown after the slash symbol. In case when fixed modulation modem profile is used, the minimum modulation will be the same as the *Maximum modulation* parameter (see below), and, in this case, when the MSE (Mean Square Error) degrades below the threshold value, radio link synchronization will be lost, and it will stop working. In the case of the ACM modem profile, when the radio signal is decreasing, the device will switch to lower modulations until the minimum modulation is reached. If the signal decreases further and the Rx level drops below the RSL sensitivity threshold value for the configured minimum modulation, link synchronization will be lost.
15) ***Maximum modulation*** – configured maximum modulation. Data capacity, which can be obtained with maximum modulation, is shown after the slash symbol. In the case of a fixed modulation modem profile, maximum modulation is the same as the minimum modulation. In the case of the ACM modem profile, if the Rx level on the radio channel is high enough, then the device will try to use the highest possible modulation until maximum modulation is reached.
16) ***Header compression*** – state of the header compression on the link.
17) ***Acquire status*** – *Locked* = the link is established (Rx level and MSE are within acceptable margins); *Sweep* = the link is not established (Rx level is below the sensitivity threshold, MSE is degraded, or there's a configuration/firmware mismatch on both sides of the link).
18) ***FEC locked*** – shows whether the Forward Error Correction algorithm is working, and the amount of corrected errors is significantly higher compared to uncorrected errors;
19) ***MSE*** – Mean Square Error indication.
20) ***FEC load*** – Forward Error Correction load.
21) ***XPD estimated*** – cross-polarization discrimination between the two orthogonal polarizations. Value 25…40dB is acceptable for normal operation.
22) ***Current Rx modulation*** – received signal modulation.
23) ***Current Tx modulation*** – transmitted signal modulation.

24) Current Rx Ethernet capacity - current available Rx capacity, in case ACM is enabled, the current received capacity can differ from the maximum available capacity.
25) Current Tx Ethernet capacity - current available Tx capacity, in case ACM is enabled, the current transmitted capacity can differ from the maximum available capacity.
26) Port – Name and connection type of the Ethernet port: RJ-45 or SFP/SFP+.
27) State – Ethernet port state – Enabled or Disabled.
28) Status – Ethernet port status, up or down (if the port is enabled).

XPIC – modify mode

In XPIC mode, configuration changes are applied for the "Local A" column only, and the "Local B" column configuration will automatically adjust when the "Execution configuration" button is pressed.

System		Local	Remote
License remaining time		Unlimited	Unlimited
Mode	1	XPIC	XPIC
Tx capacity		2208 Mbps	2208 Mbps
Rx capacity		2208 Mbps	2208 Mbps

Figure 3-17 System section of XPIC mode Main page in modify mode

Radio		Local A	Remote A	Local B	Remote B
Radio side		Low	High	Low	High
Tx mute		Disabled	Disabled	Enabled	Enabled
Tx power (10 .. 26 dBm for 4096QAM)	2	26 dBm	26 dBm	26 dBm	26 dBm
ATPC		Disabled	Disabled	Disabled	Disabled
Duplex shift (-1042.50 .. 357.50 MHz)	3	357.50 MHz	-357.50 MHz	357.50 MHz	-357.50 MHz
Tx frequency (5712.50 .. 7112.50 MHz)	4	6755.00 MHz	7112.50 MHz	6755 MHz	7112.50 MHz
Rx frequency		7112.50 MHz	6755 MHz	7112.50 MHz	6755 MHz
Rx level		-51 dBm	-50 dBm	-50 dBm	-51 dBm

Figure 3-18 Radio section of XPIC mode Main page in modify mode

1) Mode – choose **XPIC** mode.
2) Tx power - the available range depends on the radio model and selected modem profile. The possible range for selection will be indicated in brackets.
3) Duplex shift – the available Duplex (Tx/Rx) shift range is indicated in brackets. Allows setting the Duplex shift between Tx and Rx central frequencies.

Changeable Duplex shift option is available only in Integra-FIDU/FIDU+ radios without a diplexer.

4) Tx frequency - the available frequency range is indicated in brackets. TX frequency range indicates the range of central frequencies for the configured channel bandwidth.

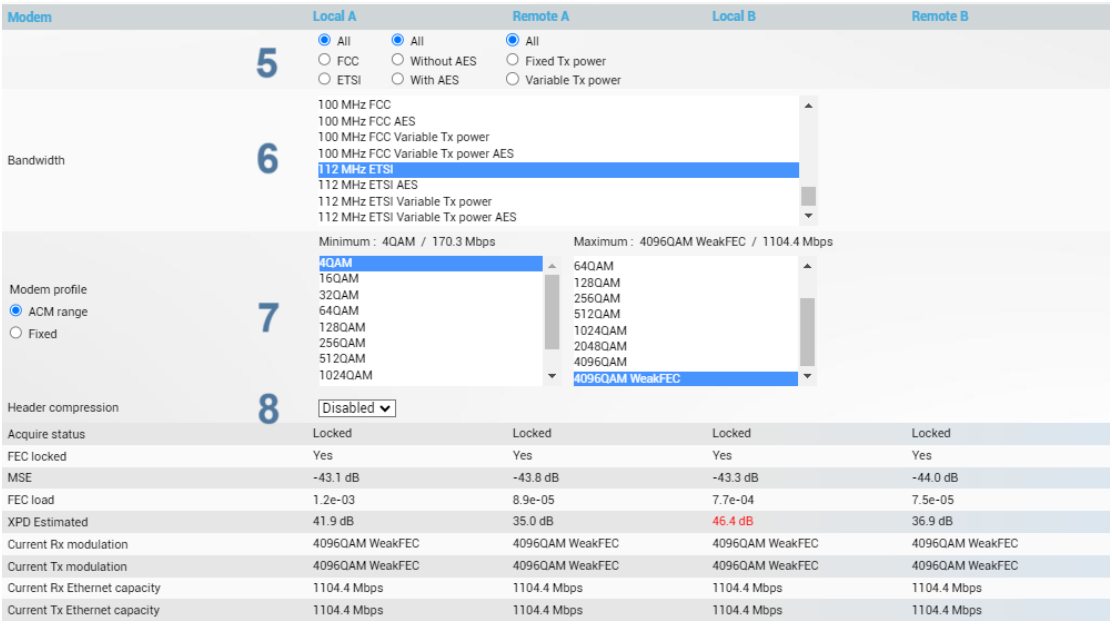


Figure 3-19 Modem section of XPIC mode Main page in modify mode

5) ***Filter for bandwidth standard*** – allows filtering bandwidth options for selection in point 5 by:
   a. radio standards: FCC or ETSI.
   b. AES encryption: with or without.

> ⚠ AES encryption is available only in Integra-X2 and Integra-FIDU/FIDU+ models.

   c. Tx power mode for ACM: fixed (Tx power will not change when ACM modulation changes) or variable (Tx power will change when ACM modulation changes. When modulation decreases, Tx power will increase, and when modulation increases, Tx power will decrease).

6) ***Bandwidth*** - allows choosing between available channel bandwidth options.

7) ***Minimum*** – allows setting the minimum modulation that can be used in the ACM algorithm. If the radio signal decreases, Integra-X/-X2/-FIDU/-FIDU+ will switch to lower modulation until minimum modulation is reached. If the signal decreases even further and RSL drops below the sensitivity threshold value for the configured minimum modulation, radio link synchronization will be lost. If minimum modulation is set the same as maximum modulation, ACM is disabled.
   Maximum – allows setting the maximum modulation that can be used in the ACM algorithm. If MSE is high enough, Integra will utilize the highest possible modulation until maximum modulation is reached. If maximum modulation is set the same as minimum modulation, ACM is disabled.

8) ***Header compression*** – allows setting up Ethernet packet header compression on the radio link. It can be:
   a. ***Disabled***.
   b. ***Default*** – enables packet header compression for up to 2048 traffic streams.
   c. ***Adaptive*** – enables packet header compression that adapts to data traffic load, and in case the load increases, Integra will compress headers only for traffic streams that have higher rates of header pattern reoccurrence.

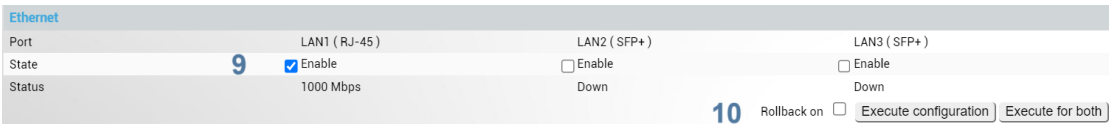


Figure 3-20 Ethernet section of XPIC mode Main page in modify mode

9) ***State*** - allows enabling/disabling each of the three available LAN ports.

10) By pressing ***Execute configuration,*** changes made to the corresponding section apply only to the local side A and B channels. If ***Rollback on*** is selected, then in case of incorrect configuration of the radio link, which caused it to stop working, the last saved or default configuration will be restored on Integra.
Execute for both - applies changes made to the corresponding section, both for the local and remote side Integra radios A and B channels. If ***Rollback on*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

The rollback procedure is triggered only when management connectivity of the devices has been lost due to the applied configuration changes. For this reason, the ***Rollback on*** option should be selected only when the radio link between the Local and Remote sites has already been established and synchronized. Rollback will not work in case the Remote side of the link has not been reachable before the configuration change took effect, and selection of this option will even display a pop-up internal error message in Integra WEB GUI.

If the configuration after modification is not saved, it will be lost after the radio restarts. Indication of unsaved configuration will be shown in the always visible MODIFY/SAVE/LOGOUT section on the top right part of the WEB GUI page with a red circle on the SAVE button and a white digit indicating the number of unsaved configuration changes on the device: 

Single polarization mode

For single-polarization operation, choose *Channel A* for Vertical or *Channel B* for Horizontal polarization, see *Set system operational mode* section.

Single polarization – status mode

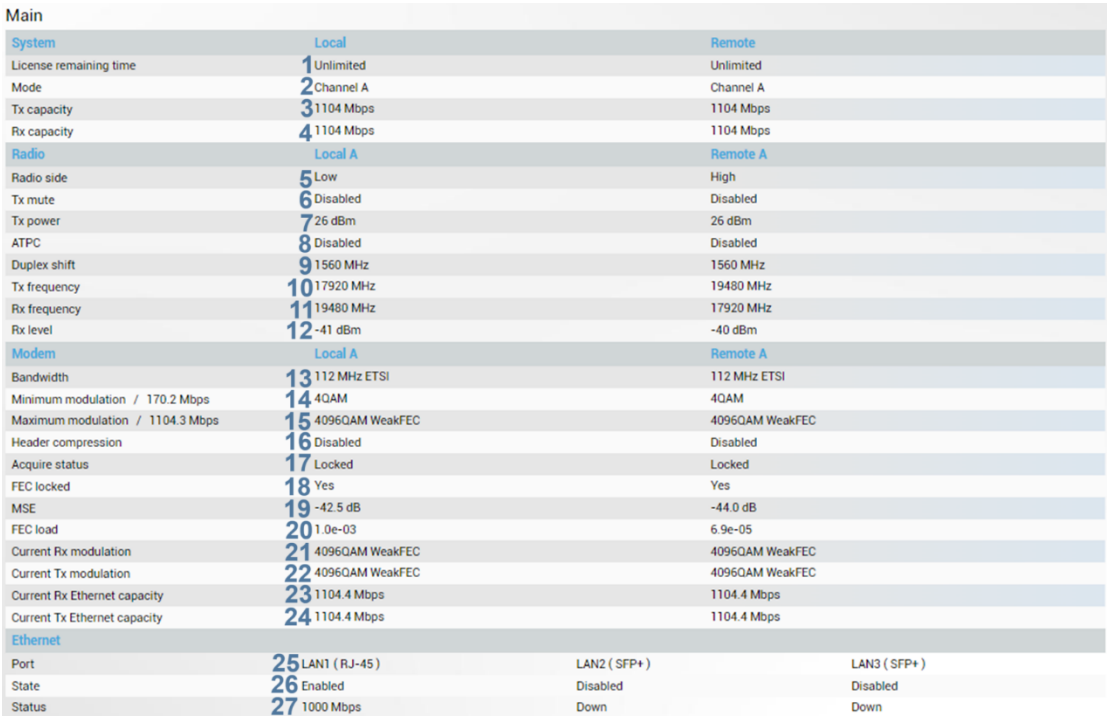


Figure 3-21 Single polarization – status mode

The local and remote sides of the link are represented. In the single Channel (polarization) mode, only two columns will be shown – Local for Channel A or B, and Remote for Channel A or B. For configuring XPIC mode, see *XPIC* section.

1) ***License remaining time*** – time left until the capacity of the system will be limited to the minimum (2Mbps). If the time limitation is not active, "Unlimited" will be shown. Refer to the chapter *System → Tools → License management* for further details.
2) ***Mode*** – system operational mode, choose Channel A for the Vertical polarization, Channel B for the Horizontal polarization. For XPIC configuration, see *XPIC* section.
3) ***Tx capacity*** – maximum available Tx capacity according to the configured modulation scheme, bandwidth, and system operational mode.
4) ***Rx capacity*** - maximum link available Rx capacity with configured maximal modulation schema, current bandwidth, and system configuration.
5) ***Radio side*** – "Low" or "High" side, depends on working frequencies of the link, not modifiable.
6) ***Tx mute*** – Tx mute status, configurable on the Over The Air page. Allows turning the transmitter power off. It may be effective when diagnosing interference existence – when the transmitter power of one side is off, you should not observe significant RSL on the other side. Synchronization is lost on the Tx channel while the transmitter is muted.
7) ***Tx power*** – currently configured Tx power.
8) ***ATPC*** – ATPC status, configurable in Over The Air page page.
9) ***Duplex shift*** – radio duplex shift, the difference between Tx and Rx frequencies, not modifiable.
10) ***Tx frequency*** – currently set the Tx frequency for local radio.
11) ***Rx frequency*** – receiving frequency for local radio. Determined by Tx frequency and duplex shift.
12) ***Rx level*** – current Rx level for the current polarization. Value updating with browser update frequency. The Rx level needs to be according to the link budget calculation within a ±2dB margin.
13) ***Bandwidth*** – currently configured bandwidth.

14) ***Minimum modulation*** – configured minimum modulation. Data capacity, which can be obtained with minimum modulation, is shown after the slash symbol. In case when fixed modulation modem profile is used, the minimum modulation will be the same as the *Maximum modulation* parameter (see below), and, in this case, when the MSE (Mean Square Error) degrades below the threshold value, radio link synchronization will be lost, and it will stop working. In the case of the ACM modem profile, when the radio signal is decreasing, the device will switch to lower modulations until the minimum modulation is reached. If the signal decreases further and the Rx level drops below the RSL sensitivity threshold value for the configured minimum modulation, link synchronization will be lost.
15) ***Maximum modulation*** – configured maximum modulation. Data capacity, which can be obtained with maximum modulation, is shown after the slash symbol. In the case of a fixed modulation modem profile, maximum modulation is the same as the minimum modulation. In the case of the ACM modem profile, if the Rx level on the radio channel is high enough, then the device will try to use the highest possible modulation until maximum modulation is reached.
16) ***Header compression*** – state of the header compression on the link.
17) ***Acquire status*** – Locked = the link is established (Rx level and MSE are within acceptable margins); Sweep = the link is not established (Rx level is below the sensitivity threshold, MSE is degraded, or there's a configuration/firmware mismatch on both sides of the link).
18) ***FEC locked*** – forward Error Correction algorithm is working, and the amount of corrected errors is significantly higher compared to uncorrected errors.
19) ***MSE*** – Mean Square Error indication.
20) ***FEC load*** – Forward Error Correction load.
21) ***Current Rx modulation*** – received signal modulation.
22) ***Current Tx modulation*** – transmitted signal modulation.
23) ***Current Rx Ethernet capacity*** - current available Rx capacity, in case ACM is enabled, the current received capacity can differ from the configured maximum capacity.
24) ***Current Tx Ethernet capacity*** - current available Tx capacity, in case ACM is enabled, the current transmitted capacity can differ from the configured maximum capacity.
25) ***Port*** – Name and connection type of the Ethernet port, RJ-45 or SFP/SFP+.
26) ***State*** – Ethernet port state –Enabled or Disabled.
27) ***Status*** – Ethernet port status: up or down (if the port is enabled).

Single polarization – modify mode

In Single polarization mode configuration changes are applied for the "Local A/B" column only.

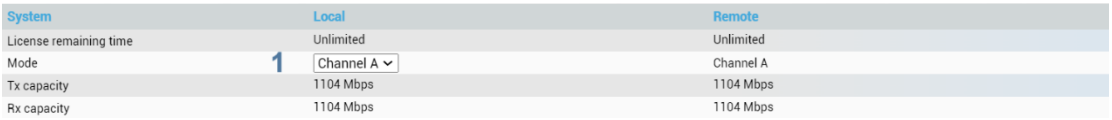


Figure 3-22 System section of Single polarization mode Main page in modify mode

Figure 3-23 Radio section of Single polarization mode Main page in modify mode

1) ***Mode*** – choose **Channel A** mode (or Channel B).
2) ***Tx power*** - the available range depends on the radio model and selected modem profile. The possible range for selection will be indicated in brackets.
3) ***Duplex shift*** – the available Duplex (Tx/Rx) shift range is indicated in brackets. Allows setting the Duplex shift between the Tx and Rx central frequencies.

Changeable Duplex shift option is available only in Integra-FIDU/FIDU+ radios without a diplexer.

4) *Tx frequency* - the available frequency range is indicated in brackets. The TX frequency range indicates the range of central frequencies for the configured channel bandwidth.

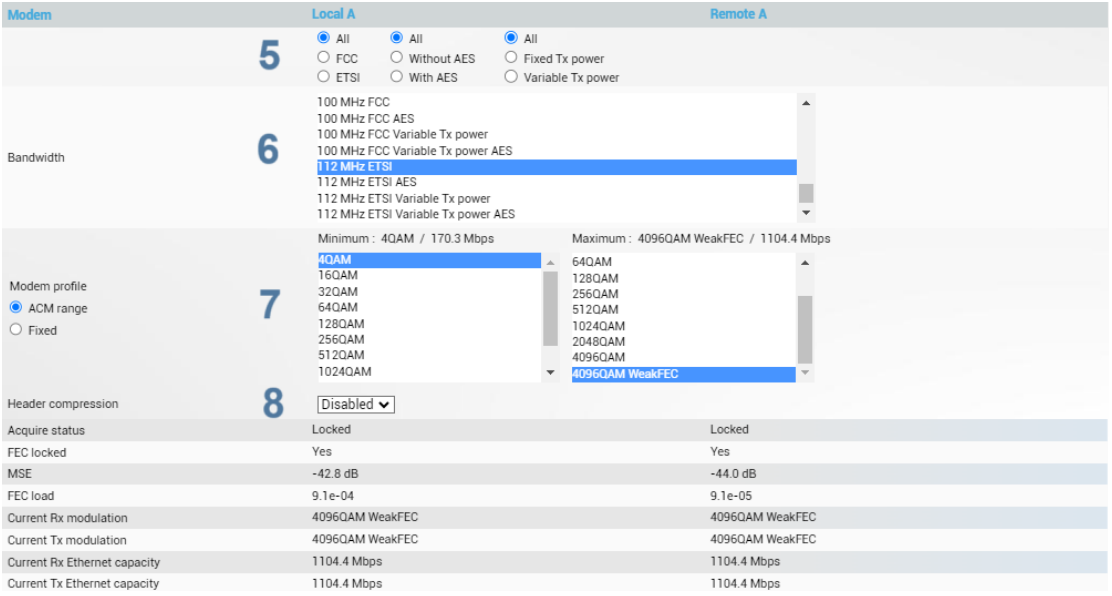


Figure 3-24 Modem section of Single polarization mode Main page in modify mode

5) *Filter for bandwidth standard* – allows filtering bandwidth options for selection in point 5 by:
   a. Radio standards: FCC or ETSI.
   b. AES encryption: with or without.

AES encryption is available only in Integra-X2 and Integra-FIDU/FIDU+ models.

   c. Tx power mode for ACM: fixed (Tx power will not change when ACM modulation changes) or variable (Tx power will change when ACM modulation changes. When modulation decreases, Tx power will increase, and when modulation increases, Tx power will decrease).

6) *Bandwidth* - allows choosing between available channel bandwidth options;

7) *Minimum* – allows setting the minimum modulation that can be used in the ACM algorithm. If the radio signal decreases, Integra-X/-X2/-FIDU/-FIDU+ will switch to lower modulation until minimum modulation is reached. If the signal decreases even further and RSL drops below the sensitivity threshold value for the configured minimum modulation, radio link synchronization will be lost. If minimum modulation is set the same as maximum modulation, ACM is disabled.
   Maximum – allows setting the maximum modulation that can be used in the ACM algorithm. If MSE is high enough, Integra will utilize the highest possible modulation until maximum modulation is reached. If maximum modulation is set the same as minimum modulation, ACM is disabled.

8) *Header compression* – allows setting up Ethernet packet header compression on the radio link. It can be:
   a. *Disabled*.
   b. *Default* – enables packet header compression for up to 2048 traffic streams.
   c. *Adaptive* – enables packet header compression that adapts to data traffic load, and in case the load increases, Integra will compress headers only for traffic streams that have higher rates of header pattern reoccurrence.

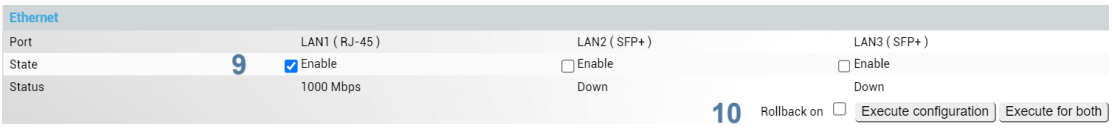
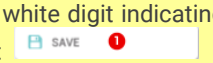


Figure 3-25 Ethernet section of Single polarization mode Main page in modify mode

9) ***State*** - allows enabling/disabling each of the three available LAN ports.

10) By pressing ***Execute configuration,*** changes made to the corresponding section apply only to the local side A or B channel. If ***Rollback on*** is selected, then in case of incorrect configuration of the radio link, which caused it to stop working, the last saved or default configuration will be restored on Integra.
Execute for both - applies changes made to the corresponding section, both for the local and remote side Integra radios A and B channels. If ***Rollback on*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

The rollback procedure is triggered only when management connectivity of the devices has been lost due to the applied configuration changes. For this reason, the ***Rollback on*** option should be selected only when the radio link between the Local and Remote sites has already been established and synchronized. Rollback will not work in case the Remote side of the link has not been reachable before the configuration change took effect, and selection of this option will even display a pop-up internal error message in Integra WEB GUI.

If the configuration after modification is not saved, it will be lost after the radio restarts. Indication of unsaved configuration will be shown in the always visible MODIFY/SAVE/LOGOUT section on the right top part of the WEB GUI page with a red circle on the SAVE button and a white digit indicating the number of unsaved configuration changes on the device: 

ACAP mode and ACCP mode

Choose “ACAP” or “ACCP” in the System operational mode configuration drop-down menu, see *Figure* 3-15. The ACCP mode is available only in 30 GHz Integra-X and Integra-X2 radios. If using the ACCP mode is required for Integra-FIDU/FIDU+ without a diplexer (with IBU connected), the “ACAP” mode must be chosen. In this case, for ACCP mode, both IBU antenna ports must be connected to the antennas in the same polarization.

ACAP and ACCP – status mode

Main

System	Local	Remote		
License remaining time	1 Unlimited	Unlimited		
Mode	2 ACAP	ACAP		
Tx capacity	3 2208 Mbps	2208 Mbps		
Rx capacity	4 2208 Mbps	2208 Mbps		
Radio	**Local A**	**Remote A**	**Local B**	**Remote B**
Radio side	5 Low	High	Low	High
Tx mute	6 Disabled	Disabled	Disabled	Disabled
Tx power	7 26 dBm	26 dBm	26 dBm	26 dBm
ATPC	8 Disabled	Disabled	Disabled	Disabled
Duplex shift	9 1560 MHz	1560 MHz	1560 MHz	1560 MHz
Tx frequency	10 17920 MHz	19480 MHz	18032 MHz	19592 MHz
Rx frequency	11 19480 MHz	17920 MHz	19592 MHz	18032 MHz
Rx level	12 -41 dBm	-40 dBm	-37 dBm	-37 dBm
Modem	**Local A**	**Remote A**	**Local B**	**Remote B**
Bandwidth	13 112 MHz ETSI	112 MHz ETSI	112 MHz ETSI	112 MHz ETSI
Minimum modulation / 170.2 Mbps	14 4QAM	4QAM	4QAM	4QAM
Maximum modulation / 1104.3 Mbps	15 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Header compression	16 Disabled	Disabled	Disabled	Disabled
Acquire status	17 Locked	Locked	Locked	Locked
FEC locked	18 Yes	Yes	Yes	Yes
MSE	19 -42.4 dB	-44.0 dB	-42.5 dB	-43.8 dB
FEC load	20 1.2e-03	6.7e-05	7.1e-04	2.3e-04
Current Rx modulation	21 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Current Tx modulation	22 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Current Rx Ethernet capacity	23 1104.4 Mbps	1104.4 Mbps	1104.4 Mbps	1104.4 Mbps
Current Tx Ethernet capacity	24 1104.4 Mbps	1104.4 Mbps	1104.4 Mbps	1104.4 Mbps
Ethernet				
Port	25 LAN1 (RJ-45)	LAN2 (SFP+)	LAN3 (SFP+)	
State	26 Enabled	Disabled	Disabled	
Status	27 1000 Mbps	Down	Down	

Figure 3-26 ACAP and ACCP – status mode

Configuration for both adjacent radio channels A and B on both the Local and Remote sides is shown.

1) *License remaining time* – time left until the capacity of the system will be limited to the minimum (2Mbps). If the time limitation is not active, "Unlimited" will be shown. Refer to the chapter *System → Tools → License management* for more details.
2) *Mode* – system operational mode, which is ACAP or ACCP in this case.
3) *Tx capacity* – maximum possible Tx capacity of the device according to the configured modulation scheme, bandwidth, and operational mode.
4) *Rx capacity* – maximum possible Rx capacity of the device according to the configured modulation scheme, bandwidth, and operational mode.
5) *Radio side* – "Low" or "High" side. Not changeable and factory hardware preset value, which is also indicated on the device label, and shows which frequency range can be used on the device.
6) *Tx mute* – Tx mute status, configurable on the Over The Air page. Allows turning the transmitter power off. It may be effective when diagnosing interference existence – when the transmitter power of one side is off, you should not observe significant RSL on the other side. The link is not operational during Tx mute.
7) *Tx power* – currently configured Tx power.
8) *ATCP* – ATPC status, configurable in Over The Air page.
9) *Duplex shift* – radio duplex shift, the difference between Tx and Rx frequencies, not modifiable, and factory hardware preset value.
10) *Tx frequency* – currently selected Tx frequency for the local radio.
11) *Rx frequency* – receiving frequency for the local radio. Determined by the Tx frequency and duplex shift.
12) *Rx level* – current signal Rx level for the corresponding polarization. Value updates with the browser refresh frequency. The Rx level needs to be according to the link budget calculation within a ±2dB margin.
13) *Bandwidth* – currently configured bandwidth for the radio channel.
14) *Minimum modulation* – configured minimum modulation. Data capacity, which can be obtained with this minimum modulation, is shown after the slash symbol. In case when

fixed modulation modem profile is used, the minimum modulation will be the same as the *Maximum modulation* parameter (see below), and, in this case, when the MSE (Mean Square Error) degrades below the threshold value, radio link synchronization will be lost, and it will stop working. In the case of the ACM modem profile, when the radio signal is decreasing, the device will switch to lower modulations until the minimum modulation is reached. If the signal decreases further and the Rx level drops below the RSL sensitivity threshold value for the configured minimum modulation, link synchronization will be lost.

15) ***Maximum modulation –*** configured maximum modulation. The data capacity that can be obtained with this maximum modulation is shown after the slash symbol. In the case of a fixed modulation modem profile, maximum modulation is the same as the minimum modulation. In the case of the ACM modem profile, if the Rx level on the radio channel is high enough, then the device will try to use the highest possible modulation until maximum modulation is reached.
16) ***Header compression –*** state of the header compression on the link.
17) ***Acquire status*** – *Locked* = the link is established (Rx level and MSE are within acceptable margins); *Sweep* = the link is not established (Rx level is below the sensitivity threshold, MSE is degraded, or there's a configuration/firmware mismatch on both sides of the link).
18) ***FEC locked*** – shows whether the Forward Error Correction algorithm is working, and the amount of corrected errors is significantly higher compared to uncorrected errors.
19) ***MSE*** – Mean Square Error indication.
20) ***FEC load*** – Forward Error Correction load.
21) ***Current Rx modulation –*** received signal modulation.
22) ***Current Tx modulation –*** transmitted signal modulation.
23) ***Current Rx Ethernet capacity*** – current available Rx capacity, in case ACM is enabled, the current received capacity can differ from the configured maximum capacity.
24) ***Current Tx Ethernet capacity*** - current available Tx capacity, in case ACM is enabled, the current transmitted capacity can differ from the maximum available capacity.
25) ***Port*** – Name and connection type of the Ethernet port: RJ-45 or SFP/SFP+.
26) ***State*** – Ethernet port state – Enabled or Disabled.
27) ***Status*** – Ethernet port status, up or down (if the port is enabled).

ACAP and ACCP – modify mode

In ACAP and ACCP modes, the configuration changes are applied for the "Local A" column and the "Local B" column separately.

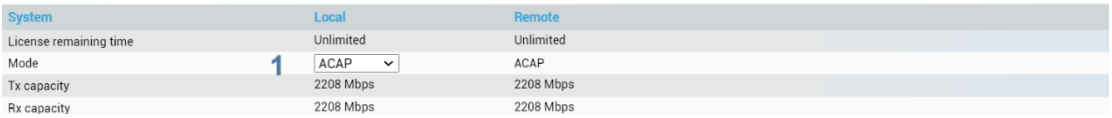


Figure 3-27 System section of ACAP mode Main page in modify mode

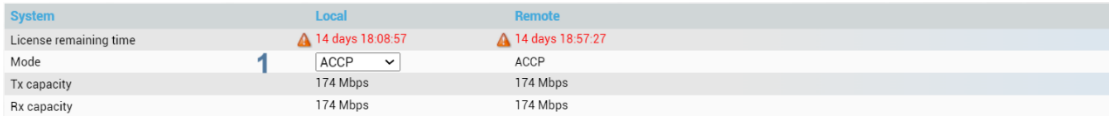


Figure 3-28 System section of ACCP mode Main page in modify mode

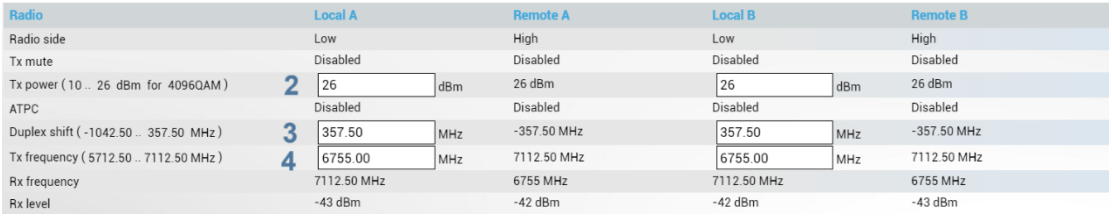


Figure 3-29 Radio section of ACAP and ACCP modes Main page in modify mode

1) *Mode* – choose **ACAP** or **ACCP** mode.
2) *Tx power* - the available range depends on the radio model and selected modem profile. The possible range for selection will be indicated in brackets.
3) *Duplex shift* – the available Duplex (Tx/Rx) shift range is indicated in brackets. Allows setting the Duplex shift between the Tx and Rx central frequencies.

Changeable Duplex shift option is available only in Integra-FIDU/FIDU+ radios without a diplexer.

4) *Tx frequency* - the available frequency range is indicated in brackets. The Tx frequency range indicates the range of central frequencies for the configured channel bandwidth.

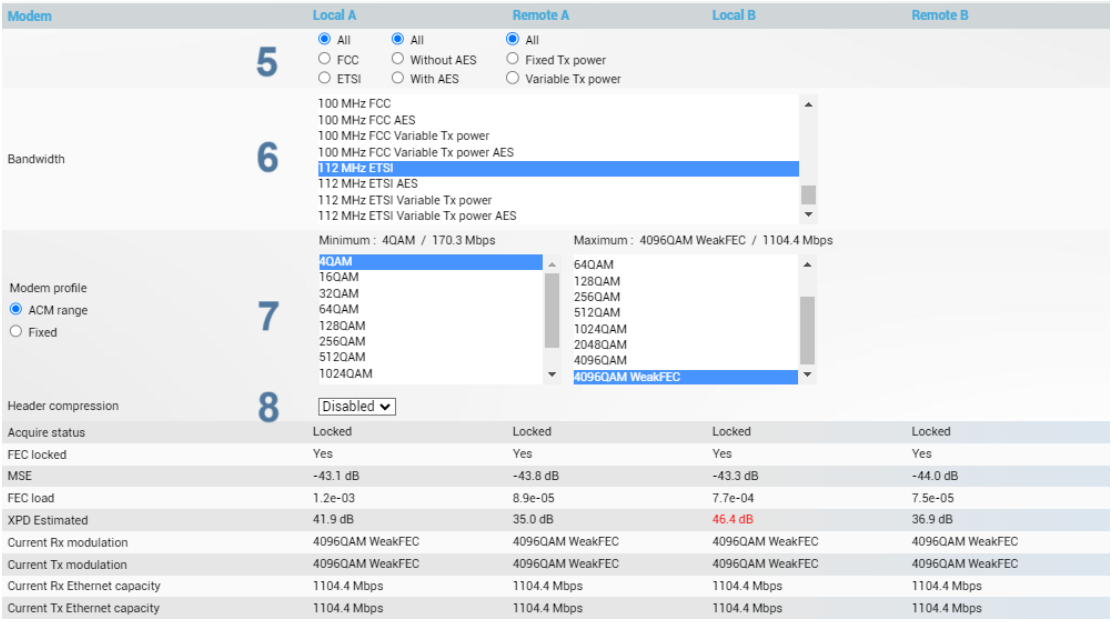


Figure 3-30 Modem section of ACAP and ACCP modes Main page in modify mode

5) *Filter for bandwidth standard* – allows filtering bandwidth options for selection in point 5 by:
   a. Radio standards: FCC or ETSI.
   b. AES encryption: with or without.

AES encryption is available only in Integra-X2 and Integra-FIDU/FIDU+ models.

   c. Tx power mode for ACM: fixed (Tx power will not change when ACM modulation changes) or variable (Tx power will change when ACM modulation changes. When modulation decreases, Tx power will increase, and when modulation increases, Tx power will decrease).
6) *Bandwidth* – allows choosing between available channel bandwidth options.
7) *Minimum* – allows setting the minimum modulation that can be used in the ACM algorithm. If the radio signal decreases, Integra-X/-X2/-FIDU/-FIDU+ will switch to lower modulation until minimum modulation is reached. If the signal decreases even further and RSL drops below the sensitivity threshold value for the configured minimum

modulation, radio link synchronization will be lost. If minimum modulation is set the same as maximum modulation, ACM is disabled.
Maximum **–** allows setting the maximum modulation, which can be used in the ACM algorithm. If MSE is high enough, Integra will utilize the highest possible modulation until maximum modulation is reached. If maximum modulation is set the same as minimum modulation, ACM is disabled.

8) ***Header compression*** **–** allows setting up Ethernet packet header compression on the radio link. It can be:
   a. ***Disabled***.
   b. ***Default*** – enables packet header compression for up to 2048 traffic streams.
   c. ***Adaptive*** – enables packet header compression that adapts to data traffic load, and in case the load increases, Integra will compress headers only for traffic streams that have higher rates of header pattern reoccurrence.

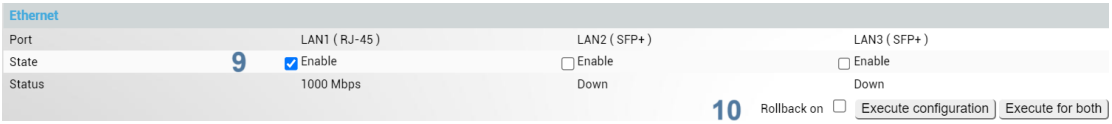
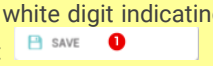


Figure 3-31 Ethernet section of ACAP and ACCP modes Main page in modify mode

9) ***State*** - allows enabling/disabling each of the three available LAN ports.

10) By pressing ***Execute configuration,*** changes made to the corresponding section apply only to the local side A and B channels. If ***Rollback on*** is selected, then in case of incorrect configuration of the radio link, which caused it to stop working, the last saved or default configuration will be restored on Integra.
Execute for both - applies changes made to the corresponding section, both for the local and remote side Integra radios A and B channels. If ***Rollback on*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

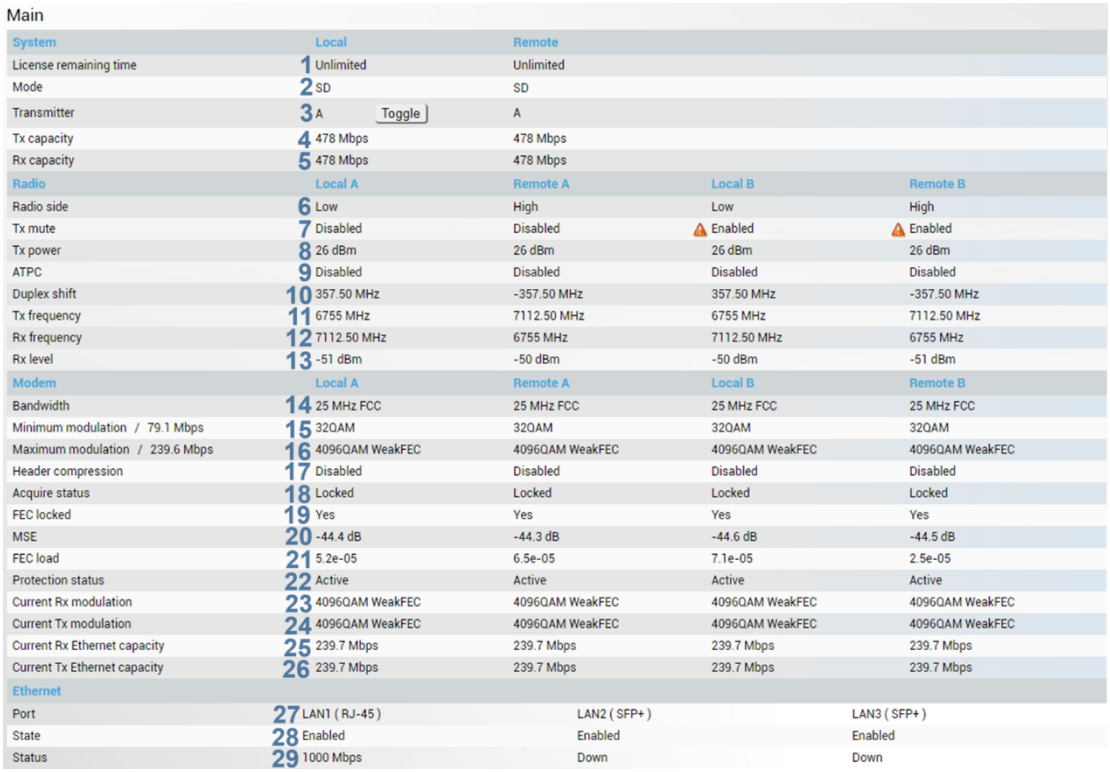
The rollback procedure is triggered only when management connectivity of the devices has been lost due to the applied configuration changes. For this reason, the ***Rollback on*** option should be selected only when the radio link between the Local and Remote sites has already been established and synchronized. Rollback will not work in case the Remote side of the link has not been reachable before the configuration change took effect, and selection of this option will even display a pop-up internal error message in Integra WEB GUI.

If the configuration after modification is not saved, it will be lost after the radio restarts. Indication of unsaved configuration will be shown in the always visible MODIFY/SAVE/LOGOUT section on the top right part of the WEB GUI page with a red circle on the SAVE button and a white digit indicating the number of unsaved configuration changes on the device: 

SD mode and HSB mode

To enable 1+1 SD (Space Diversity) or 1+1 HSB (Hot Standby) protection modes, choose “SD” or “HSB” in the System operational mode configuration drop-down menu, see *Figure* 3-15. More details about 1+1 SD and HSB modes refer to *1+1 SD, HSB and FD configurations* section.

SD and HSB – status mode



Main

System	Local	Remote		
License remaining time	1 Unlimited	Unlimited		
Mode	2 SD	SD		
Transmitter	3 A Toggle	A		
Tx capacity	4 478 Mbps	478 Mbps		
Rx capacity	5 478 Mbps	478 Mbps		
Radio	**Local A**	**Remote A**	**Local B**	**Remote B**
Radio side	6 Low	High	Low	High
Tx mute	7 Disabled	Disabled	⚠ Enabled	⚠ Enabled
Tx power	8 26 dBm	26 dBm	26 dBm	26 dBm
ATPC	9 Disabled	Disabled	Disabled	Disabled
Duplex shift	10 357.50 MHz	-357.50 MHz	357.50 MHz	-357.50 MHz
Tx frequency	11 6755 MHz	7112.50 MHz	6755 MHz	7112.50 MHz
Rx frequency	12 7112.50 MHz	6755 MHz	7112.50 MHz	6755 MHz
Rx level	13 -51 dBm	-50 dBm	-50 dBm	-51 dBm
Modem	**Local A**	**Remote A**	**Local B**	**Remote B**
Bandwidth	14 25 MHz FCC	25 MHz FCC	25 MHz FCC	25 MHz FCC
Minimum modulation / 79.1 Mbps	15 32QAM	32QAM	32QAM	32QAM
Maximum modulation / 239.6 Mbps	16 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Header compression	17 Disabled	Disabled	Disabled	Disabled
Acquire status	18 Locked	Locked	Locked	Locked
FEC locked	19 Yes	Yes	Yes	Yes
MSE	20 -44.4 dB	-44.3 dB	-44.6 dB	-44.5 dB
FEC load	21 5.2e-05	6.5e-05	7.1e-05	2.5e-05
Protection status	22 Active	Active	Active	Active
Current Rx modulation	23 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Current Tx modulation	24 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Current Rx Ethernet capacity	25 239.7 Mbps	239.7 Mbps	239.7 Mbps	239.7 Mbps
Current Tx Ethernet capacity	26 239.7 Mbps	239.7 Mbps	239.7 Mbps	239.7 Mbps
Ethernet				
Port	27 LAN1 (RJ-45)	LAN2 (SFP+)	LAN3 (SFP+)	
State	28 Enabled	Enabled	Enabled	
Status	29 1000 Mbps	Down	Down	

Figure 3-32 SD and HSB – status mode

Configuration for both radio channels A and B on both the Local and Remote sides is shown.

1) ***License remaining time*** – time left until the capacity of the system will be limited to the minimum (2Mbps). If the time limitation is not active, "Unlimited" will be shown. Refer to the chapter *System → Tools → License management* for more details.
2) ***Mode*** – system operational mode, which is SD or HSB in this case.
3) ***Transmitter*** – indicates active transmitter. It is possible to change the active transmitter by pressing "Toggle" button.
4) ***Tx capacity*** – maximum possible Tx capacity of the device according to the configured modulation scheme, bandwidth, and operational mode.
5) ***Rx capacity*** – maximum possible Rx capacity of the device according to the configured modulation scheme, bandwidth, and operational mode.
6) ***Radio side*** – "Low" or "High" side. Not changeable and factory hardware preset value, which is also indicated on the device label, and shows which frequency range can be used on the device.
7) ***Tx mute*** – Tx mute status, configurable on the page. Allows turning the transmitter power off. It may be effective when diagnosing interference existence – when the transmitter power of one side is off, you should not observe significant RSL on the other side. The link is not operational during Tx mute.
8) ***Tx power*** – currently configured Tx power.
9) ***ATPC*** – ATPC status, configurable in Over The Air page.
10) ***Duplex shift*** – radio duplex shift, the difference between Tx and Rx frequencies, not modifiable, and factory hardware preset value.
11) ***Tx frequency*** – currently selected Tx frequency for the local radio.
12) ***Rx frequency*** – receiving frequency for the local radio. Determined by the Tx frequency and duplex shift.
13) ***Rx level*** – current signal Rx level for the corresponding polarization. Value updates with the browser refresh frequency. The Rx level needs to be according to the link budget calculation within a ±2dB margin.
14) ***Bandwidth*** – currently configured bandwidth for the radio channel.

15) ***Minimum modulation*** – configured minimum modulation. The data capacity that can be obtained with this minimum modulation is shown after the slash symbol. In case when fixed modulation modem profile is used, the minimum modulation will be the same as the *Maximum modulation* parameter (see below), and, in this case, when the MSE (Mean Square Error) degrades below the threshold value, radio link synchronization will be lost, and it will stop working. In the case of the ACM modem profile, when the radio signal is decreasing, the device will switch to lower modulations until the minimum modulation is reached. If the signal decreases further and the Rx level drops below the RSL sensitivity threshold value for the configured minimum modulation, link synchronization will be lost.
16) ***Maximum modulation –*** configured maximum modulation. The data capacity that can be obtained with this maximum modulation is shown after the slash symbol. In the case of a fixed modulation modem profile, maximum modulation is the same as the minimum modulation. In the case of the ACM modem profile, if the Rx level on the radio channel is high enough, then the device will try to use the highest possible modulation until maximum modulation is reached.
17) ***Header compression –*** state of the header compression on the link.
18) ***Acquire status*** – *Locked* = the link is established (Rx level and MSE are within acceptable margins); *Sweep* = the link is not established (Rx level is below the sensitivity threshold, MSE is degraded, or there's a configuration/firmware mismatch on both sides of the link).
19) ***FEC locked*** – shows whether the Forward Error Correction algorithm is working, and the amount of corrected errors is significantly higher compared to uncorrected errors.
20) ***MSE*** – Mean Square Error indication.
21) ***FEC load*** – Forward Error Correction load.
22) ***Protection status*** – indicates current 1+1 protection status.
23) ***Current Rx modulation –*** received signal modulation.
24) ***Current Tx modulation –*** transmitted signal modulation.
25) ***Current Rx Ethernet capacity*** – current available Rx capacity, in case ACM is enabled, the current received capacity can differ from the configured maximum capacity.
26) ***Current Tx Ethernet capacity*** - current available Tx capacity, in case ACM is enabled, the current transmitted capacity can differ from the maximum available capacity.
27) ***Port*** – Name and connection type of the Ethernet port: RJ-45 or SFP/SFP+.
28) ***State*** – Ethernet port state – Enabled or Disabled.
29) ***Status*** – Ethernet port status, up or down (if the port is enabled).

SD and HSB – modify mode

In SD and HSB modes, configuration changes are applied for the "Local A" column only.

System		Local	Remote
License remaining time		Unlimited	Unlimited
Mode	1	SD	SD
Transmitter	2	A	A
Tx capacity		478 Mbps	478 Mbps
Rx capacity		478 Mbps	478 Mbps

Figure 3-33 System section of SD mode Main page in modify mode

System		Local	Remote
License remaining time		Unlimited	Unlimited
Mode	1	HSB	HSB
Preferred transmitter	2	A	A
Tx capacity		478 Mbps	478 Mbps
Rx capacity		478 Mbps	478 Mbps

Figure 3-34 System section of HSB mode Main page in modify mode

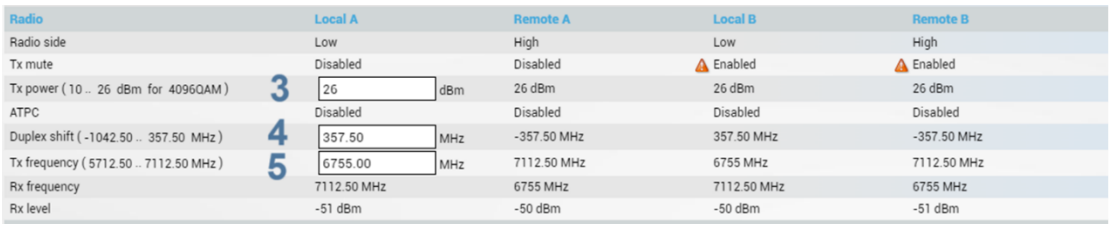


Figure 3-35 Radio section of SD and HSB modes Main page in modify mode

1) *Mode* – choose **SD** or **HSB** mode.
2) *Transmitter* – choose an active transmitter.
3) *Tx power* - the available range depends on the radio model and selected modem profile. The possible range for selection will be indicated in brackets.
4) *Duplex shift* – the available Duplex (Tx/Rx) shift range is indicated in brackets. Allows setting the Duplex shift between the Tx and Rx central frequencies.

Changeable Duplex shift option is available only in Integra-FIDU/FIDU+ radios without a diplexer.

5) *Tx frequency* - the available frequency range is indicated in brackets. The Tx frequency range indicates the range of central frequencies for the configured channel bandwidth.

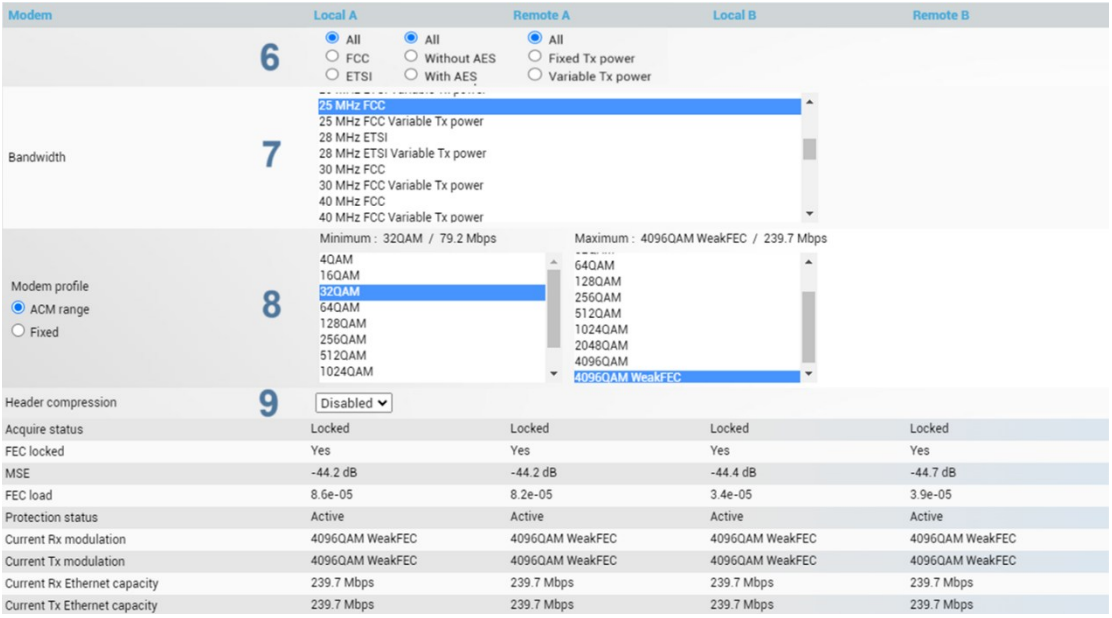


Figure 3-36 Modem section of SD and HSB modes Main page in modify mode

6) *Filter for bandwidth standard* – allows filtering bandwidth options for selection in point 5 by:
   a. Radio standards: FCC or ETSI.
   b. AES encryption: with or without.

AES encryption is available only in Integra-X2 and Integra-FIDU/FIDU+ models.

   c. Tx power mode for ACM: fixed (Tx power will not change when ACM modulation changes) or variable (Tx power will change when ACM modulation changes. When modulation decreases, Tx power will increase, and when modulation increases, Tx power will decrease).
7) *Bandwidth* - allows choosing between available channel bandwidth options.
8) *Minimum* – allows setting the minimum modulation that can be used in the ACM algorithm. If the radio signal decreases, Integra-X/-X2/-FIDU/-FIDU+ will switch to lower modulation until minimum modulation is reached. If the signal decreases even further

and RSL drops below the sensitivity threshold value for the configured minimum modulation, radio link synchronization will be lost. If minimum modulation is set the same as maximum modulation, ACM is disabled.

Maximum **–** allows setting the maximum modulation that can be used in the ACM algorithm. If MSE is high enough, Integra will utilize the highest possible modulation until maximum modulation is reached. If maximum modulation is set the same as minimum modulation, ACM is disabled.

9) ***Header compression*** **–** allows setting up Ethernet packet header compression on the radio link. It can be:
   a. ***Disabled***.
   b. ***Default*** – enables packet header compression for up to 2048 traffic streams.
   c. ***Adaptive*** – enables packet header compression that adapts to data traffic load, and in case the load increases, Integra will compress headers only for traffic streams that have higher rates of header pattern reoccurrence.

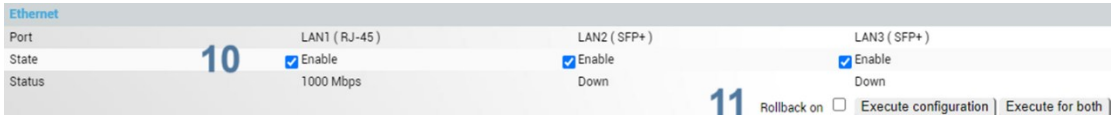


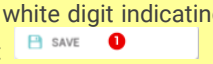
Figure 3-37 Ethernet section of SD and HSB modes Main page in modify mode

10) ***State*** - allows enabling/disabling each of the three available LAN ports.

11) By pressing ***Execute configuration***, changes made to the corresponding section apply only to the local side A and B channels. If ***Rollback on*** is selected, then in case of incorrect configuration of the radio link, which caused it to stop working, the last saved or default configuration will be restored on Integra.

Execute for both - applies changes made to the corresponding section, both for the local and remote side Integra radios A and B channels. If ***Rollback on*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

The rollback procedure is triggered only when management connectivity of the devices has been lost due to the applied configuration changes. For this reason, the ***Rollback on*** option should be selected only when the radio link between the Local and Remote sites has already been established and synchronized. Rollback will not work in case the Remote side of the link has not been reachable before the configuration change took effect, and selection of this option will even display a pop-up internal error message in Integra WEB GUI.

If the configuration after modification is not saved, it will be lost after the radio restarts. Indication of unsaved configuration will be shown in the always visible MODIFY/SAVE/LOGOUT section on the top right part of the WEB GUI page with a red circle on the SAVE button and a white digit indicating the number of unsaved configuration changes on the device: 

FD mode

To enable 1+1 FD (Frequency Diversity) protection mode, choose “FD” in the System operational mode configuration drop-down menu, see More details about the 1+1 FD mode refer to *1+1 SD, HSB and FD configurations* section.

FD – status mode

Main

System	Local	Remote		
License remaining time	1 Unlimited	Unlimited		
Mode	2 FD	FD		
Tx capacity	3 478 Mbps	418 Mbps		
Rx capacity	4 418 Mbps	478 Mbps		
Radio	**Local A**	**Remote A**	**Local B**	**Remote B**
Radio side	5 Low	High	Low	High
Tx mute	6 Disabled	Disabled	Disabled	Disabled
Tx power	7 26 dBm	26 dBm	26 dBm	26 dBm
ATPC	8 Disabled	Disabled	Disabled	Disabled
Duplex shift	9 357.50 MHz	-357.50 MHz	357.50 MHz	-357.50 MHz
Tx frequency	10 6755 MHz	7112.50 MHz	6755 MHz	7112.50 MHz
Rx frequency	11 7112.50 MHz	6755 MHz	7112.50 MHz	6755 MHz
Rx level	12 -43 dBm	-42 dBm	-42 dBm	-43 dBm
Modem	**Local A**	**Remote A**	**Local B**	**Remote B**
Bandwidth	13 25 MHz FCC	25 MHz FCC	25 MHz FCC	25 MHz FCC
Minimum modulation / 79.1 Mbps	14 32QAM	32QAM	32QAM	32QAM
Maximum modulation / 239.6 Mbps	15 4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC	4096QAM WeakFEC
Header compression	16 Disabled	Disabled	Disabled	Disabled
Acquire status	17 Locked	Locked	Locked	Locked
FEC locked	18 Yes	Yes	Yes	Yes
MSE	19 -39.3 dB	-45.7 dB	-42.2 dB	-44.8 dB
FEC load	20 5.9e-05	1.5e-05	0.0e+00	1.3e-05
Protection status	21 Active	Active	Active	Active
Current Rx modulation	22 2048QAM	4096QAM WeakFEC	2048QAM	4096QAM WeakFEC
Current Tx modulation	23 4096QAM WeakFEC	2048QAM	4096QAM WeakFEC	2048QAM
Current Rx Ethernet capacity	24 209.6 Mbps	239.7 Mbps	209.6 Mbps	239.7 Mbps
Current Tx Ethernet capacity	25 239.7 Mbps	209.6 Mbps	239.7 Mbps	209.6 Mbps
Ethernet				
Port	26 LAN1 (RJ-45)	LAN2 (SFP+)	LAN3 (SFP+)	
State	27 Enabled	Enabled	Enabled	
Status	28 Down	Down	Down	

Figure 3-38 FD – status mode

Configuration for both radio channels A and B on both the Local and Remote sides is shown.

1) ***License remaining time*** – time left until the capacity of the system will be limited to the minimum (2Mbps). If the time limitation is not active, "Unlimited" will be shown. Refer to the chapter *System → Tools → License management* for more details.
2) ***Mode*** – system operational mode, which is FD in this case.
3) ***Tx capacity*** – maximum possible Tx capacity of the device according to the configured modulation scheme, bandwidth, and operational mode.
4) ***Rx capacity*** – maximum possible Rx capacity of the device according to the configured modulation scheme, bandwidth, and operational mode.
5) ***Radio side*** – "Low" or "High" side. Not changeable and factory hardware preset value, which is also indicated on the device label, and shows which frequency range can be used on the device.
6) ***Tx mute*** – Tx mute status, configurable on the Over The Air page. Allows turning the transmitter power off. It may be effective when diagnosing interference existence – when the transmitter power of one side is off, you should not observe significant RSL on the other side. The link is not operational during Tx mute.
7) ***Tx power*** – currently configured Tx power.
8) ***ATCP*** – ATPC status, configurable in Over The Air page.
9) ***Duplex shift*** – radio duplex shift, the difference between Tx and Rx frequencies, not modifiable, and factory hardware preset value.
10) ***Tx frequency*** – currently selected Tx frequency for the local radio.
11) ***Rx frequency*** – receiving frequency for the local radio. Determined by the Tx frequency and duplex shift.
12) ***Rx level*** – current signal Rx level for the corresponding polarization. Value updates with the browser refresh frequency. The Rx level needs to be according to the link budget calculation within a ±2dB margin.
13) ***Bandwidth*** – currently configured bandwidth for the radio channel.
14) ***Minimum modulation*** – configured minimum modulation. Data capacity, which can be obtained with this minimum modulation, is shown after the slash symbol. In case when fixed modulation modem profile is used, the minimum modulation will be the same as

the *Maximum modulation* parameter (see below), and, in this case, when the MSE (Mean Square Error) degrades below the threshold value, radio link synchronization will be lost, and it will stop working. In the case of the ACM modem profile, when the radio signal is decreasing, the device will switch to lower modulations until the minimum modulation is reached. If the signal decreases further and the Rx level drops below the RSL sensitivity threshold value for the configured minimum modulation, link synchronization will be lost.

15) ***Maximum modulation*** **–** configured maximum modulation. The data capacity that can be obtained with this maximum modulation is shown after the slash symbol. In the case of a fixed modulation modem profile, maximum modulation is the same as the minimum modulation. In the case of the ACM modem profile, if the Rx level on the radio channel is high enough, then the device will try to use the highest possible modulation until maximum modulation is reached.
16) ***Header compression*** **–** state of the header compression on the link.
17) ***Acquire status*** – *Locked* = the link is established (Rx level and MSE are within acceptable margins); *Sweep* = the link is not established (Rx level is below the sensitivity threshold, MSE is degraded, or there's a configuration/firmware mismatch on both sides of the link).
18) ***FEC locked*** – shows whether the Forward Error Correction algorithm is working, and the amount of corrected errors is significantly higher compared to uncorrected errors.
19) ***MSE*** – Mean Square Error indication.
20) ***FEC load*** – Forward Error Correction load.
21) ***Protection status*** – indicates current 1+1 protection status.
22) ***Current Rx modulation*** **–** received signal modulation.
23) ***Current Tx modulation*** **–** transmitted signal modulation.
24) ***Current Rx Ethernet capacity*** – current available Rx capacity, in case ACM is enabled, the current received capacity can differ from the configured maximum capacity.
25) ***Current Tx Ethernet capacity*** - current available Tx capacity, in case ACM is enabled, the current transmitted capacity can differ from the maximum available capacity.
26) ***Port*** – Name and connection type of the Ethernet port: RJ-45 or SFP/SFP+.
27) ***State*** – Ethernet port state – Enabled or Disabled.
28) ***Status*** – Ethernet port status, up or down (if the port is enabled).

FD – modify mode

In FD mode, the configuration changes are applied for the "Local A" column and the "Local B" column separately.

System		Local	Remote
License remaining time		Unlimited	Unlimited
Mode	1	FD	FD
Tx capacity		478 Mbps	418 Mbps
Rx capacity		418 Mbps	478 Mbps

Figure 3-39 System section of FD mode Main page in modify mode

Radio		Local A	Remote A	Local B	Remote B
Radio side		Low	High	Low	High
Tx mute		Disabled	Disabled	Disabled	Disabled
Tx power (10 .. 26 dBm for 4096QAM)	2	26 dBm	26 dBm	26 dBm	26 dBm
ATPC		Disabled	Disabled	Disabled	Disabled
Duplex shift (-1042.50 .. 357.50 MHz)	3	357.50 MHz	-357.50 MHz	357.50 MHz	-357.50 MHz
Tx frequency (5712.50 .. 7112.50 MHz)	4	6755.00 MHz	7112.50 MHz	6755.00 MHz	7112.50 MHz
Rx frequency		7112.50 MHz	6755 MHz	7112.50 MHz	6755 MHz
Rx level		-43 dBm	-42 dBm	-42 dBm	-43 dBm

Figure 3-40 Radio section of FD mode Main page in modify mode

1) ***Mode*** – choose **FD** mode.
2) ***Tx power*** - the available range depends on the radio model and selected modem profile. The possible range for selection will be indicated in brackets.
3) ***Duplex shift*** – the available Duplex (Tx/Rx) shift range is indicated in brackets. Allows setting the Duplex shift between the Tx and Rx central frequencies.

Changeable Duplex shift option is available only in Integra-FIDU/FIDU+ radios without a diplexer.

4) *Tx frequency* - the available frequency range is indicated in brackets. The Tx frequency range indicates the range of central frequencies for the configured channel bandwidth.

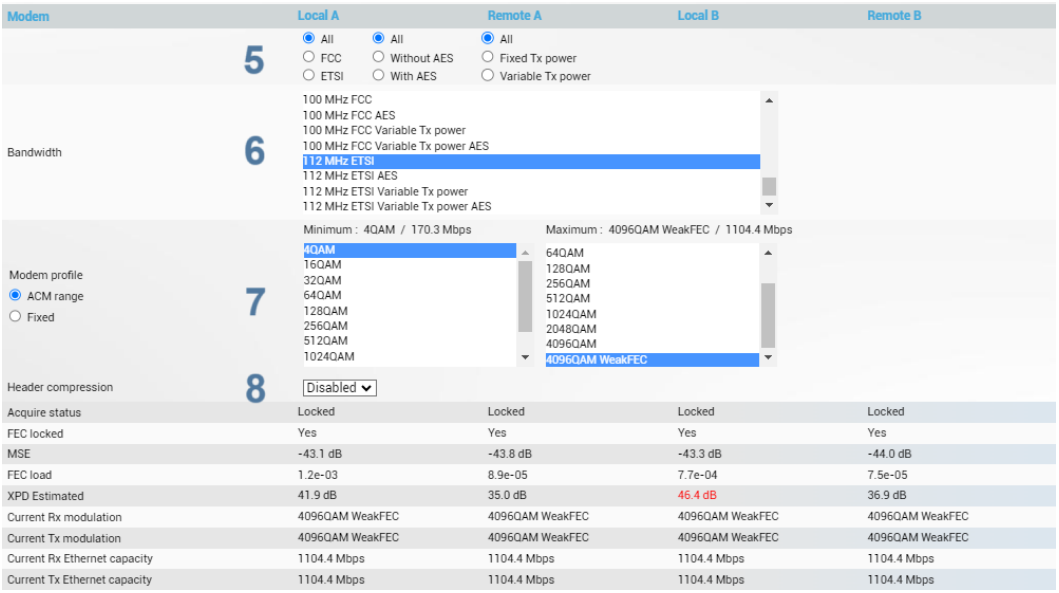


Figure 3-41 Modem section of FD mode Main page in modify mode

5) *Filter for bandwidth standard* – allows filtering bandwidth options for selection in point 5 by
   a. Radio standards: FCC or ETSI.
   b. AES encryption: with or without.

AES encryption is available only in Integra-X2 and Integra-FIDU/FIDU+ models.

   c. Tx power mode for ACM: fixed (Tx power will not change when ACM modulation changes) or variable (Tx power will change when ACM modulation changes. When modulation decreases, Tx power will increase, and when modulation increases, Tx power will decrease).

6) *Bandwidth* - allows choosing between available channel bandwidth options.

7) *Minimum* – allows setting the minimum modulation that can be used in the ACM algorithm. If the radio signal decreases, Integra-X/-X2/-FIDU/-FIDU+ will switch to lower modulation until minimum modulation is reached. If the signal decreases even further and RSL drops below the sensitivity threshold value for the configured minimum modulation, radio link synchronization will be lost. If minimum modulation is set the same as maximum modulation, ACM is disabled.
   Maximum – allows setting the maximum modulation that can be used in the ACM algorithm. If MSE is high enough, Integra will utilize the highest possible modulation until maximum modulation is reached. If maximum modulation is set the same as minimum modulation, ACM is disabled.

8) *Header compression* – allows setting up Ethernet packet header compression on the radio link. It can be:
   a. *Disabled*.
   b. *Default* – enables packet header compression for up to 2048 traffic streams.
   c. *Adaptive* – enables packet header compression that adapts to data traffic load, and in case the load increases, Integra will compress headers only for traffic streams that have higher rates of header pattern reoccurrence.

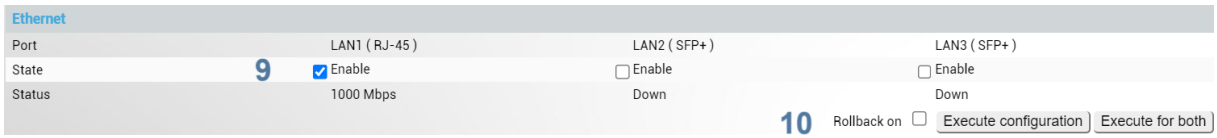
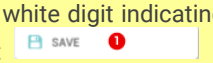


Figure 3-42 Ethernet section of FD mode Main page in modify mode

9) ***State*** - allows enabling/disabling each of the three available LAN ports.

10) By pressing ***Execute configuration,*** changes made to the corresponding section apply only to the local side A and B channels. If ***Rollback on*** is selected, then in case of incorrect configuration of the radio link, which caused it to stop working, the last saved or default configuration will be restored on Integra.
Execute for both - applies changes made to the corresponding section, both for the local and remote side Integra radios A and B channels. If ***Rollback on*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

The rollback procedure is triggered only when management connectivity of the devices has been lost due to the applied configuration changes. For this reason, the ***Rollback on*** option should be selected only when the radio link between the Local and Remote sites has already been established and synchronized. Rollback will not work in case the Remote side of the link has not been reachable before the configuration change took effect, and selection of this option will even display a pop-up internal error message in Integra WEB GUI.

If the configuration after modification is not saved, it will be lost after the radio restarts. Indication of unsaved configuration will be shown in the always visible MODIFY/SAVE/LOGOUT section on the top right part of the WEB GUI page with a red circle on the SAVE button and a white digit indicating the number of unsaved configuration changes on the device: 

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

radio status	Use to show radio status.
radio power {A|B|every} <Tx power>	Use to set Tx power in dBm for each radio channel or both of them together (every)
radio power {A|B|every} off	Disable Tx power permanently for each radio channel or both of them together (every)
radio frequency {A|B|every} <frequency>	Use to set the Tx frequency in kHz for each radio channel or both of them together (every)
modem allowed show <profile name>	Use to check the modem concrete profile parameters.
modem configuration set <profile name>	Use to set modem configuration – bandwidth, minimum, and maximum modulation.
modem configuration variant {A|B|ACAP|XPIC}	Use to set the modem operational mode.
modem configuration set factory	Use to reset modem settings to factory defaults – bandwidth and modulation will be reset to a minimum.
radio factory {A|B}	Use to reset each of the radio channels to factory defaults – Tx power will be disabled and frequencies set to the factory defaults.
network port show info	Use to show the current operational status of all Ethernet ports.

network port show config	Use to show the configuration of all ports.
network port set <LAN1|LAN2|LAN3> **admin-state** {enable|disable}	Use to enable or disable a particular Ethernet port.

Over The Air

Over The Air → Radio → Configuration

The Radio configuration page allows defining the main radio and modem parameters such as Tx power (Tx mute) and bandwidth/modulation, as well as enabling ATPC and ACMB functionality. It also allows you to configure the RSSI LED indicator.

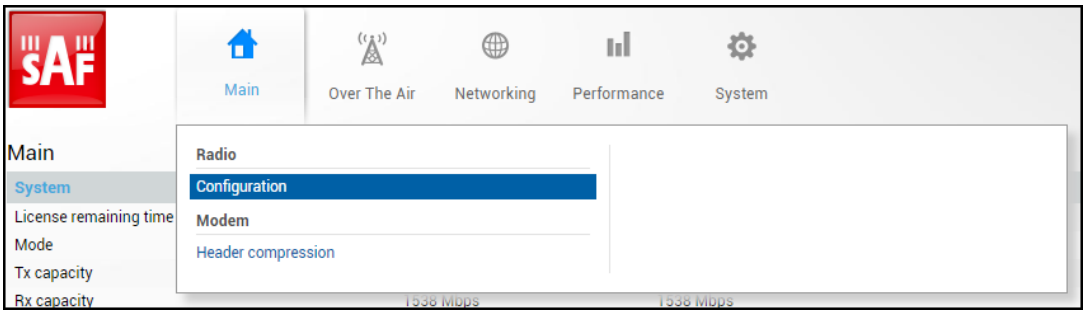


Figure 3-43 Accessing Radio configuration page

The Radio configuration page is available on the menu Over The Air→ Radio→Configuration.

> ⚠ System operational mode (XPIC/single channel/ACAP) can be changed only from the device's Main page by *Modifying basic system parameters*.

XPIC/SD/HSB - status mode

Over The Air / Radio configuration

Radio Channel		Local A	Local B
Tx power (10 .. 26 dBm for 4096QAM)	1	26 dBm	26 dBm
Duplex shift (-1042.50 .. 357.50 MHz)	2	357.50 MHz	357.50 MHz
Tx frequency (5712.50 .. 7112.50 MHz)	3	6755 MHz	6755 MHz
Tx mute [>= 10 sec]	4	Disabled	Disabled
ATPC	5	Disabled	Disabled
ATPC update period (1 .. 5 sec)	6	5 sec	5 sec
Tx power correction	7	0 dB	0 dB
Rx (remote) level range (-75..-30 dBm)	8	-50 dBm -45 dBm	-50 dBm -45 dBm
Difference between Rx min and Rx max must be at least 3 dBm			
Bandwidth	9	25 MHz FCC	25 MHz FCC
Minimum modulation / 79.1 Mbps	10	32QAM	32QAM
Maximum modulation / 239.6 Mbps	11	4096QAM WeakFEC	4096QAM WeakFEC
RSSI			
RSSI Channel	12	A	
RSSI Audio	13	Disable	
RSSI LED Channel	14	A	
RSSI LED mode	15	1	

Figure 3-44 Radio configuration - status mode

Information from both radio channels is shown.

Press MODIFY button.

XPIC/SD/HSB - modify mode

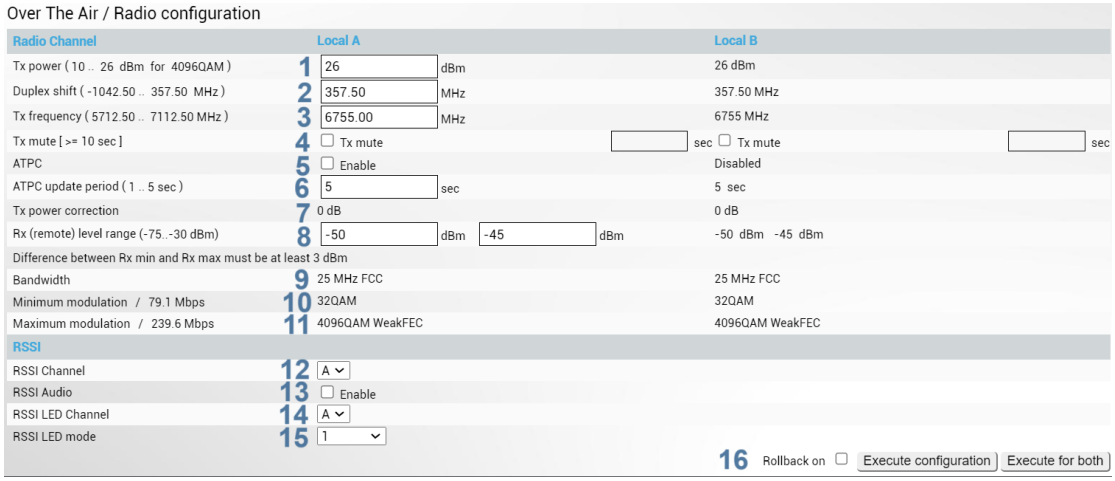


Figure 3-45 Radio configuration - modify mode

1) ***Tx power*** – Indicates current Tx (transmit) power value (status mode); allows specifying Tx power value (modify mode). When modifying Tx power for Local A channel, Local B channel follows. The available range depends on the radio model and selected modem profile. The usable range is indicated in brackets. In case when impossible Tx power value is entered, then this field and its incorrect value will be highlighted in red color. The ⚠ sign could indicate that the momentary Tx power value on the output was adjusted by ATPC. Move the mouse over the sign for further details.
2) ***Duplex shift*** – Indicates current Duplex shift between Tx and Rx frequencies (status mode); allows specifying Duplex shift value (modify mode). The available range depends on the radio model. The usable range is indicated in brackets. In case when impossible Duplex shift value is entered, then this field and its incorrect value will be highlighted in red color.

⚠ Changeable Duplex shift option is available only in Integra-FIDU/FIDU+ radios without a diplexer.

3) ***Tx frequency*** – Indicates current configured Tx (transmit) frequency (status mode); allows specifying Tx frequency (modify mode). When modifying the Tx frequency for Local A channel, Local B channel will follow. The Tx frequency range indicates the range of central frequencies for the configured channel bandwidth. The default frequency range (indicated on the device labeling) is defined for a 5 MHz channel bandwidth, see *Figure 1-4*.
4) ***Tx mute [>=10 sec]*** – Indicates whether Tx mute is enabled or disabled for Channel A and/or Channel B (status mode); allows muting the transmitter to a limited time interval in seconds for Channel A and/or Channel B (modify mode). The minimum interval is 10 seconds, and the maximum interval is 99999999 seconds, which is more than 1157 days. Note that the transmitter will be muted only if a valid time interval value is entered. The link will be interrupted for the applied time interval. Radio channel muting may be useful when checking for external interference on the link – when the transmitter is powered off on one side, there should not be any noticeable signal on the other side.
5) ***ATPC*** – Indicates whether ATPC (Automatic Transmit Power Control) is enabled (status mode); allows enabling/disabling ATPC (modify mode). By default, this feature is disabled. Please refer to the *ATPC (Automatic Transmit Power Control)* description for further details.
6) ***ATPC update period*** – Indicates the ATPC update period (status mode); allows defining the period in seconds with which ATPC parameters are being updated (modify mode). By default, the update period is 5 seconds. The range is 1...5 seconds. Please refer to the *ATPC (Automatic Transmit Power Control)* description for further details.

7) ***Tx power correction*** - displays the amount of transmitter power in decibels that ATPC has currently corrected.
8) ***Rx (remote) level range (-75..-15dBm)*** – Indicates minimum and maximum Rx level of the remote side Integra for ATPC operation (status mode); allows defining the minimum and maximum Rx level of the remote side Integra (modify mode). At least a 3dB difference between min and max values should be specified. ATPC Tx power correction will be performed only in case of exceeding the configured thresholds. Values should be defined between -75 and -15 dBm, the recommended range is -45…-35. The field is modifiable only when ATPC is enabled. Please refer to chapter *ATPC (Automatic Transmit Power Control)* for further details.

The minimum Rx level threshold should be set at least 10dB above the sensitivity threshold to avoid ACM/ATPC switching loops.

9) ***Bandwidth*** – Indicates the currently configured available channel bandwidth.
10) ***Minimum modulation*** **–** shows minimum modulation, which is used on both radio channels. If the radio signal is decreasing, then the device will switch to lower modulations until the minimum modulation is reached. If the signal decreases even more and the Rx level on the radio channel becomes less than the sensitivity RSL threshold value for the configured minimum modulation, then radio link synchronization will be lost, and it will stop working.
11) ***Maximum modulation*** **–** shows maximum modulation, which is used on both radio channels. If the Rx level on the radio channel is high enough, then the device will try to use the highest possible modulation until maximum modulation is reached.
12) ***RSSI Channel*** – shows which radio channel (A or B) Rx signal level is translated to the RSSI/audio port of the device (status mode); allows setting radio channel (A or B) which will have its Rx signal level translated to RSSI/audio port of the device (modify mode).
13) ***RSSI Audio*** – Indicates whether RSSI audio is enabled or disabled (status mode); allows disabling or enabling RSSI audio (modify mode). RSSI audio is available using the 3.5mm jack beside the USB port. By default, RSSI Audio is disabled. Please refer to the chapter *RSSI/audio port* description for further details.
14) ***RSSI LED Channel –***shows which radio channel (A or B) the Rx signal level is translated to RSSI LED indication (status mode); allows setting the radio channel (A or B) that will have its Rx signal level translated to RSSI LED indication (modify mode). See the chapter *RSSI LED* for further details.
15) ***RSSI LED mode –*** Indicates which RSSI LED mode is active (status mode); allows selecting RSSI LED operation mode (modify mode). By default, mode 1 is enabled. Please refer to the chapter *RSSI LED* for further details.
16) By pressing ***„Execute configuration"***, changes made to the current configuration page will apply only to the local side Integra device. If ***„Rollback on"*** is selected, then the configuration will be reverted to the last operational version in case erroneous configuration changes are applied.
Pressing ***„Execute for both"*** will apply changes made to the current configuration page for both (local and remote side) Integra devices.

Single polarization – status mode

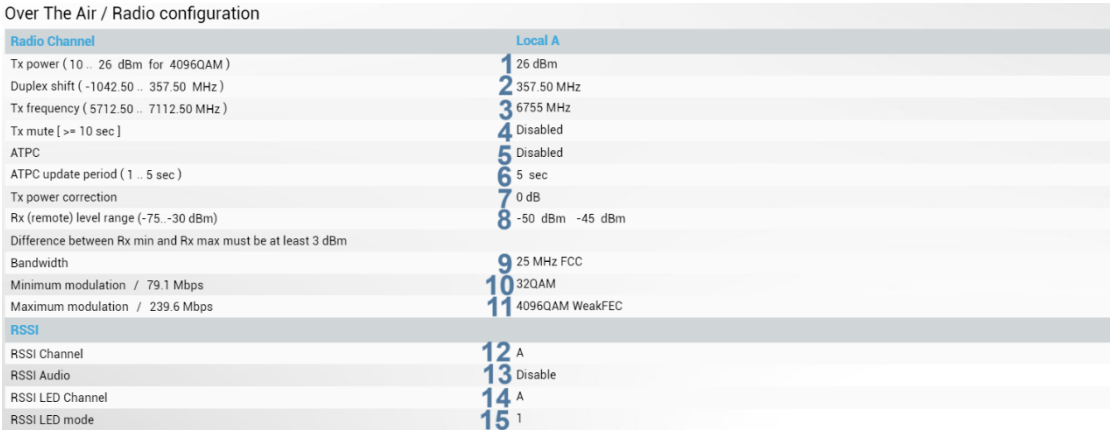


Figure 3-46 Single polarization – status mode

Information for the chosen radio channel (A for vertical polarization and B for horizontal polarization) is shown. For a description, see the next paragraph *Single polarization* .

Single polarization – modify mode

Press MODIFY button to edit.

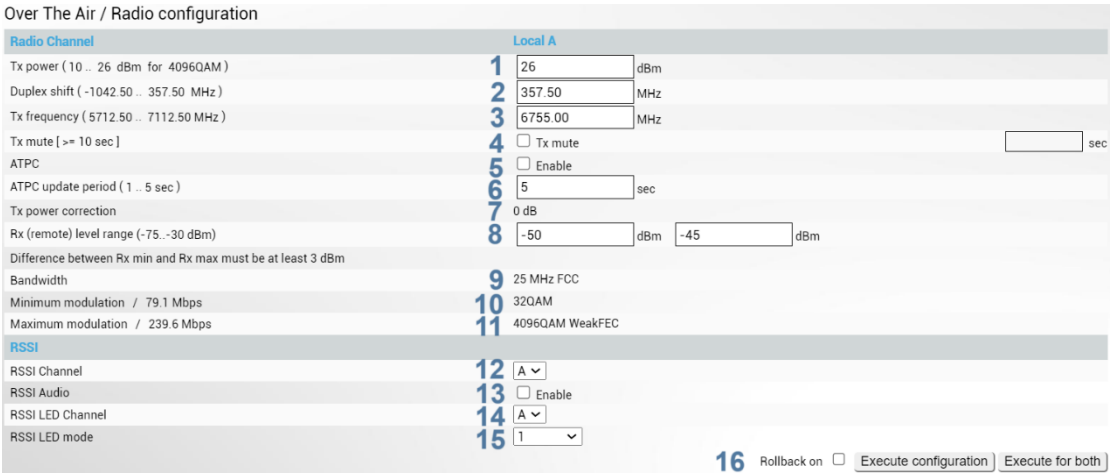


Figure 3-47 Single polarization – modify mode

1) ***Tx power*** – Indicates current Tx (transmit) power value (status mode); allows specifying Tx power value (modify mode). When modifying the Tx power for Local A channel, Local B channel follows. The available range depends on the radio model and selected modem profile. The usable range is indicated in brackets. In case when impossible Tx power value is entered, then this field and its incorrect value will be highlighted in red color. The ⚠ sign could indicate that the momentary Tx power value on the output was adjusted by ATPC. Move the mouse over the sign for further details.
2) ***Duplex shift*** – Indicates current Duplex shift between Tx and Rx frequencies (status mode); allows specifying Duplex shift value (modify mode). The available range depends on the radio model. The usable range is indicated in brackets. In case when impossible Duplex shift value is entered, then this field and its incorrect value will be highlighted in red color.

⚠ Changeable Duplex shift option is available only in Integra-FIDU/FIDU+ radios without a diplexer.

3) ***Tx frequency*** – Indicates current configured Tx (transmit) frequency (status mode); allows specifying Tx frequency (modify mode). When modifying the Tx frequency for Local A channel, Local B channel will follow. The Tx frequency range indicates the range of central frequencies for the configured channel bandwidth. The default frequency range (indicated on the device labeling) is defined for a 5 MHz channel bandwidth, see *Figure 1-4*.
4) ***Tx mute [>=10 sec]*** – Indicates whether Tx mute is enabled or disabled for Channel A and/or Channel B (status mode); allows muting the transmitter to a limited time interval in seconds for Channel A and/or Channel B (modify mode). The minimum interval is 10 seconds, and the maximum interval is 99999999 seconds, which is more than 1157 days. Note that the transmitter will be muted only if a valid time interval value is entered. The link will be interrupted for the applied time interval. Radio channel muting may be useful when checking for external interference on the link – when the transmitter is powered off on one side, there should not be any noticeable signal on the other side.
5) ***ATPC*** – Indicates whether ATPC (Automatic Transmit Power Control) is enabled (status mode); allows enabling/disabling ATPC (modify mode). By default, this feature is disabled. Please refer to the *ATPC (Automatic Transmit Power Control)* description for further details.
6) ***ATPC update period*** – Indicates the ATPC update period (status mode); allows defining the period in seconds with which ATPC parameters are being updated (modify mode). By default, the update period is 5 seconds. The range is 1...5 seconds. Please refer to the *ATPC (Automatic Transmit Power Control)* description for further details.
7) ***Tx power correction*** - displays the amount of transmitter power in decibels that ATPC has currently corrected.
8) ***Rx (remote) level range (-75..-15dBm)*** – Indicates minimum and maximum Rx level of the remote side Integra for ATPC operation (status mode); allows defining the minimum and maximum Rx level of the remote side Integra (modify mode). At least a 3dB difference between min and max values should be specified. ATPC Tx power correction will be performed only in case of exceeding the configured thresholds. Values should be defined between -75 and -15 dBm, the recommended range is -45...-35. The field is modifiable only when ATPC is enabled. Please refer to the chapter *ATPC (Automatic Transmit Power Control)* for further details.

The minimum Rx level threshold should be set at least 10dB above the sensitivity threshold to avoid ACM/ATPC switching loops.

9) ***Bandwidth*** – Indicates the currently configured available channel bandwidth.
10) ***Minimum modulation –*** shows minimum modulation, which is used on both radio channels. If the radio signal is decreasing, then the device will switch to lower modulations until the minimum modulation is reached. If the signal decreases even more and the Rx level on the radio channel becomes less than the sensitivity RSL threshold value for the configured minimum modulation, then radio link synchronization will be lost, and it will stop working.
11) ***Maximum modulation –*** shows maximum modulation, which is used on each of both radio channels. If the Rx level on the radio channel is high enough, then the device will try to use the highest possible modulation until maximum modulation is reached.
12) ***RSSI Channel*** – shows which radio channel (A or B) Rx signal level is translated to the RSSI/audio port of the device (status mode); allows setting radio channel (A or B) which will have its Rx signal level translated to RSSI/audio port of the device (modify mode);
13) ***RSSI Audio*** – Indicates whether RSSI audio is enabled or disabled (status mode); allows disabling or enabling RSSI audio (modify mode). RSSI audio is available using the 3.5mm jack beside the USB port. By default, RSSI Audio is disabled. Please refer to the *RSSI/audio port* description for further details.
14) ***RSSI LED Channel*** – shows which radio channel (A or B) Rx signal level is translated to RSSI LED indication (status mode); allows setting the radio channel (A or B) that will have its Rx signal level translated to RSSI LED indication (modify mode). See the chapter *RSSI LED* for further details.

15) ***RSSI LED mode*** – Indicates which RSSI LED mode is active (status mode); allows selecting RSSI LED operation mode (modify mode). By default, mode 1 is enabled. Please refer to the chapter *RSSI LED* for further details.

16) By pressing ***„Execute configuration"***, changes made to the current configuration page will apply only to the local side Integra device. If ***„Rollback on"*** is selected, then the configuration will be reverted to the last operational version in case erroneous configuration changes are applied.
Pressing ***„Execute for both"*** will apply changes made to the current configuration page for both (local and remote side) Integra devices.

ACAP/FD - status mode

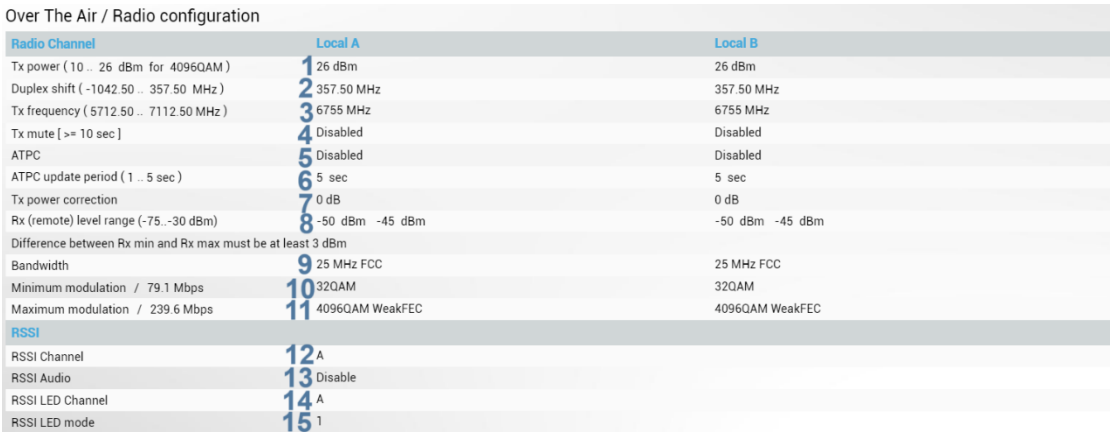


Figure 3-48 ACAP/FD – status mode

Information for both radio channels is shown.

ACAP/FD - modify mode

Press MODIFY button to edit.

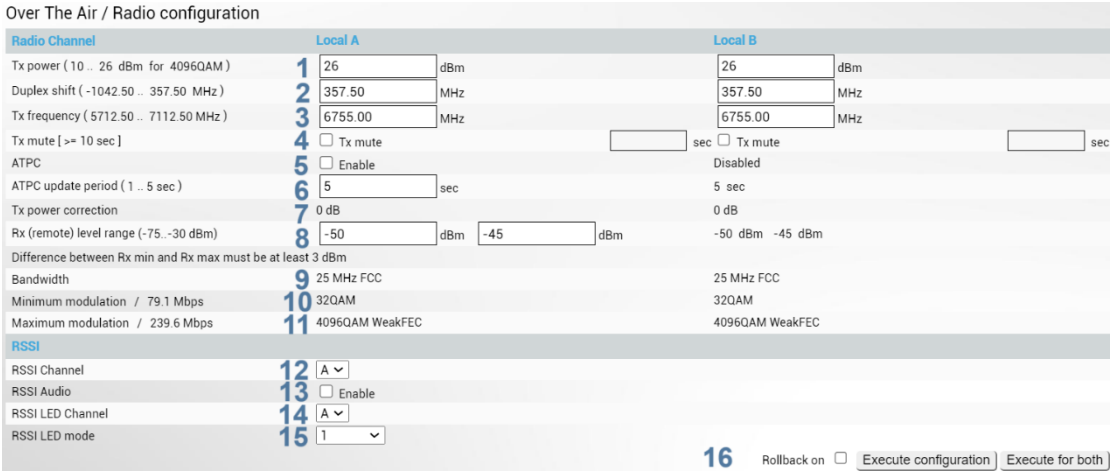


Figure 3-49 ACAP/FD – modify mode

1) ***Tx power*** – Indicates current Tx (transmit) power value (status mode); allows specifying Tx power value (modify mode). When modifying the Tx power for Local A channel, Local B channel follows. The available range depends on the radio model and selected modem profile. The usable range is indicated in brackets. In case an invalid Tx power value is entered, then this field and its incorrect value will be highlighted in red color. The ⚠ sign could indicate that the momentary Tx power value on the output was adjusted by ATPC. Move the mouse over the sign for further details.

2) ***Duplex shift*** – Indicates current Duplex shift between Tx and Rx frequencies (status mode); allows specifying Duplex shift value (modify mode). The available range depends on the radio model. The usable range is indicated in brackets. In case when impossible Duplex shift value is entered, then this field and its incorrect value will be highlighted in red color.

Changeable Duplex shift option is available only in Integra-FIDU/FIDU+ radios without a diplexer.

3) ***Tx frequency*** – Indicates current configured Tx (transmit) frequency (status mode); allows specifying Tx frequency (modify mode). When modifying the Tx frequency for Local A channel, Local B channel will follow. The Tx frequency range indicates the range of central frequencies for the configured channel bandwidth. The default frequency range (indicated on the device labeling) is defined for a 5 MHz channel bandwidth, see *Figure 1-4*.
4) ***Tx mute [>=10 sec]*** – Indicates whether Tx mute is enabled or disabled for Channel A and/or Channel B (status mode); allows muting the transmitter to a limited time interval in seconds for Channel A and/or Channel B (modify mode). The minimum interval is 10 seconds, maximum interval is 99999999 seconds, which is more than 1157 days. Note that the transmitter will be muted only if a valid time interval value is entered. The link will be interrupted for the applied time interval. Radio channel muting may be useful when checking for external interference on the link – when the transmitter is powered off on one side, there should not be any noticeable signal on the other side.
5) ***ATPC*** – Indicates whether ATPC (Automatic Transmit Power Control) is enabled (status mode); allows enabling/disabling ATPC (modify mode). By default, this feature is disabled. Please refer to the *ATPC (Automatic Transmit Power Control)* description for further details.
6) ***ATPC update period*** – Indicates the ATPC update period (status mode); allows defining the period in seconds with which ATPC parameters are being updated (modify mode). By default, the update period is 5 seconds. The range is 1..5 seconds. Please refer to the *ATPC (Automatic Transmit Power Control)* description for further details.
7) ***Tx power correction*** - displays the amount of transmitter power in decibels that ATPC has currently corrected.
8) ***Rx (remote) level range (-75..-15dBm)*** – Indicates minimum and maximum Rx level of the remote side Integra for ATPC operation (status mode); allows defining the minimum and maximum Rx level of the remote side Integra (modify mode). At least a 3dB difference between min and max values should be specified. ATPC Tx power correction will be performed only in case of exceeding the configured thresholds. Values should be defined between -75 and -15 dBm, the recommended range is -45...-35. The field is modifiable only when ATPC is enabled. Please refer to the chapter *ATPC (Automatic Transmit Power Control)* for further details.

The minimum Rx level threshold should be set at least 10dB above the sensitivity threshold to avoid ACM/ATPC switching loops.

9) ***Bandwidth*** – Indicates the currently configured available channel bandwidth.
10) ***Minimum modulation*** – shows minimum modulation, which is used on both radio channels. If the radio signal is decreasing, then the device will switch to lower modulations until the minimum modulation is reached. If the signal decreases even more and the Rx level on the radio channel becomes less than the sensitivity RSL threshold value for the configured minimum modulation, then radio link synchronization will be lost, and it will stop working.
11) ***Maximum modulation*** – shows maximum modulation, which is used on both radio channels. If the Rx level on the radio channel is high enough, then the device will try to use the highest possible modulation until maximum modulation is reached.
12) ***RSSI Channel*** – shows which radio channel (A or B) Rx signal level is translated to the RSSI/audio port of the device (status mode); allows setting radio channel (A or B) which will have its Rx signal level translated to RSSI/audio port of the device (modify mode).
13) ***RSSI Audio*** – Indicates whether RSSI audio is enabled or disabled (status mode); allows disabling or enabling RSSI audio (modify mode). RSSI audio is available using the 3.5mm

jack beside the USB port. By default, RSSI Audio is disabled. Please refer to the *RSSI/audio port* description for further details.

14) ***RSSI LED Channel*** **–** shows which radio channel (A or B) Rx signal level is translated to RSSI LED indication (status mode); allows setting the radio channel (A or B) that will have its Rx signal level translated to RSSI LED indication (modify mode). See the chapter *RSSI LED* for further details.
15) ***RSSI LED mode*** **–** Indicates which RSSI LED mode is active (status mode); allows selecting RSSI LED operation mode (modify mode). By default, mode 1 is enabled. Please refer to the chapter *RSSI LED* for further details.
16) By pressing ***„Execute configuration"***, changes made to the current configuration page will apply only to the local side Integra device. If ***„Rollback on"*** is selected, then the configuration will be reverted to the last operational version in case erroneous configuration changes are applied.
17) Pressing ***„Execute for both"*** will apply changes made to the current configuration page for both (local and remote side) Integra devices.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

radio status	Use to show the radio status.
radio power {A|B|every} <Tx power | off >	Use to set Tx power in dBm for each radio channel or both of them together (every). Using "off" radio transmitter can be muted permanently.
radio frequency {A|B|every} <frequency>	Use to set the Tx frequency in kHz for each radio channel or both of them together (every).
radio tx_mute {A|B|every} < time | off >	Use to mute a transmitter of each radio channel of both of them for a specific time in seconds. If off is selected, then the muted channel will be unmuted.
radio rssi	Display current RSSI indication settings.
radio rssi-led	Display current RSSI indication settings.
radio rssi audio <disable | enable>	Use to enable or disable RSSI audio indication.
radio rssi channel {A|B}	Use to switch A or B radio channels to RSSI audio port indication.
radio rssi-led led {disable | enable}	Use to enable or disable RSSI LED operation.
radio rssi-led mode {1|2|3}	Use to enable or disable the RSSI LED's operation. Example: "**radio rssi-led mode 2**" sets the LED on the radio in mode 2. For details, refer to the chapter *RSSI LED*.
radio rssi-led channel {A|B}	Use to switch the RSSI LEDs for A or B radio channel indication.
modem allowed show <configuration name>	Use to check modem profile parameters.
modem configuration set <configuration name>	Use to set the modem configuration described by the configuration name.
modem configuration set factory	Use to reset modem settings to factory defaults – bandwidth and modulation will be reset to a minimum.

modem loopback [{none | digital <time>}]	Use to check, disable, or enable modem loopback for n seconds.
radio factory {A|B}	Use to reset radio settings to factory defaults – Tx power will be disabled and frequencies set to factory defaults. It could be executed separately for each radio.
radio info	Use to check the radio software version.
radio upgrade {A|B|every} <firmware>	Use to upgrade the radio firmware version. The firmware file must be located in the FTP directory.

Over The Air → Modem → Header compression

The Header compression page allows enabling the functionality and shows statistical parameters such as the number of compressed flows and the compression gain.

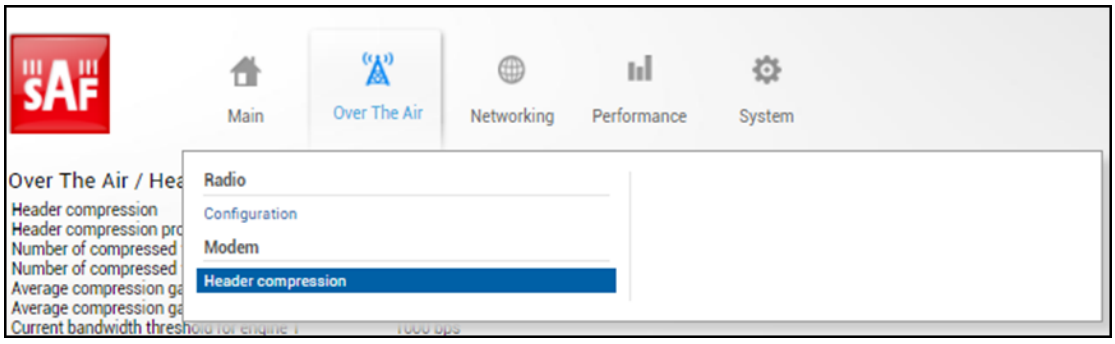


Figure 3-50 Accessing Header compression configuration page

Status mode

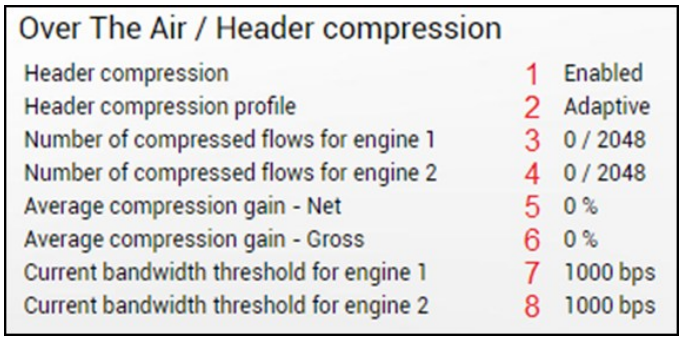


Figure 3-51 Header compression page in Modify mode

Modify mode

Figure 3-52 Header compression page in Modify mode

1) ***Header compression*** – status information whether header compression is enabled on the device.
2) ***Header compression profile*** – shows what header compression profile is used on the device (status mode); allows enabling/disabling header compression and selecting default or adaptive profile for it (modify mode).
3) ***Number of compressed flows for engine 1 –*** status information visible in the case when header compression is enabled on the device, and shows for how many traffic streams/flows header compression is applied on the device compression engine 1.
4) ***Number of compressed flows for engine 2 -*** status information visible in the case when header compression is enabled on the device, and shows for how many traffic streams/flows header compression is applied on the device compression engine 2.
5) ***Average compression gain – Net*** – status information visible in the case when header compression is enabled on the device, and shows header compression ratio as a percentage of the header compression outgoing bytes to the incoming bytes.

6) ***Average compression gain – Gross*** - status information visible in the case when header compression is enabled on the device and shows header compression ratio as a percentage of the header compression outgoing + overhead bytes to the incoming + overhead bytes.
7) ***Current bandwidth threshold for engine 1*** - status information visible in the case when header compression is enabled on the device, and shows the minimum rate for the traffic flow header field re-occurrence to start header compression for the traffic flow on the device compression engine 1. The default value is 1000 bps.
8) ***Current bandwidth threshold for engine 2*** - status information visible in the case when header compression is enabled on the device, and shows the minimum rate for the traffic flow header field re-occurrence to start header compression for the traffic flow on the device compression engine 2. The default value is 1000 bps.
9) By pressing ***„Execute configuration"***, changes made to the current configuration page will apply only to the local side Integra device. If ***„Rollback on"*** is selected, then the configuration will be reverted to the last operational version in the case erroneous configuration changes are applied.
Pressing ***„Execute for both"*** *will* apply changes made to the current configuration page for both (local and remote side) Integra devices.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

modem hc	Use to see the current header compression mode
modem hc preset {disabled| default| adaptive}	Use to set the operational mode of header compression.
modem hc statistics	Use to see operational data of the active header compression configuration.

Over The Air → Security → AES encryption

Enabling AES encryption provides payload data encryption over the air using Advanced Encryption Standard (AES).

For more details, see *AES - Advanced Encryption Standard* in Chapter 5.

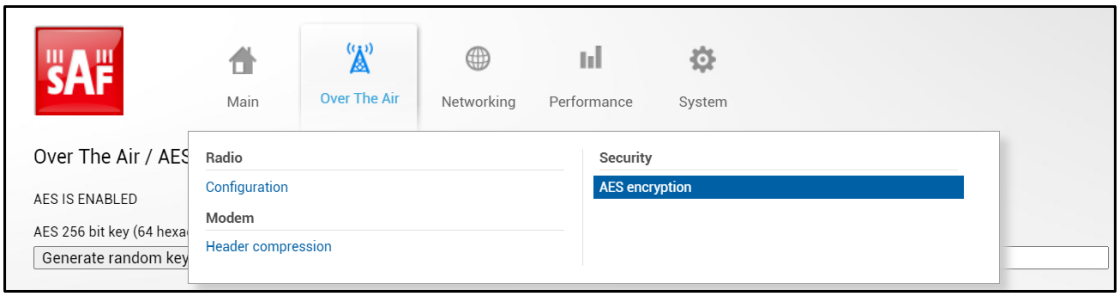


Figure 3-53 Accessing AES encryption configuration page

AES encryption is available only in Integra-X2 and Integra-FIDU/FIDU+ models.

Status mode

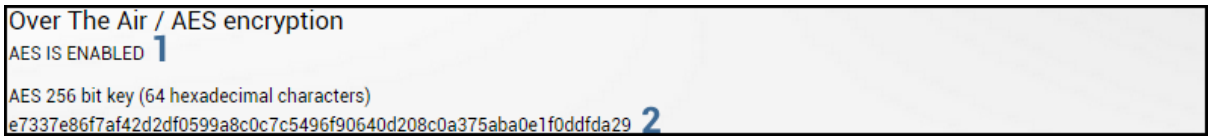


Figure 3-54 AES encryption page in Status mode

Press MODIFY button.

Modify mode

Figure 3-55 AES encryption page in Modify mode

1) Indicates current AES status – enabled or disabled.
2) ***AES 256 bit key (64 hexadecimal characters)*** – Indicates AES key used and allows to set or generate a random key. The key should be exactly 64 hexadecimal characters long. A dialog window will not allow more than 64 characters.
3) By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

aes counters	Use to show AES counters.
aes key <64hexkey>	Use to set AES 256-bit key (64 hex characters).
aes random_key	Use to generate a random AES key.
aes state {enable | disable}	Use to set AES state.
aes status	Use to show AES state, key, and statistics.

Activation of AES for Integra-X2 and Integra-FIDU/FIDU+ radios

1) Upload and activate the license key enabling AES functionality:

⚠ Skip this step if the AES license is already uploaded.

a) Go to "System→Tools→License management" on the remote side of the link.

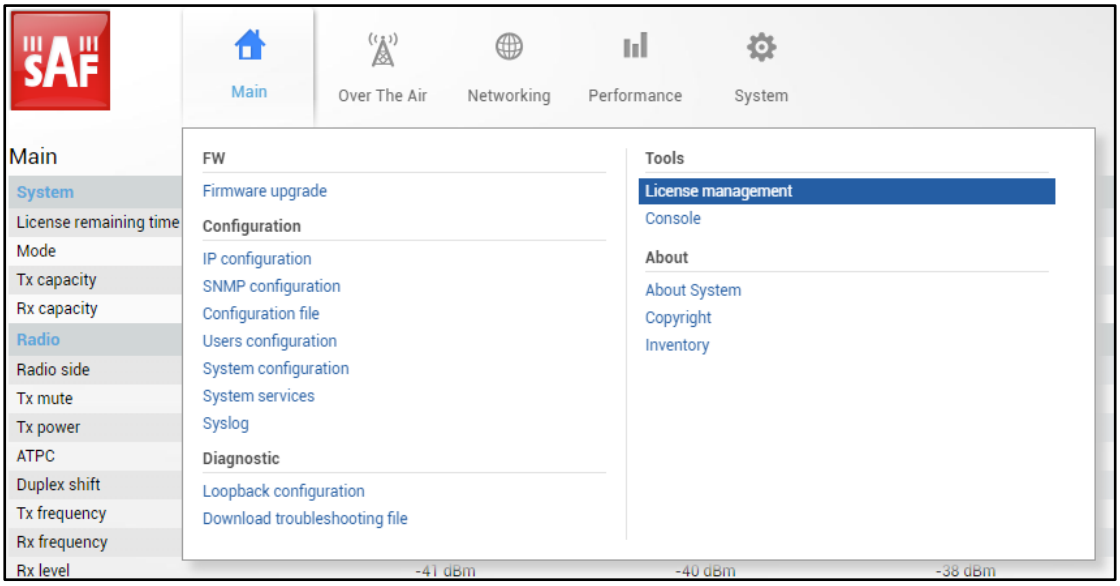


Figure 3-56 Accessing License management page

b) Press MODIFY button.

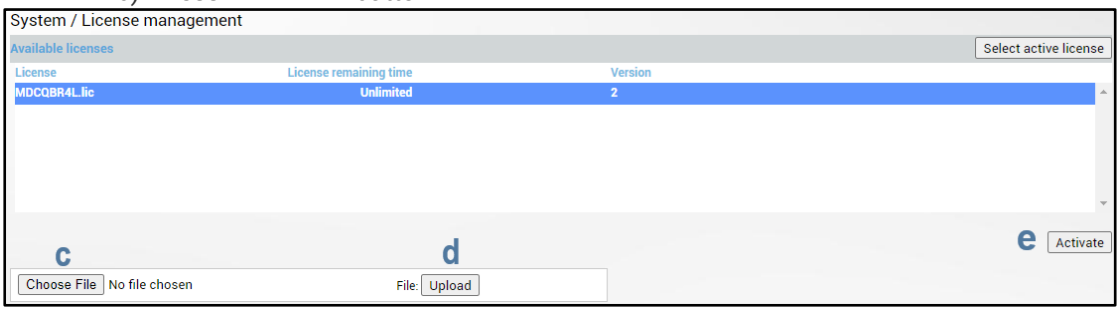


Figure 3-57 License management page in Modify mode

c) Locate *.lic license file on your hard disk drive.
d) Upload the selected *.lic license file.
e) Select the uploaded *.lic license file from the list and press “Activate”.
f) Repeat a)-d) for the local side of the link.

2) Set bandwidth with AES:

a) Go to “Main” page.
b) Press MODIFY button.
c) Select the required bandwidth with AES and the required modulation.

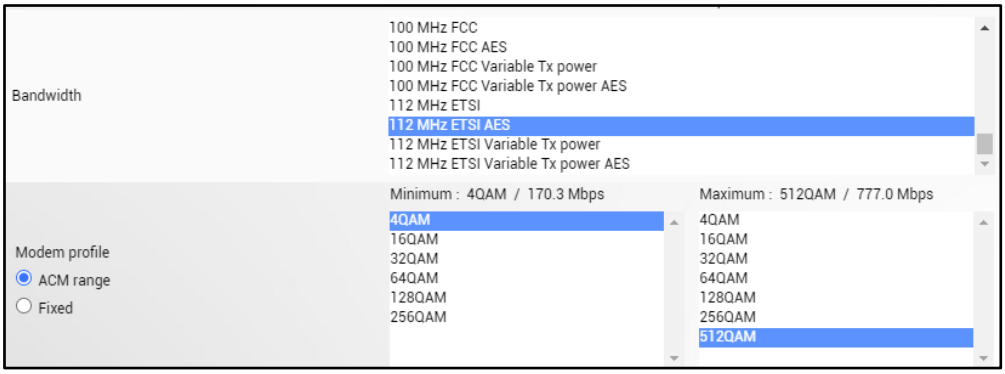


Figure 3-58 Modem configuration on Main page in Modify mode

d) Press “Execute for both” button.

3) Apply AES 256-bit key:

a) Go to “Over The Air→Security→AES encryption” on the remote side of the link.

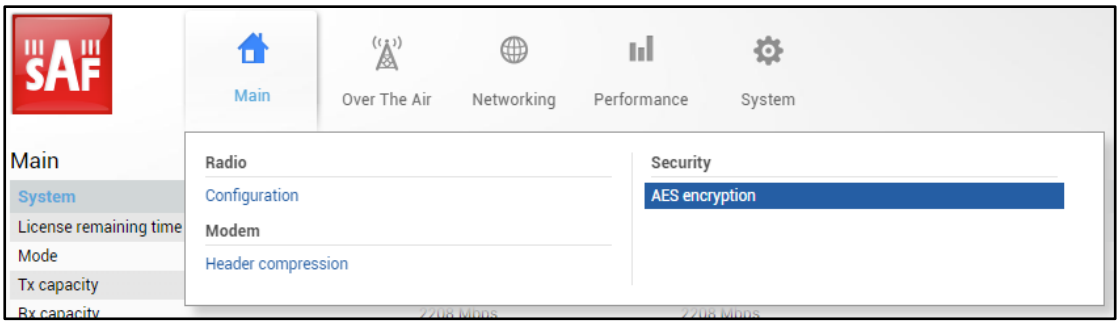


Figure 3-59 Accessing AES encryption page

b) Press MODIFY button.

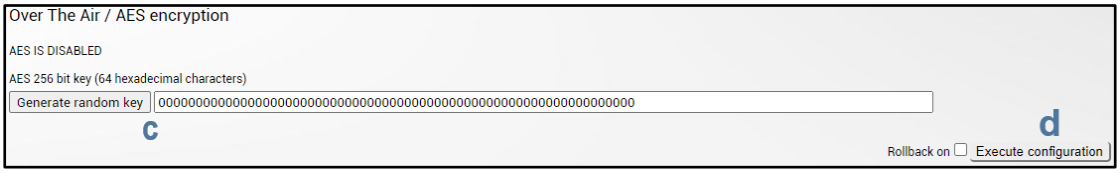


Figure 3-60 AES encryption page in Modify mode

c) Enter a 64-symbol key consisting of hexadecimal values (0-9, A-F) or press “Generate random key” button.
d) Select and copy the generated key.
e) Press “Execute configuration” button.
f) Repeat steps a)-e) for the local side of the link using the same copied AES key.

Networking

Networking → Ethernet → VLAN

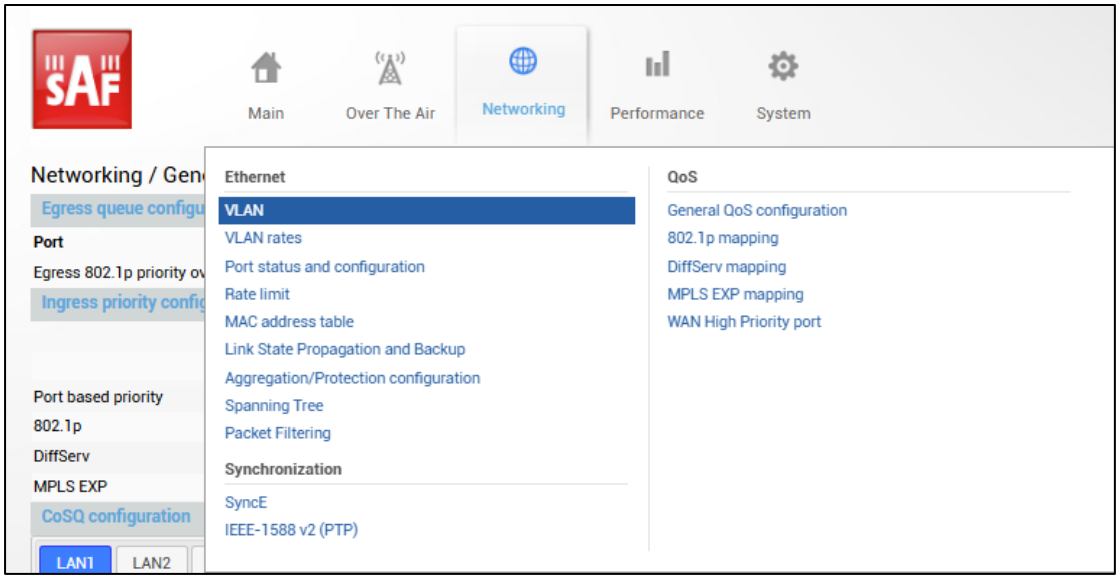


Figure 3-61 Accessing VLAN config window

Status mode

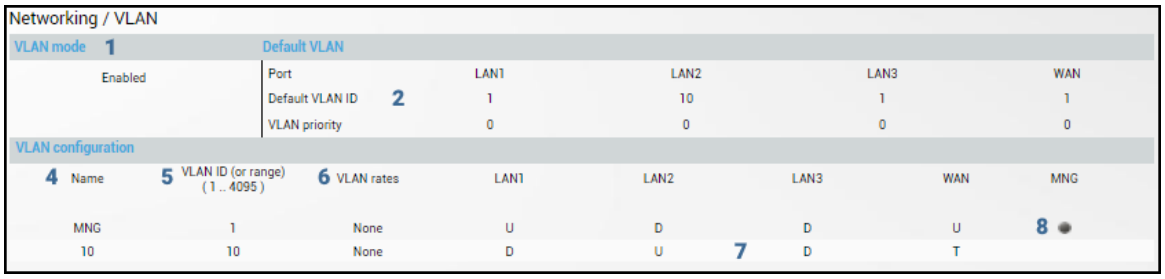


Figure 3-62 VLAN page in status mode

The VLAN configuration window provides the configuration of port-based Ethernet Virtual Local Area Networks (VLANs), allowing up to 4094 different VLAN IDs. It is possible to set VLAN IDs as tagged or untagged members on each LAN port.

To add a VLAN tag to untagged packets in the ingress direction, “Default VLAN” (2) should be specified. By default, the “Default VLAN” value on all ports is VLAN ID 1.

Press MODIFY button.

Modify mode

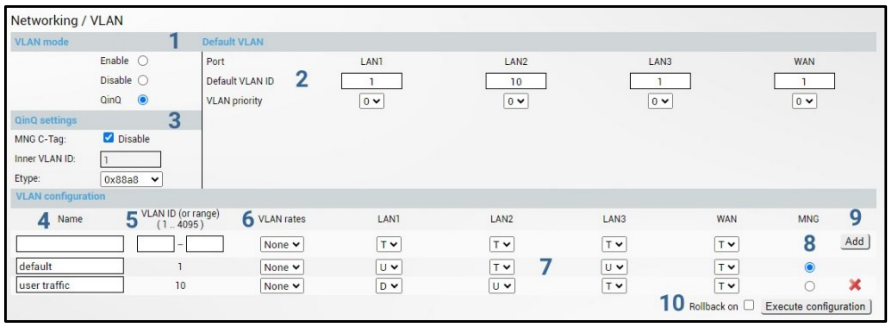


Figure 3-63 Modify VLAN

1) *VLAN mode* – indicates VLAN operational mode. The default is "Disable" – 802.1Q disabled. Change to "Enable" to enable 802.1Q VLAN support. Change to "QinQ" to enable 802.1ad QinQ (Double Tagging) VLAN support.

> As soon as you enable VLAN operational mode, connectivity with untagged traffic will be lost.

2) *Default VLAN* – indicates Default VLAN IDs on LAN and WAN ports (status mode); allows specifying the default VLAN ID on each of the LAN and WAN ports (modify mode). The specified VLAN ID will be added to the untagged ingress packets. VLAN ID will be removed according to the tagged/untagged configuration of that particular port. Allows configuring VLAN priority 0…7.
3) *QinQ settings* – this panel becomes visible only when QinQ VLAN mode is selected, allowing to enable/disable the inner MNG C-tag, to specify the inner VLAN ID, and to select the TPID (Etype) between 0x88a8, 0x9100, and 0x9200.

> Note that only the outer VLAN ID (S-tag) will be accepted by the MNG port, see *8) MNG* below. To work with the inner tag (C-tag) for the management traffic, uncheck the "Disable" mark and specify the "Inner VLAN ID" that is used for management.

4) *Name* – indicates configured (if assigned) VLAN ID or VLAN ID range names (status mode); allows entering a name for each entry, i.e., individual VLAN ID or VLAN ID range (modify mode).
5) *VID (1 .. 4094)* – indicates configured VLAN IDs and VLAN ID ranges (status mode); allows entering individual VLAN IDs or VLAN ID ranges, e.g., "100-300", "500" (modify mode);
6) *VLAN rates* – indicates configured VLAN rate (status mode); allows selection of a defined VLAN rate (modify mode).
7) *T/U/D* – indicates whether VLAN ID entries are configured in U – untagged (access) mode, T – tagged (trunk) mode, or D – disabled (status mode); allows changing VLAN mode on LAN and WAN ports (modify mode). Changing from T to U will change the previous untagged VLAN ID on the same port to T (trunk) mode and will highlight this change in yellow color. Note that only a single U (untagged) VLAN ID can be configured on each available port. Also, U (untagged) mode is not available on the WAN port.
8) *MNG* – indicates management VLAN ID (status mode); allows specifying which individual VLAN ID will be used for management access (modify mode). The management port is an access port on the Integra-X/-X2/-FIDU/-FIDU+ switch for the management CPU.
9) *Add / Delete* – press "Add" to add the entered individual VLAN ID or VLAN ID range, or press the red cross (✖) to delete the VLAN entry.
10) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If *„Rollback on"* is selected, the

configuration will be reverted in case erroneous configuration changes are applied and the management connection between link sides is lost.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network vlan set mng <1…4094>	Use to set the Management (MNG) VLAN ID.
network vlan set mode {disable | enable | qinq}	Use to set VLAN operation mode. “disable” – packets ingress/egress unmodified; “enable” – packets are handled according to VLAN configuration; “qinq” – QinQ functionality will be enabled.
network vlan set mode qinq inner_mng {<1 – 4095> | disable}	Use to set VLAN QinQ C-Tag for management traffic ("disable" if unused).
network vlan set mode qinq tpid {0x88a8 | 0x9100 | 0x9200}	Use to set VLAN QinQ Ethernet Type ID in hex.
network vlan set vid <1…4094> **add** {tagged | untagged} {LAN1 | LAN2 | LAN3 | WAN}	Use to add VLAN ID as a tagged (trunk) or untagged (access) type on a specified port.
network vlan set vid <1…4094> **delete** {LAN1 | LAN2 | LAN3 | WAN}	Use to delete the VLAN ID on a specified port.
network vlan set vid <1…4094> **name** <name>	Use to name a VLAN ID. The same name can be applied to multiple VLAN IDs.
network vlan set default vid <1…4094>	Use to set the default VLAN ID for untagged packets.
network vlan show summary	Use to show the general VLAN configuration summary.
network vlan show default	Use to show the configuration of untagged packets.
network vlan show mng	Use to show Management (MNG) VLAN ID.
network vlan show mode	Use to show the current VLAN operational mode and custom EtherType ID.
network vlan show vids	Use to show currently configured VLAN IDs on all ports.

Networking → Ethernet → VLAN rates

The VLAN rates page allows configuring rates for selected VLANs.

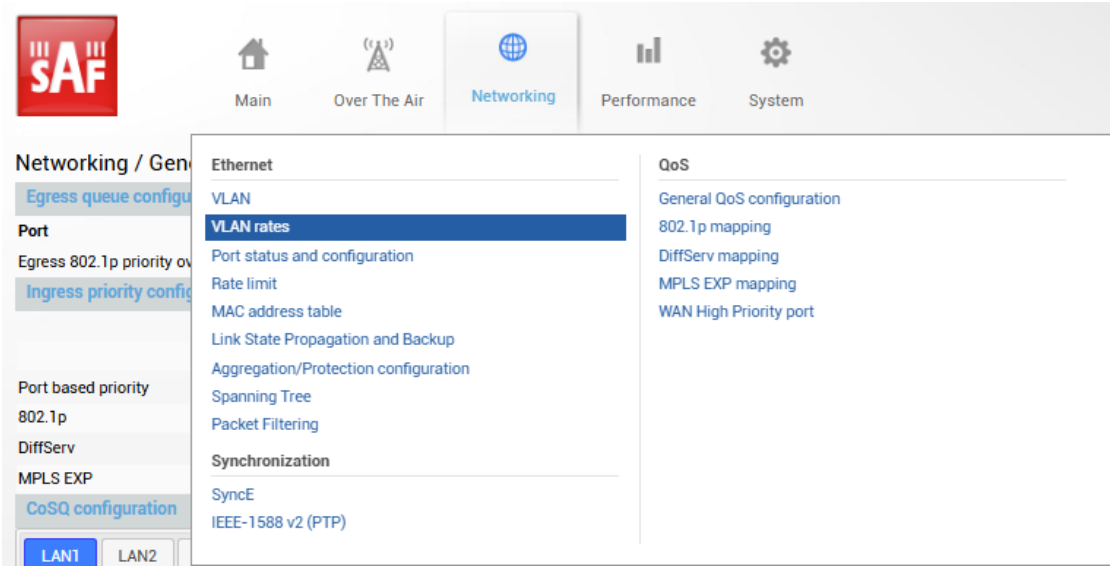


Figure 3-64 Accessing VLAN rates page

Status mode

Figure 3-65 VLAN rates – status mode

Modify mode

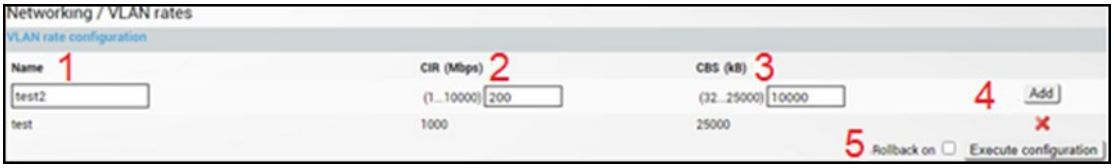


Figure 3-66 VLAN rates – modify mode

1) ***Name*** – indicates whether the egress rate is enabled or disabled on a particular VLAN (status mode); allows enabling/disabling egress rate on a particular VLAN (modify mode).
2) ***CIR (Mbps)*** – indicates configured rate CIR (Committed Information Rate) on a particular VLAN rate item in Mbps (status mode); allows setting rate CIR on a particular VLAN rate item in Mbps (modify mode).
3) ***CBS (kB)*** – indicates configured rate CBS (Committed Burst Size) on a particular VLAN rate item in kB (status mode); allows setting rate CBS on a particular VLAN rate item in kB (modify mode).
4) ***Add / Delete*** – press "Add" to add the entered VLAN rate or press the red cross (×) to delete this entry.
5) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If ***„Rollback on"*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network vlan show rates	Use to show created rate profiles.
Network vlan set rate cir cbs {add|delete} <name> <1000…1000000kbps> <32…671kB>	Use to create new or delete existing rate configuration profiles. Please refer to *Networking → Ethernet → VLAN* section to apply the created rate profile to a VLAN ID.

Networking → Ethernet → Port status and configuration

Shows the status of Ethernet switch ports, allows enabling and disabling the ports, modifying the link speed for the LAN1 RJ45 port, and shows the SFP module information if supported.

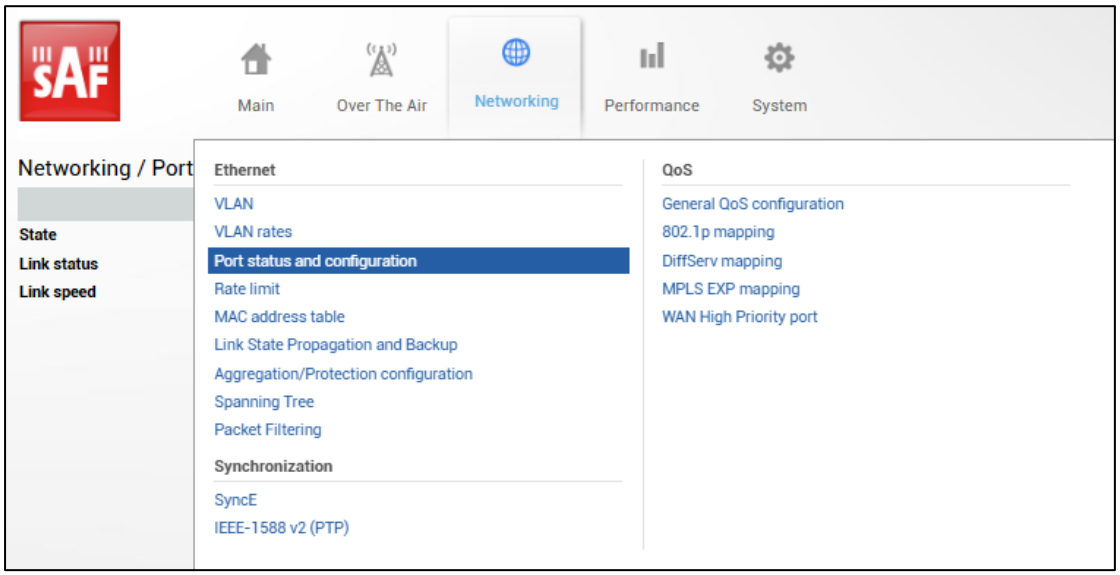


Figure 3-67 Accessing port status and config page

Status mode

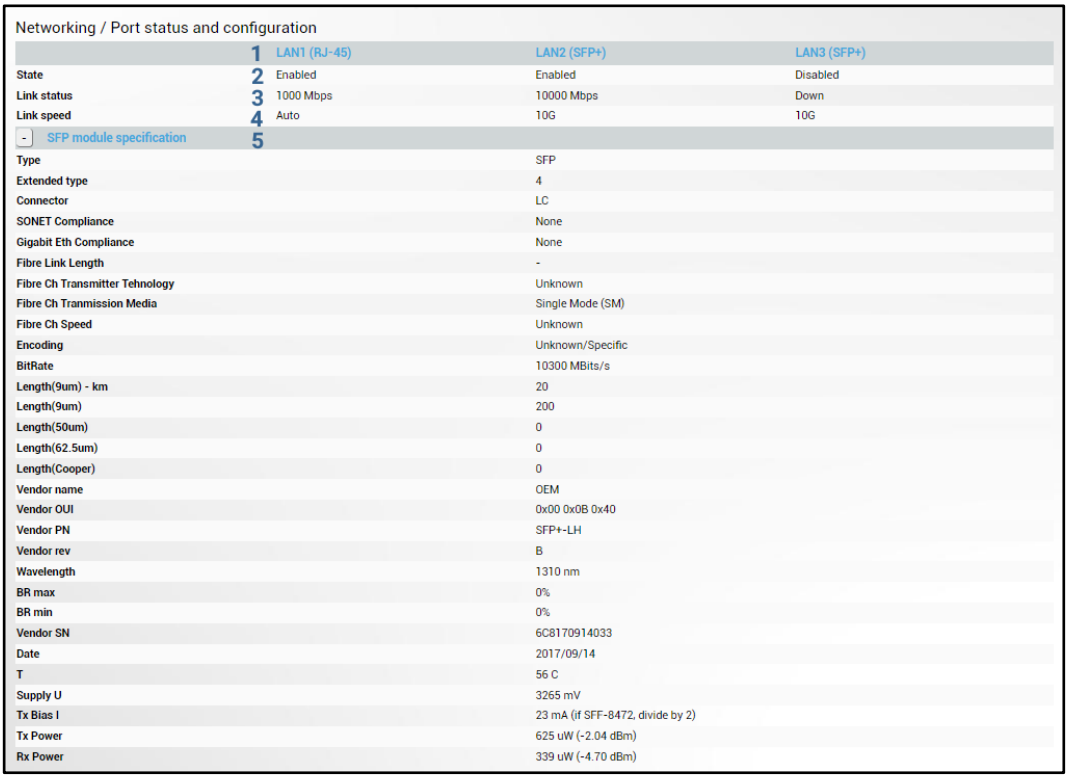


Figure 3-68 Port status window

Press MODIFY button.

Modify mode

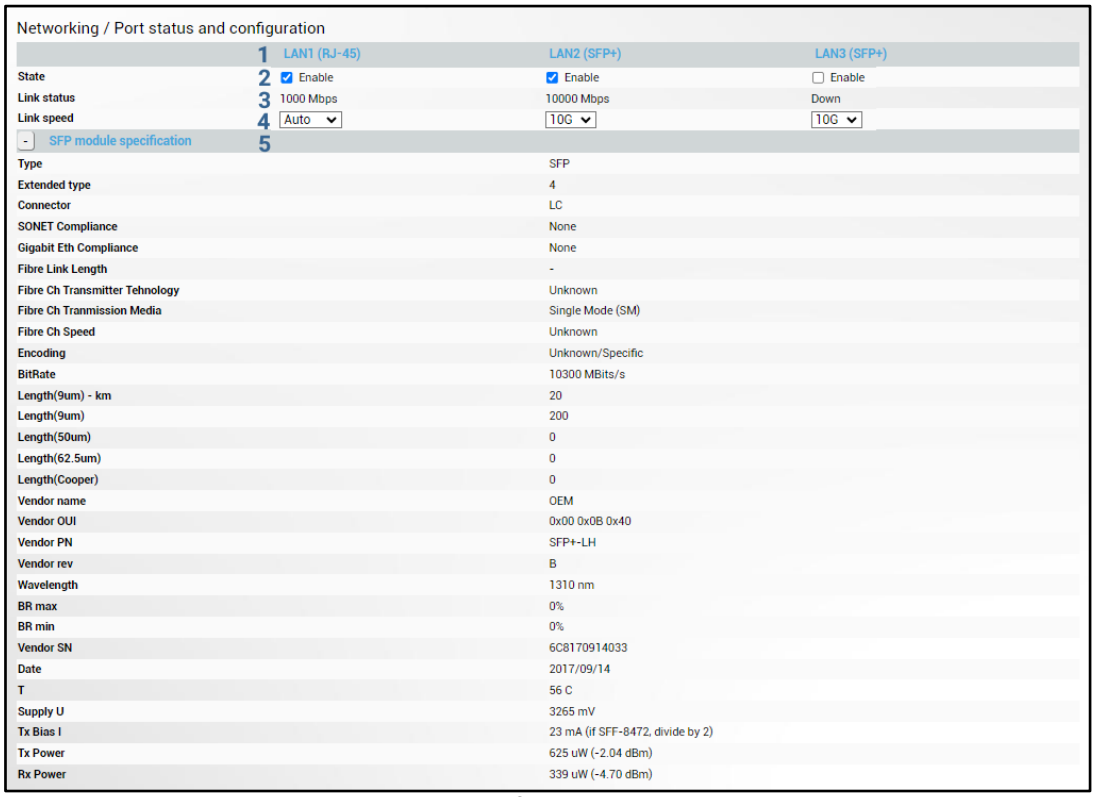


Figure 3-69 Modifying ports parameters

1) *Port* – indicates available switch ports.
2) *State* – Indicates operation status of each LAN port (status mode); allows enabling/disabling each LAN port (modify mode).

If you disable port LAN1, management access through LAN1 will be lost.

3) *Link status* – Indicates whether a link with the appropriate port is established, as well as its link speed.
4) *Link speed* – Indicates the link speed in Status mode. In Modify mode, connection speeds for the port could be changed:
   a. RJ-45 port: Auto for 1000 Mbps (default setting, which is also used for Gigabit Ethernet connection setup), 100fdx for 100 Mbps or 10fdx for 10 Mbps;
   b. SFP/SFP+ ports: 1G for 1 Gbps (default setting), 2G5 for 2.5 Gbps, 10G for 10 Gbps (available only for SFP+ modules), or Auto, which is reserved for future use. Note that Integra-X/-X2/-FIDU/-FIDU+ supports only 1000BASE-T type Gigabit Ethernet SFP modules when using electrical copper twisted pair SFP modules.
5) *SFP module specification* – shows the SFP module information below the corresponding port if the SFP module in the port supports SFF-8472 diagnostic memory mapping (only for LAN2 and LAN3 ports). This information becomes visible by pressing the "+" sign.
6) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network port show info	Use to show the status of all ports.
Network port show config	Use to show the configuration of all ports.
Network port set <port> **admin-state** {enable|disable}	Use to enable or disable the particular port.
Network port set LAN1 speed {auto|100fdx|10fdx}	Use to change the speed and duplex setting on the LAN1 port. The default value is "auto" (auto negotiation).
Network port set LAN {2|3} **speed** {auto|10G|1G|2G5}	Use to change the speed and duplex setting on LAN2 and LAN3 ports. The default value is "auto" (auto-negotiation).
Network port set LAN {1|2|3} **reset-on-linkup** {enable|disable}	Use to enable or disable port reset on link state change on LAN1, LAN2, and LAN3 ports. The default value is "enabled".

Networking → Ethernet → Rate limit

The rate limit page, see *Figure* 3-72 , allows configuring ingress and egress rates on available Ethernet switch ports. In case a license with an Ethernet rate limitation is applied, the Ethernet limitation will be indicated as the egress rate of the WAN port.

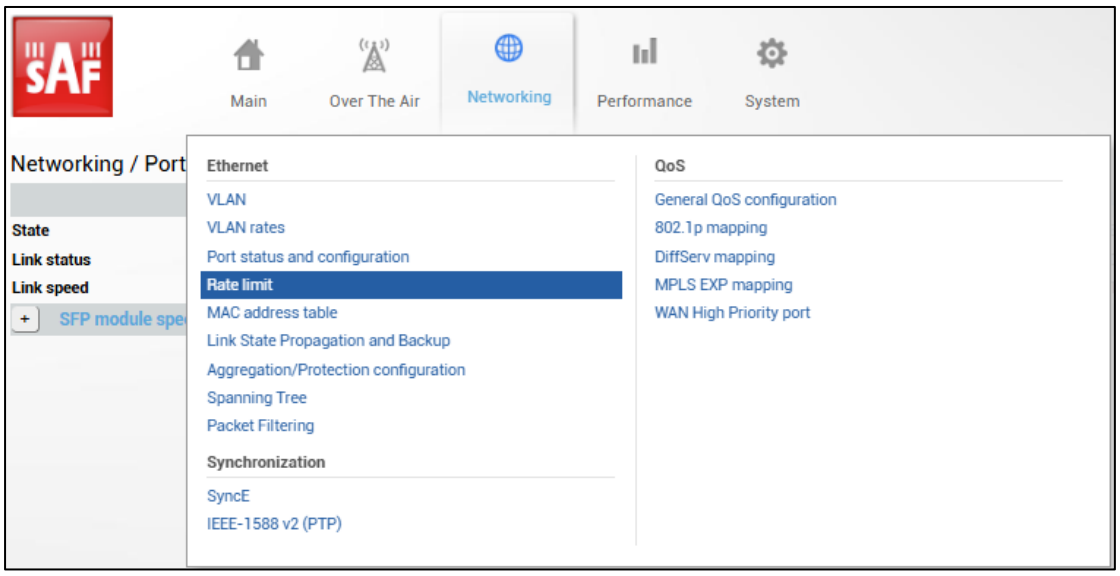


Figure 3-70 Accessing Rate limit settings

Status mode

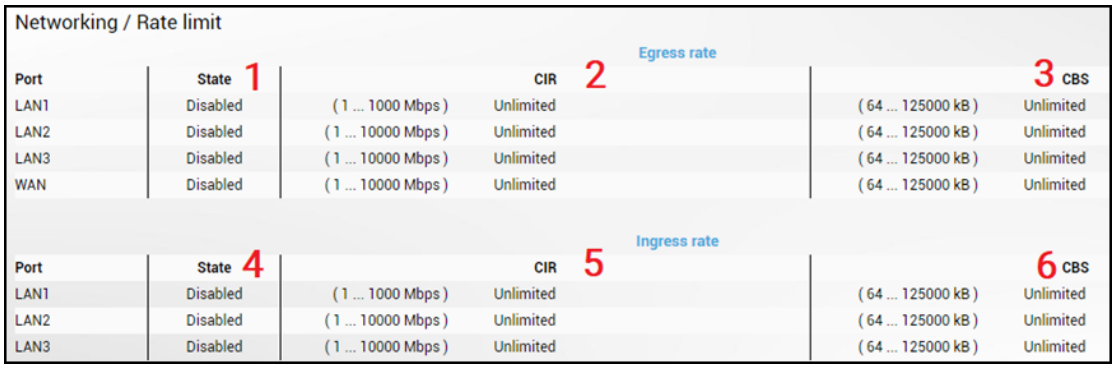


Figure 3-71 Status mode

Press MODIFY button.

Modify mode

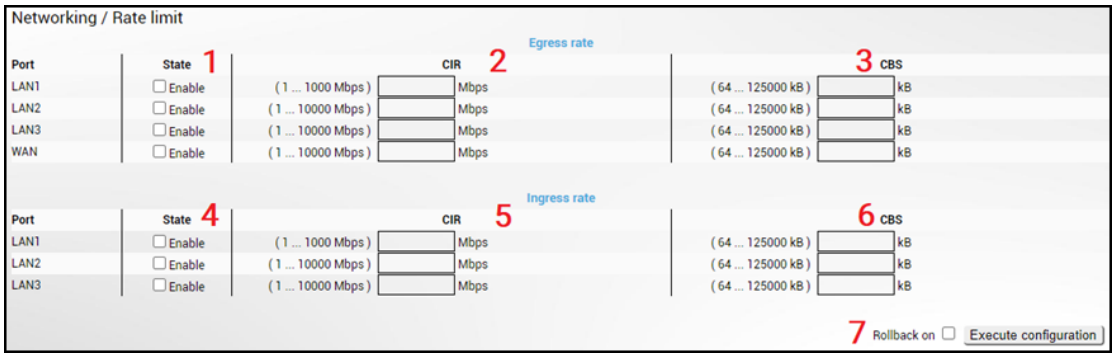


Figure 3-72 Modify mode

1) ***Egress rate / Status*** – Indicates whether the egress rate is enabled or disabled on a particular port (status mode); allows enabling/disabling egress rate on a particular port (modify mode).

2) *Egress rate / CIR* – Indicates the configured egress rate CIR (Committed Information Rate) on a particular port in Mbps (status mode); allows setting egress rate CIR on a particular port in Mbps (modify mode). The default setting is "1000".
3) *Egress rate / CBS* – Indicates the configured egress rate CBS (Committed Burst Size) on a particular port in kB (status mode); allows setting egress rate CBS on a particular port in kB (modify mode). The default setting is "2000".
4) *Ingress rate / Status* – Indicates whether the ingress rate is enabled or disabled on a particular port (status mode); allows enabling/disabling the ingress rate on a particular port (modify mode).
5) *Ingress rate / CIR* – Indicates configured ingress rate CIR (Committed Information Rate) on a particular port in Mbps (status mode); allows setting ingress rate CIR on a particular port in Mbps (modify mode). The default setting is "1000".
6) *Ingress rate / CBS* – Indicates configured ingress rate CBS (Committed Burst Size) on a particular port in kB (status mode); allows setting ingress rate CBS on a particular port in kB (modify mode). The default setting is "2000".
7) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network port show egress-rate <port>	Use to show egress rate limit settings and the status of a particular port.
Network port show ingress-rate <port>	Use to show ingress rate limit settings and the status of a particular port.
Network port set LAN1 egress-rate cir <96…1000000kbps> **cbs** <64…125000kB>	Use to set the Committed Information Rate (CIR) and Committed Burst Size (CBS) value for the egress rate limit on the LAN1 port.
Network port set <LAN2|LAN3> **egress-rate cir** <96…10000000kbps> **cbs** <64…125000kB>	Use to set the Committed Information Rate (CIR) and Committed Burst Size (CBS) value for the egress rate limit on the LAN2 or LAN3 port.
Network port set LAN1 ingress-rate cir <96…1000000> **cbs** <64…125000>	Use to set the Committed Information Rate (CIR) and Committed Burst Size (CBS) value for the ingress rate limit on the LAN1 port.
Network port set <LAN2|LAN3> **ingress-rate cir** <96…10000000> **cbs** <64…125000>	Use to set the Committed Information Rate (CIR) and Committed Burst Size (CBS) value for the ingress rate limit on the LAN2 or LAN3 port.
Network port set <port> **egress-rate state** {enable|disable}	Use to enable or disable egress rate limiting on a particular port.
Network port set <port> **ingress-rate state** {enable|disable}	Use to enable or disable ingress rate limiting on a particular port.

In case the applied rate limit is less than possible by radio conditions, there will be a warning indication on the main page, see the example below where the rate limit is set to 500Mbps while the maximum physically possible capacity is 965Mbps.

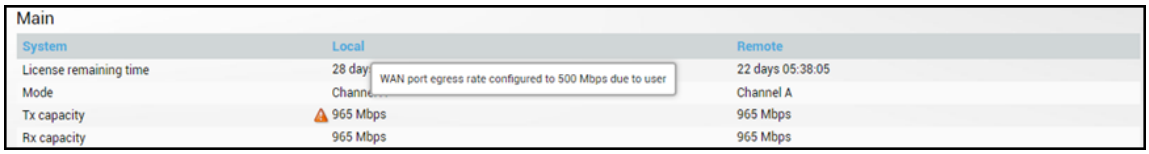


Figure 3-73 Main page warning for rate limit

Networking → Ethernet → MAC address table

The MAC address table displays the forwarding table of MAC addresses learned by the switch (Dynamic) and manually entered (Static).

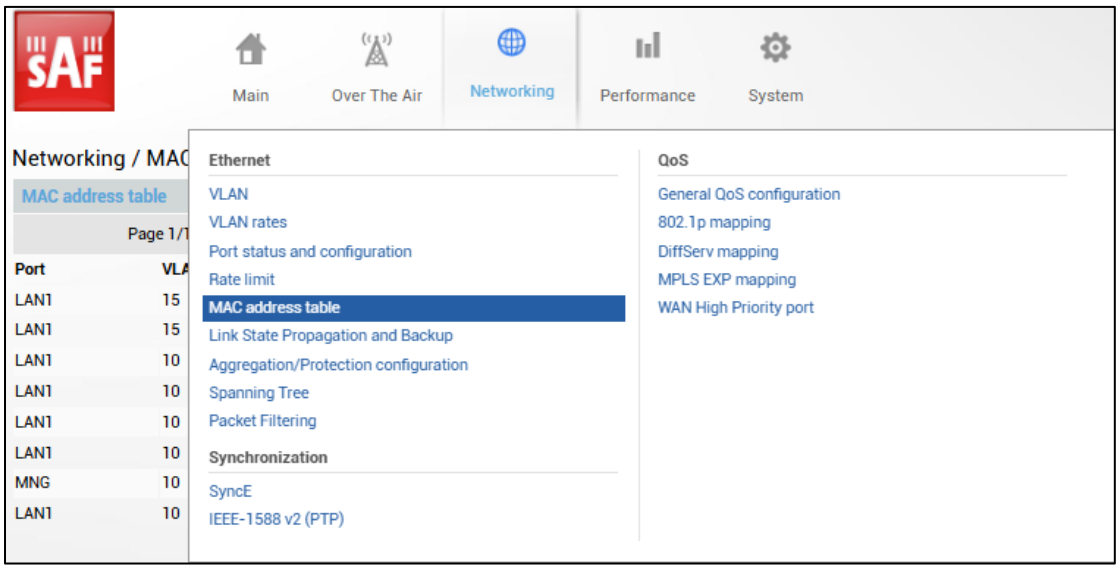


Figure 3-74 Accessing MAC address table

Status mode

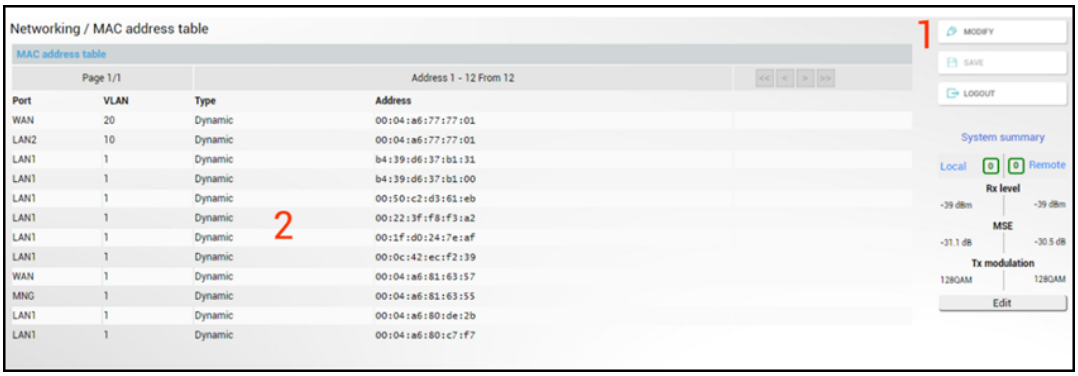


Figure 3-75 MAC address table view

1) Modify – press to modify.

2) Switch MAC address table on a particular port. Press MODIFY button.

Modify mode

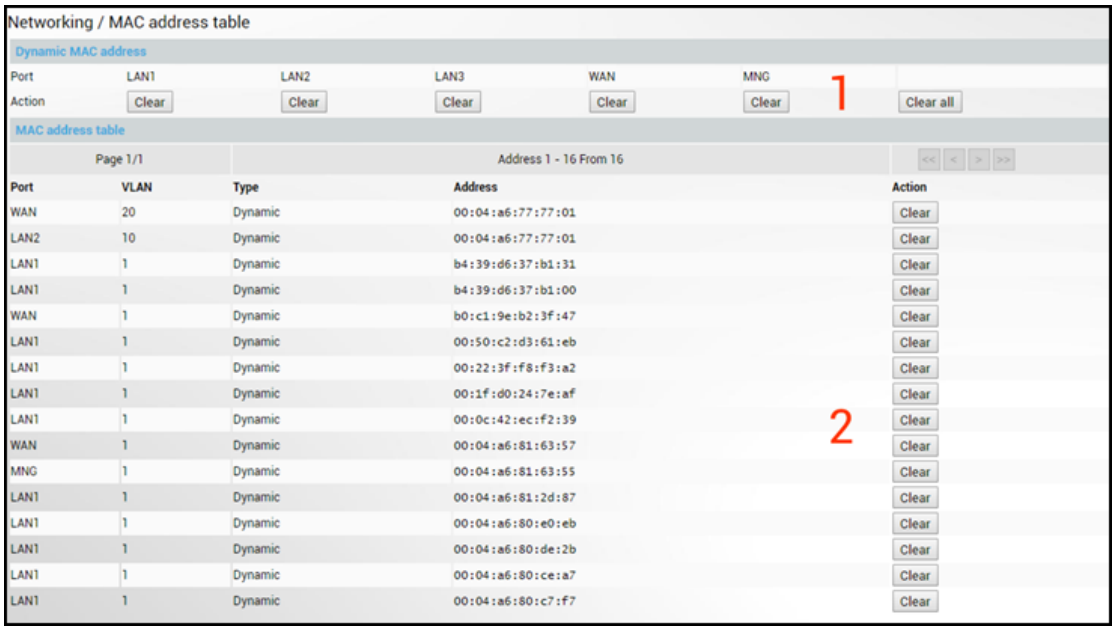


Figure 3-76 MAC table modify page

1) Clear the dynamic MAC address table on a particular port (“Clear” below the port number) or all ports simultaneously (“Clear all”).
2) Clear a specific MAC address entry.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network mac table clear all	All – Clear all records from the MAC address table
network mac table clear port <port>	Use to clear the MAC table entries for a specific port
network mac table info	Show information about the MAC address table.
network mac table show	Show the content of the MAC address table.

Networking → Ethernet → Link State Propagation and Backup

Link State Propagation (LSP) and Backup provide the functionality described in *Link state propagation*.

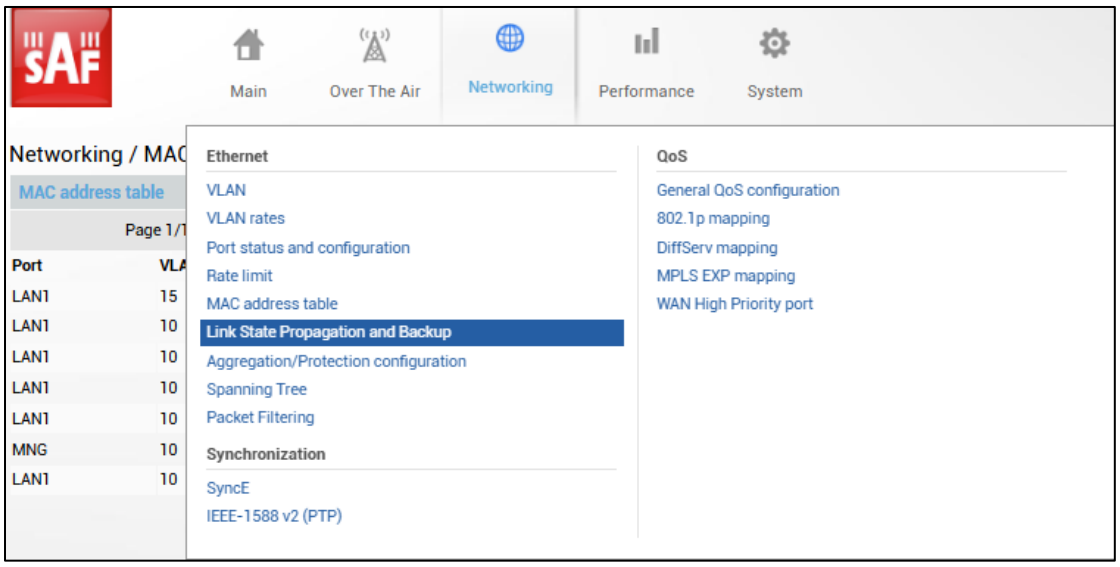


Figure 3-77 Accessing Link State Propagation and Backup menu

Link State Propagation and Backup status window in LSP Enabled state

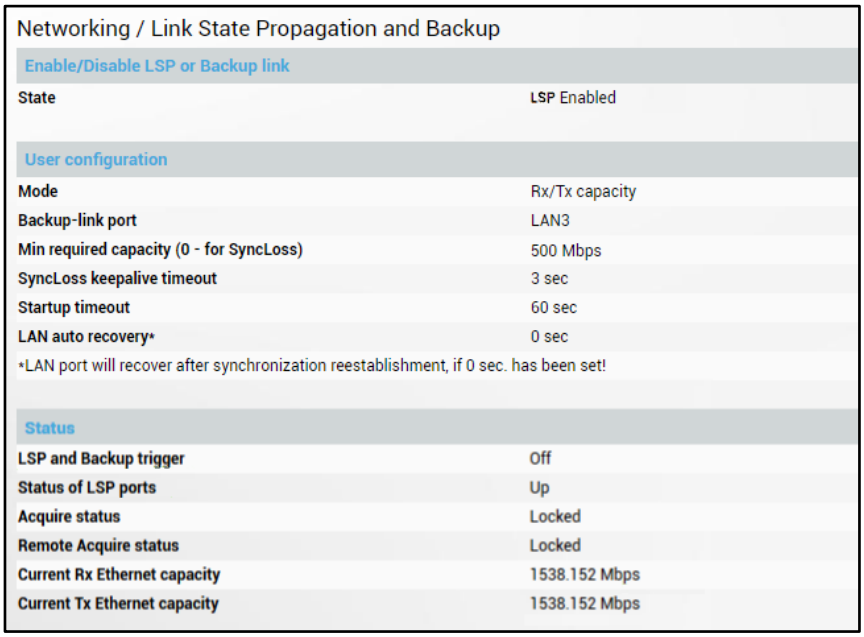


Figure 3-78 LSP configuration and status page

Link State Propagation and Backup modify window for LSP Enabled state configuration

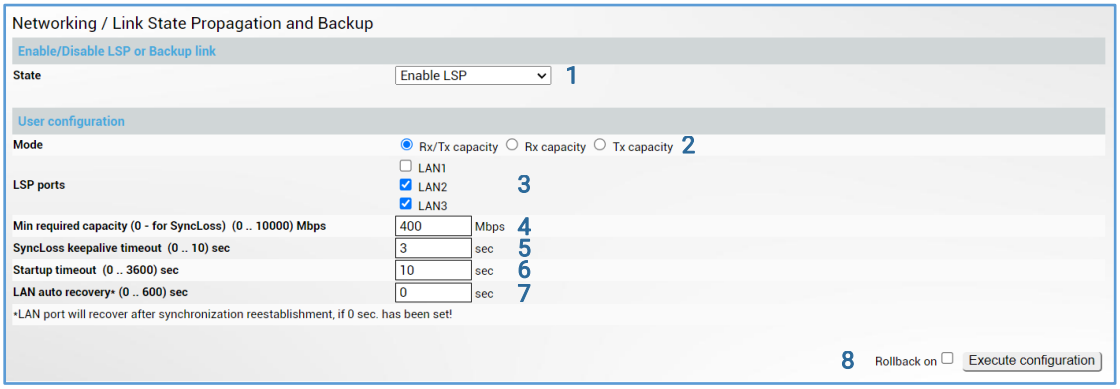


Figure 3-79 LSP configuration page

1) ***State:***

Disable – LSP and backup are disabled (default state).

Enable LSP – LSP is enabled.

Enable Backup-link – Backup-link is enabled.

Enable Inverse Backup – Inverse backup state is enabled.

LSP Advanced – Advanced LSP state is enabled.

The MAC address table is cleared when the LSP is activated or deactivated.

2) ***Mode*** – specify a parameter for LSP triggering - Rx or Tx, or Rx/Tx capacity.
3) ***LSP ports*** – select port(s) for LSP triggering.

LSP blocks the LAN port, and hence, management may not be accessible when LSP is active.

4) ***Min. required capacity*** – used to specify the minimal link Ethernet (Tx, Rx, Tx, or Rx) capacity threshold, exceeding which LSP is triggered, and the configured LSP (LAN) port is blocked. The default value is "0", meaning that LSP is triggered only in case of synchronization loss.
5) ***SyncLoss keepalive timeout*** – LAN port shutdown delay after capacity has dropped below "Min. required capacity" or in case of synchronization loss, and after exceeding "Min. required capacity" or synchronization recovery events.
6) ***Startup timeout*** – LSP activity delay after management CPU start-up and configuration script execution. During this period, capacity drops or synchronization events are ignored.
7) ***LAN auto recovery*** – capacity drop below "Min. required capacity" and synchronization loss timeout after which port is enabled even if link capacity is still below the configured threshold or synchronization is still lost, otherwise, timeout is ignored. If the parameter is set to "0", the port will not be enabled until the actual link capacity exceeds the configured "Min. required capacity" value or link synchronization is recovered (if "Min. required capacity" is 0).
8) By pressing „Execute configuration", changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If „Rollback on" is selected, the configuration will be reverted in case erroneous configuration changes are applied.

For indications during LSP activation, please see the figures below.

Status		
LSP and Backup trigger	9	Off
Status of LSP ports	10	Up
Acquire status	11	Locked
Remote Acquire status	12	Locked
Current Rx Ethernet capacity	13	524.794 Mbps
Current Tx Ethernet capacity	14	524.794 Mbps

Figure 3-80 LSP trigger off, normal operation

Status		
LSP and Backup trigger	9	On
Status of LSP ports	10	Down
Acquire status	11	Locked
Remote Acquire status	12	Locked
Current Rx Ethernet capacity	13	250.772 Mbps
Current Tx Ethernet capacity	14	208.838 Mbps

Figure 3-81 LSP active, LSP port/ports down

Status		
LSP and Backup trigger	9	On
Status of LSP ports	10	Up
Acquire status	11	Locked
Remote Acquire status	12	Locked
Current Rx Ethernet capacity	13	208.838 Mbps
Current Tx Ethernet capacity	14	208.838 Mbps

Figure 3-82 LSP trigger is on, LSP port/ports are up after the timeout "*LAN auto recovery*" ended

9) ***LSP and Backup trigger*** – LSP and backup trigger status:
   - ***On*** – LSP is triggered and active.
   - ***Off*** – LSP is inactive.

10) ***Status of LSP ports:***
   - ***Up*** – ports are in normal operational mode.
   - ***Down*** – LSP triggered, and the LAN port is blocked.

11) ***Acquire status*** – local modem status.

12) ***Remote Acquire status*** – remote modem status.

13) ***Current Rx Ethernet capacity*** – Current ingress Ethernet capacity on Integra-X/X2/FIDU/FIDU+ WAN port.

14) ***Current Tx Ethernet capacity*** – Current egress Ethernet capacity on Integra-X/X2/FIDU/FIDU+ WAN port.

CLI commands for LSP state (Chapter 4 *COMMAND LINE INTERFACE*)

network lsp	Show LSP/backup status
network lsp status	Show LSP/backup status.
network lsp state < advanced | backup | backup_inverse | disable | enable >	Changing LSP state: disable, enable LSP, enable Backup, enable Inverse Backup, enable LSP Advanced.
network lsp set auto_recovery <0 - 600>	Set auto recovery timeout in seconds.
network lsp set capacity <0 - 10000000>	Set minimal required WAN capacity, “0” for sync loss, kbps.
network lsp set keep_alive <0 - 10>	Set “keep alive” timeout.
network lsp set mode <rx> or <rx_tx> or <tx>	Select the minimal required capacity direction.
network lsp set port <add> or <remove> ports {LAN1, LAN2, LAN3}	Select LSP ports, add or remove LAN1, LAN2, or LAN3.
network lsp set start_up <0-3600>	Set start-up timeout, seconds.

Link State Propagation and Backup modify window for Enable Backup-link state configuration

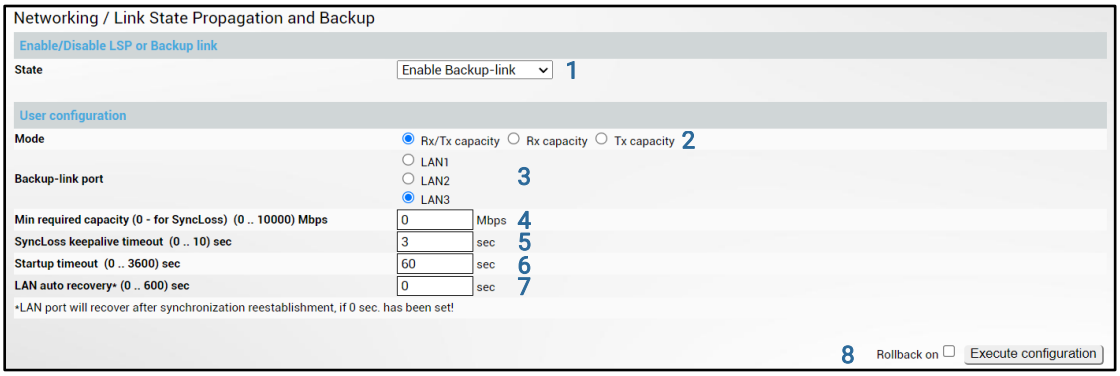


Figure 3-83 Enabling Backup-link

1) ***State:***

Disable – LSP and Backup-link are disabled (default state).
Enable LSP – LSP is enabled.
Enable Backup-link – Backup-link is enabled.
Enable Inverse Backup – Inverse Backup state is enabled.
LSP Advanced – Advanced LSP state enabled.

WAN port is disabled while Backup-link is triggered and active.

The MAC address table is cleared when the Backup link is activated or deactivated.

2) ***Mode*** – specify a parameter for LSP triggering - Rx or Tx, or Rx/Tx capacity.
3) ***Backup-link port*** – select a port for Backup-link.

4) *Min. required capacity* – used to specify the minimal link Ethernet (Tx, Rx, Tx or Rx) capacity threshold, exceeding which the Backup-link is triggered and the configured Backup-link (LAN) port is opened. The default value is "0", meaning that Backup-link is triggered only in case of synchronization loss.
5) *SyncLoss keepalive timeout* – Backup-link activation delay after capacity has dropped below "Min. required capacity" or in case of synchronization loss, and after exceeding "Min. required capacity" or synchronization recovery events.
6) *Startup timeout* – Backup-link activity delay after management CPU start-up and configuration script execution. During this period, capacity drops or synchronization events are ignored.
7) *LAN auto recovery* – after a defined time, Backup-link is disabled and WAN is enabled even if the link capacity is still below the configured threshold or synchronization is still lost, otherwise, the timeout is ignored. If the parameter is set to "0", the WAN port will not be enabled until capacity is exceeded or link synchronization is recovered.
8) By pressing „Execute configuration", changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If „Rollback on" is selected, the configuration will be reverted in case erroneous configuration changes are applied.

For an indication of when Backup-link is active, please see the figures below.

Status					
LSP and Backup trigger	9	Off			
Backup port link status	10	Inactive	WAN Status	11	Forwarding
Acquire status	12	Locked			
Remote Acquire status	13	Locked			
Current Rx Ethernet capacity	14	524.794 Mbps			
Current Tx Ethernet capacity	15	524.794 Mbps			

Figure 3-84 Backup-link trigger is off

Status					
LSP and Backup trigger	9	On			
Backup port link status	10	Active	WAN Status	11	Discarding
Acquire status	12	Locked			
Remote Acquire status	13	Locked			
Current Rx Ethernet capacity	14	230.728 Mbps			
Current Tx Ethernet capacity	15	208.838 Mbps			

Figure 3-85 Backup-link active

Status					
LSP and Backup trigger	9	On			
Backup port link status	10	Inactive	WAN Status	11	Forwarding
Acquire status	12	Locked			
Remote Acquire status	13	Locked			
Current Rx Ethernet capacity	14	230.728 Mbps			
Current Tx Ethernet capacity	15	208.838 Mbps			

Figure 3-86 Backup link after the timeout "*LAN auto recovery*" ended

9) *LSP and Backup trigger* – LSP and backup trigger status:
   On – Backup-link is triggered and active.
   Off – Backup-link is inactive.
10) *Backup port link status:*
   Link Down – Backup-link is not active, Backup-link configured port is down.
   Active – Backup-link is triggered and active, Backup-link configured port is up, and WAN port is in Discarding state.
11) *WAN Status* - WAN link status:
   Forwarding – WAN port is active, and data transmission is established through the WAN.
   Discarding – WAN port is not active, data switched to backup-link port.

WAN port will be kept in a Forwarding state if the Backup-link configured port cannot be activated (link is down).

12) Acquire status – local modem status.
13) Remote Acquire status – remote modem status.
14) Current Rx Ethernet capacity – Current ingress Ethernet capacity on WAN port.
15) Current Tx Ethernet capacity – Current egress Ethernet capacity on WAN port.

CLI commands for Backup-link state (Chapter 4 *COMMAND LINE INTERFACE*)

network lsp	Show LSP/backup status.
network lsp status	Show LSP/backup status.
network lsp state < advanced | backup | backup_inverse | disable | enable >	Changing LSP state: disable, enable LSP, enable Backup, enable Inverse Backup, enable LSP Advanced.
network lsp set auto_recovery <0 - 600>	Set auto recovery timeout in seconds.
network lsp set backup_port <LAN1> or <LAN2> or <LAN3>	Select the backup link port.
network lsp set capacity <0 - 10000000>	Set minimal required WAN capacity, "0" for sync loss, kbps.
network lsp set keep_alive <0 - 10>	Set "keep alive" timeout.
network lsp set mode <rx> or <rx_tx> or <tx>	Select the minimal required capacity direction.
network lsp set start_up <0-3600>	Set start-up timeout, seconds.

Link State Propagation and Backup modify window for Enable Inverse Backup state configuration

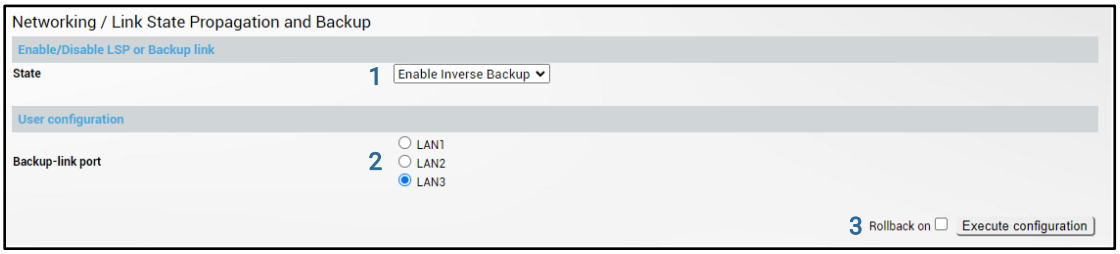


Figure 3-87 Enabling Inverse Backup

1) State:

Disable – LSP and Backup-link are disabled (default state).
Enable LSP – LSP is enabled.
Enable Backup-link – Backup-link is enabled.
Enable Inverse Backup – Inverse Backup state is enabled.
LSP Advanced – Advanced LSP state is enabled.

WAN port is disabled until Inverse Backup is triggered and active.

The MAC address table is cleared when the Inverse Backup is activated or deactivated.

2) *Backup-link port* – select a port for Backup-link.
3) By pressing „Execute configuration", changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If „Rollback on" is selected, the configuration will be reverted in case erroneous configuration changes are applied.

For an indication of when Inverse Backup is active, please see the figures below.

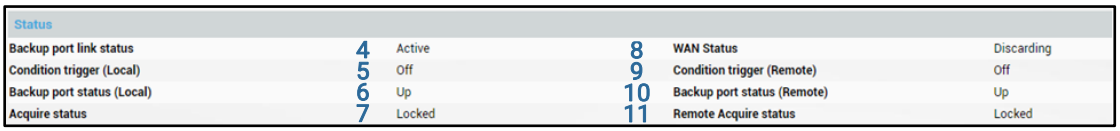


Figure 3-88 Condition trigger is off

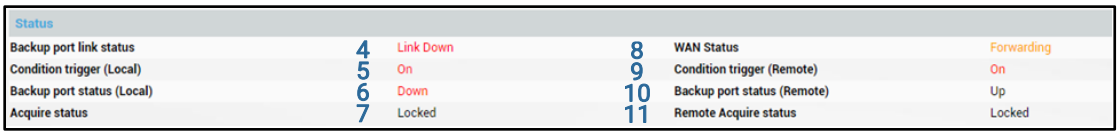


Figure 3-89 Condition trigger is on, Local backup port is down, Backup link is active

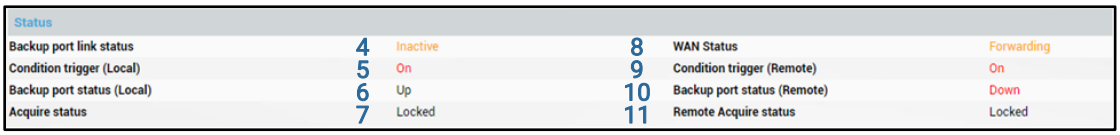


Figure 3-90 Condition trigger is on, Remote backup port is down, Backup link is active

4) *Backup port link status:*
   Link Down – Main data link is not active, Backup-link configured port is down.
   Inactive – Main data link is not active, Backup-link configured port is up.
   Active – Backup-link is not triggered and not active, Backup-link configured port is up and WAN port is in Discarding state.
5) *Condition trigger (Local):*
   On – Backup-link triggered and active.
   Off – Backup-link is inactive.
6) *Backup port status (Local):*
   Up – Backup-link is not active, Backup-link configured port is up on the local side.
   Down – Backup-link is triggered and active, Backup-link configured port is down, and WAN port is in Forwarding state on the local side.
7) *Acquire status* – local modem status.
8) *WAN Status* – WAN link status:
   Forwarding – WAN port is active, and data transmission is established through the WAN.
   Discarding – WAN port is not active, data switched to backup-link port.

WAN port will be kept in a Forwarding state if the Backup-link configured port cannot be activated (link is down).

9) *Condition trigger (Remote):*
   On – Backup-link triggered and active.
   Off – Backup-link is inactive.
10) *Backup port status (Remote):*

Up – Backup-link is not active, Backup-link configured port is up on the remote side.

Down – Backup-link is triggered and active, Backup-link configured port is down, and WAN port is in Forwarding state on the remote side.

11) Remote Acquire status – remote modem status.

CLI commands for Inverse Backup state (Chapter 4 *COMMAND LINE INTERFACE*)

network lsp	Show LSP/backup status.
network lsp status	Show LSP/backup status.
network lsp state < advanced | backup | backup_inverse | disable | enable >	Changing LSP state: disable, enable LSP, enable Backup, enable Inverse Backup, enable LSP Advanced.
network lsp set backup_port <LAN1> or <LAN2> or <LAN3>	Select backup link port.

Link State Propagation and Backup modify window for LSP Advanced Enabled state configuration

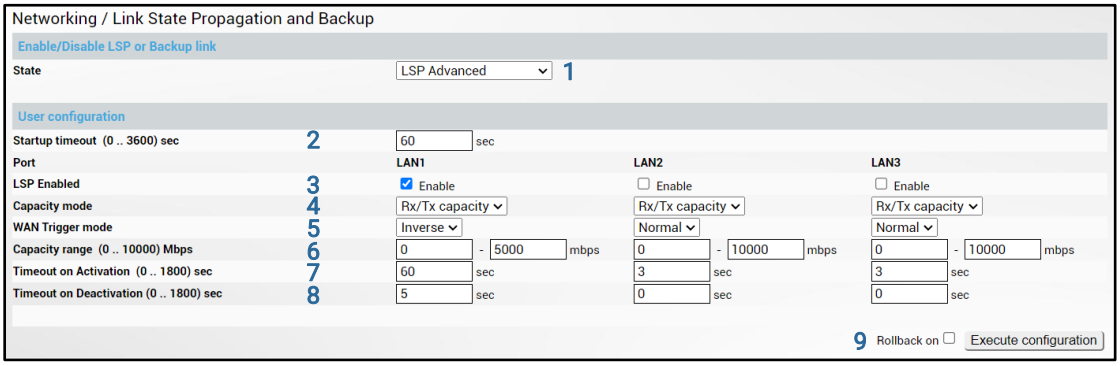


Figure 3-91 Enabling LSP Advanced

1) State:

Disable – LSP and backup are disabled (default state).

Enable LSP – LSP is enabled.

Enable Backup-link – Backup link is enabled.

Enable Inverse Backup – inverse backup state is enabled.

LSP Advanced – advanced LSP state is enabled.

The MAC address table is cleared when the LSP Advanced is activated or deactivated.

2) Startup timeout – LSP activity delay after management CPU start-up and configuration script execution. During this period, capacity drops or synchronization events are ignored.

3) LSP Enabled – select port(s) for LSP triggering.

LSP blocks the LAN port, and hence, management may not be accessible when LSP is active.

4) Capacity mode – specify a parameter for LSP triggering - Rx or Tx, or Rx/Tx capacity.

5) WAN Trigger mode:

Normal – trigger is active when the Ethernet (Tx, Rx, Tx, or Rx) capacity of the link is out of the configured capacity range (Capacity < *min* or Capacity > *max*).

Inverse – trigger is active when the Ethernet (Tx, Rx, Tx, or Rx) capacity of the link is within the configured capacity range (Capacity > *min* and Capacity < *max*).

6) ***Capacity range*** – used to specify the Ethernet (according to "Capacity mode") capacity range of the link threshold, which is used to trigger the LSP and block the configured LSP (LAN) port. The value "0" means that LSP Advanced is triggered only in case of synchronization loss.
7) ***Timeout on Activation*** – LAN port shutdown delay after the WAN Trigger activation.
8) ***Timeout on Deactivation*** – LAN port recovery delay after the WAN Trigger deactivation.
9) By pressing „Execute configuration", changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If „Rollback on" is selected, the configuration will be reverted in case erroneous configuration changes are applied.

For indications during LSP Advanced activation, please see the figures below.

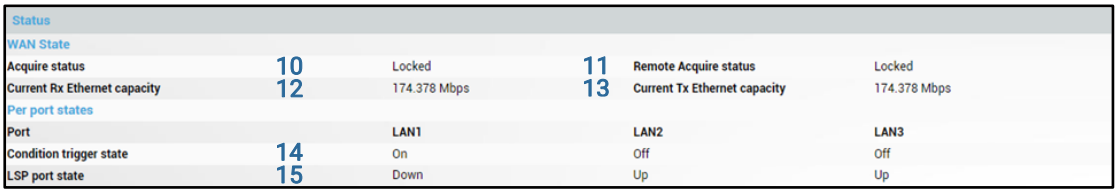


Figure 3-92 Condition trigger is On for LAN1 port and Off for LAN2 and LAN3 ports

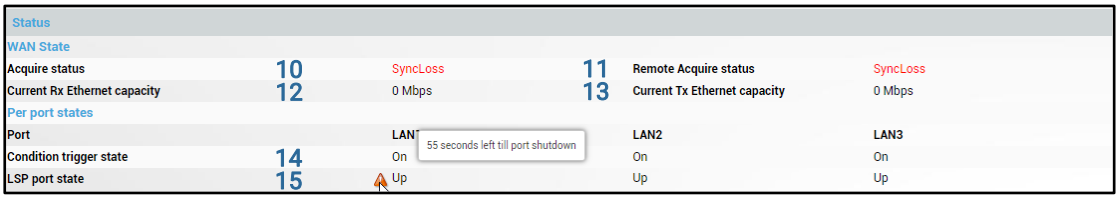


Figure 3-93 LSP Advanced status in case of SyncLoss

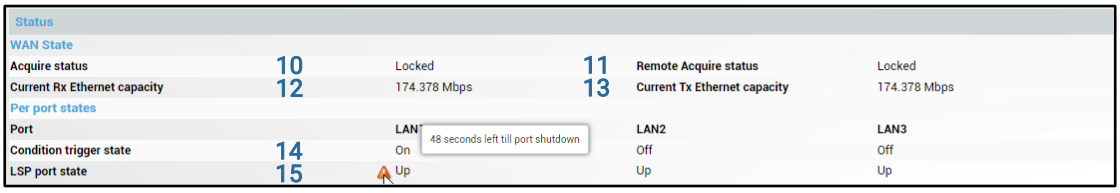


Figure 3-94 Timeout on Activation indication

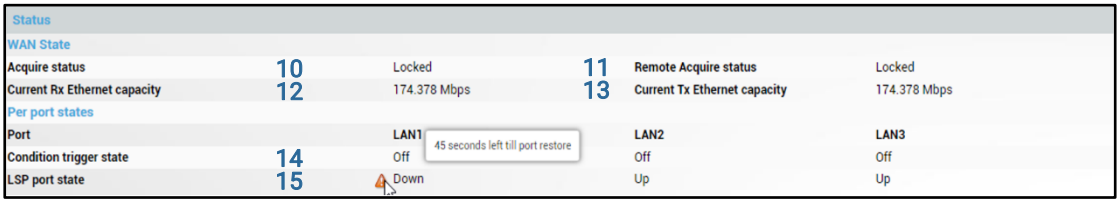


Figure 3-95 Timeout on Deactivation indication

10) ***Acquire status*** – local modem status.
11) ***Remote Acquire status*** – remote modem status.
12) ***Current Rx Ethernet capacity*** – Current ingress Ethernet capacity on the WAN port.
13) ***Current Tx Ethernet capacity*** – Current egress Ethernet capacity on the WAN port.
14) ***Condition trigger state:***
    On – LSP is triggered and active.
    Off – LSP is inactive.
15) ***LSP port state***
    Up – ports are in normal operational mode.
    Down – LSP triggered, and the LAN port is blocked.

The ⚠ sign will indicate that the Timeout on Activation or Timeout on Deactivation has taken effect.

CLI commands for LSP Advanced state (Chapter 4 *COMMAND LINE INTERFACE*)

network lsp	Show LSP/backup status
network lsp status	Show LSP/backup status
network lsp state < advanced | backup | backup_inverse | disable | enable >	Changing LSP state: disable, enable LSP, enable Backup, enable Inverse Backup, enable LSP Advanced
network lsp set advanced <port> **state** <enable | disable>	Enable or disable LSP Advanced on LAN1-3
network lsp set advanced <port> **mode** <rx> or <rx_tx> or <tx>	Select the required capacity direction on LAN1-3
network lsp set advanced <port> **wan_trigger** <normal> or <inverse>	Select WAN Trigger mode: Normal or Inverse on LAN1 - 3
network lsp set advanced <port> **capacity_min** <0 - 10000000>	Set minimal required WAN capacity on LAN1-3, “0” for sync loss, kbps
network lsp set advanced <port> **capacity_max** <0 - 10000000>	Set maximal required WAN capacity on LAN1-3, “0” for sync loss, kbps
network lsp set advanced <port> **activation_tout** <0 - 1800>	Set WAN Trigger activation timeout on LAN1-3, seconds
network lsp set advanced <port> **deactivation_tout** <0 - 1800>	Set WAN Trigger deactivation timeout on LAN1-3, seconds
network lsp set start_up <0-3600>	Set start up timeout, seconds

Networking → Ethernet → Aggregation/protection configuration

Link aggregation/protection in 4+0 mode allows utilizing up to 4.4 Gbps Ethernet Layer 2 and 3 throughput by using an independent frequency pair for each link.

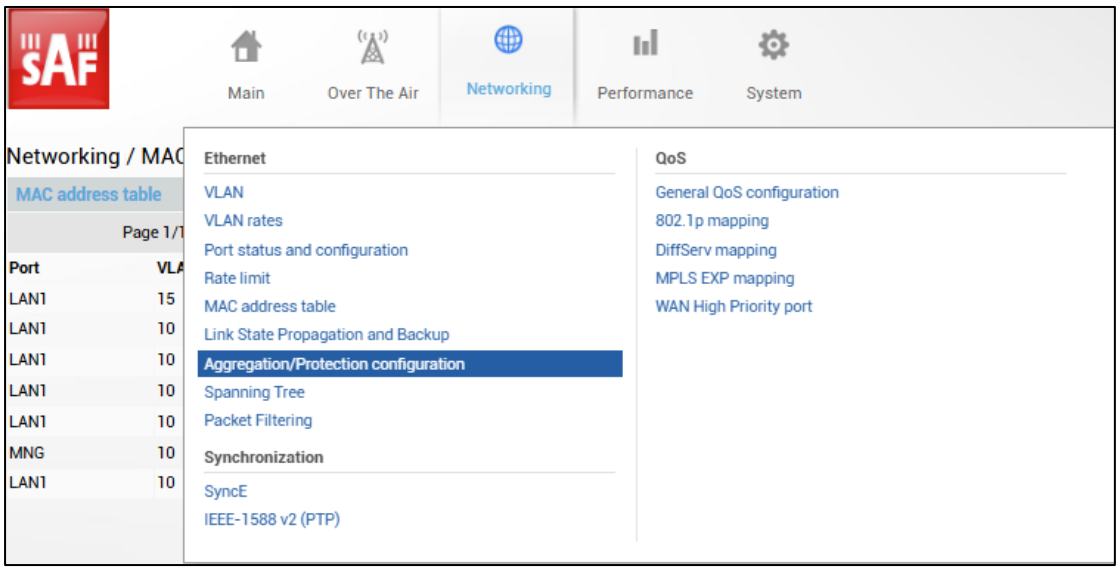


Figure 3-96 Accessing Aggregation/protection configuration menu

Aggregation/protection requires two Integra-X/-X2/-FIDU/-FIDU+ links – primary and secondary. The aggregation/protection setup consists of four radios: 2 x primary and 2 x secondary, where the primary device is responsible for actual traffic aggregation and the secondary device is responsible for passing aggregated traffic via a secondary link.

Devices on the local side are named: Local Primary and Local Secondary. Thereby, remote devices are named: Remote Primary and Remote Secondary.

If a specific device is selected, then there is a relative naming:

- Local – the unit you are referring
- Alternate – local neighbor unit (over LAN)
- Remote – remote neighbor unit (over WAN)
- Remote alternate – a neighbor unit of a remote neighbor device

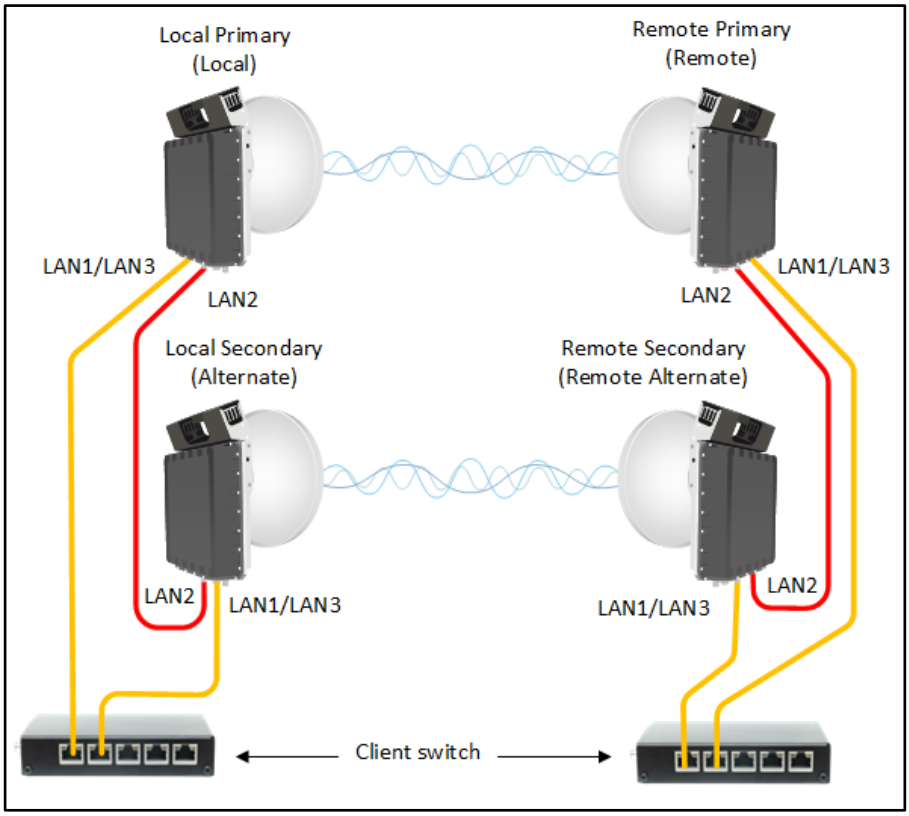


Figure 3-97 Aggregation setup schematic and naming

Please refer to *4+0 aggregation configuration* for more installation schematics.

The primary device balances traffic among two links. The aggregation engine is based on a hashing algorithm, which load balances traffic between primary and secondary links. A hash key mechanism to load balance frames is based on Layer 2 and Layer 3 fields:

- Layer 2 hash calculation is based on the following Ethernet frame L2 fields: SRC MAC, DST MAC, and VLAN.
- Layer 3 hash calculation is based on the following Ethernet frame L3 and L4 fields: IPv4, IPv6, MPLS, TCP/UDP. Traffic distribution between two links is based upon a combination of source and destination IPv4 addresses, source and destination IPv6 addresses, IPv6 flow labels, MPLS labels, and/or payload, and source and destination TCP/UDP ports of network packets.

Secondary device isolates the following ports into two separate domains:

- Aggregated traffic domain – aggregation port LAN2 and WAN.
- Management traffic domain – LAN1, LAN3, MNG.

If power protection is enabled, in case of Local Primary device failure (Local Primary is down and does not aggregate traffic), the Local Secondary starts passing traffic on its own (only if the setup with an external switch is used). Two domains look like the following:

- Isolated domain – LAN2.
- User traffic and management domain – LAN1, LAN3, MNG, WAN.

The states in the Primary and Secondary devices are managed by the Aggregation FSM (Finite State Machine). Radios exchange aggregation/protection status information of each device in the setup via the SAF Mailbox Protocol (SMP). To avoid traffic aggregation via broken path (either primary or secondary), FSM in each device in the given setup monitors the state of neighbours, Ethernet links, and wireless links. In case one of the devices is down, one of the Ethernet links is down, or one of the wireless links runs into Synchronization Loss, the primary devices will detect failure and will not aggregate traffic via the broken path. For example,

primary link runs into Synchronization Loss, then the primary units will distribute traffic only via a secondary path (transmit over a secondary device via LAN2).

General configuration guide:

Do not interconnect Integra-X/-X2/-FIDU/-FIDU+ units with each other, and do not plug Integra-X/-X2/-FIDU/-FIDU+ units into switches before the configuration of each node is finished.

1) Choose one link (low/high side radio) which will operate as the "Primary". The second link will operate as the "Secondary".
2) Configure radio/modem parameters for each link. It's important that the channel bandwidths must be the same (e.g., 112MHz), but all other parameters can differ for both links.
3) Selected frequency channels for both links must be different. As a minimum, it is recommended to have a guard band equal to ¼ BW (e.g., 28 MHz in the case of 112 MHz channels)
4) Configure different IP addresses for all 4 Integra-X/-X2/-FIDU/-FIDU+ radios.
5) The remote IP address for all units must be entered manually. To do that, remove the selection in the "Auto" checkbox and afterwards enter the appropriate remote IP address in the menu "IP configuration" (refer to chapter *System → Configuration → IP configuration*).
6) Proceed with aggregation/protection configuration.

The setup should be designed so that the capacity of the Primary link doesn't exceed the capacity of the Secondary link most of the time. Otherwise, packet loss will occur on the Secondary link.

On both sides, "Primary" and "Secondary" managements must be interconnected via an external switch or directly on LAN1 or LAN3 ports (in addition to LAN2 interconnection) for aggregation/protection to work. This connection is used to interchange 4+0 aggregation/protection statuses for proper operation. Please refer to *4+0 aggregation configuration* for more installation schematics.

Spanning Tree should be disabled on external equipment in the ports to which Integra-X/-X2/-FIDU/-FIDU+ radios are connected and on the Integra-X/-X2/-FIDU/-FIDU+ radio in the Spanning Tree section (please refer to chapter *Networking → Ethernet → Spanning Tree).*

Aggregation configuration in Web GUI

Status mode

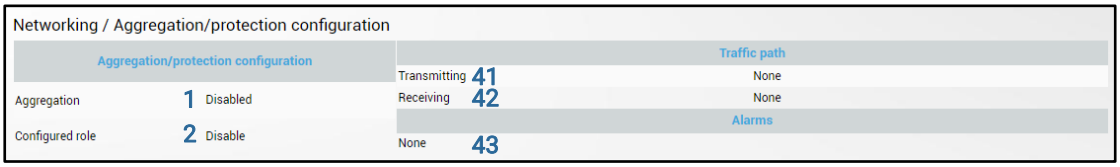


Figure 3-98 Aggregation/protection – status mode

Press MODIFY button.

Modify mode

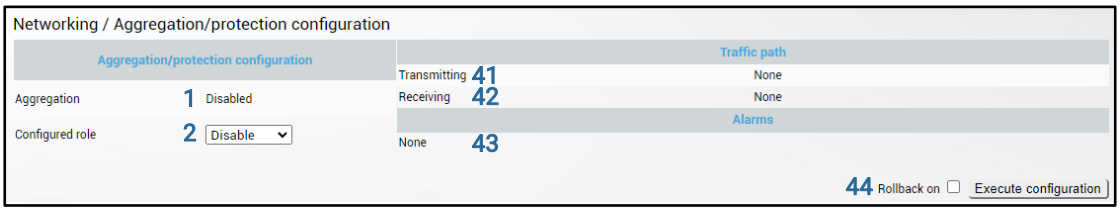


Figure 3-99 Aggregation/protection – modify mode

Primary Status mode after enabling aggregation

Networking / Aggregation/protection configuration

Aggregation/protection configuration		
Aggregation	1	Enabled
Configured role	2	Primary
Mode	3	2+0
Hashing algorithm	4	Layer 2
Power protection	5	Disabled
Current state	6	Primary OK
FSM state	7	Primary Active
Instance ID	8	1
Ethernet traffic port	9	LAN3

Traffic path		
Transmitting	41	Via Primary and Secondary links
Receiving	42	Both

Alarms	
None	43

Neighbour Status Data		Local	Alternate	Remote	Remote alternate
Index	11	4154	59780	1040	50727
Configured role	12	Primary	Secondary	Primary	Secondary
Current state	13	Primary OK	Secondary OK	Primary OK	Secondary OK
FSM state	14	Primary Active	Secondary Active	Primary Active	Secondary Active
Ethernet traffic port	15	LAN3	LAN3	LAN3	LAN3
Ethernet alternate port	16	LAN2	LAN2	LAN2	LAN2
Power protection	17	Disabled	Disabled	Disabled	Disabled
Ethernet MAC address	18	00:04:a6:81:78:cb	00:04:a6:81:7d:c6	00:04:a6:81:78:ca	00:04:a6:81:7d:c7
IP address	19	192.168.205.10	192.168.205.20	192.168.205.11	192.168.205.21
IP mask	20	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
MB ID	21	7	4	7	4
Link states					
LAN1	22	Down	Down	Down	Down
LAN2	23	Up	Up	Up	Up
LAN3	24	Up	Up	Up	Up
WAN	25	Up	Up	Up	Up
Setup neighbour counters					
Timeout last	26	10	7	11	12
Last outage duration	27	2022	0	1008	1049
Timeout max	28	1642	52	1002	1005
Outage count	29	1	0	1	1

Protocol message counters		
Neigbour data updates	30	45
Neigbour data update discards	31	0
SMP Rx No Errors	32	1411241
SMP Rx Error[EtherType]	33	0
SMP Rx Error[Preamble]	34	0
SMP Rx Error[Instance ID]	35	0
SMP Rx Error[CRC]	36	0
SMP Rx Error[Packet Size]	37	0
SMP Rx Error[Other reason]	38	0
SMP Tx Sent	39	961518
SMP Tx Dropped	40	0

Figure 3-100 Primary aggregation/protection after enabling aggregation – status mode

Press MODIFY button.

Primary Modify mode after enabling aggregation

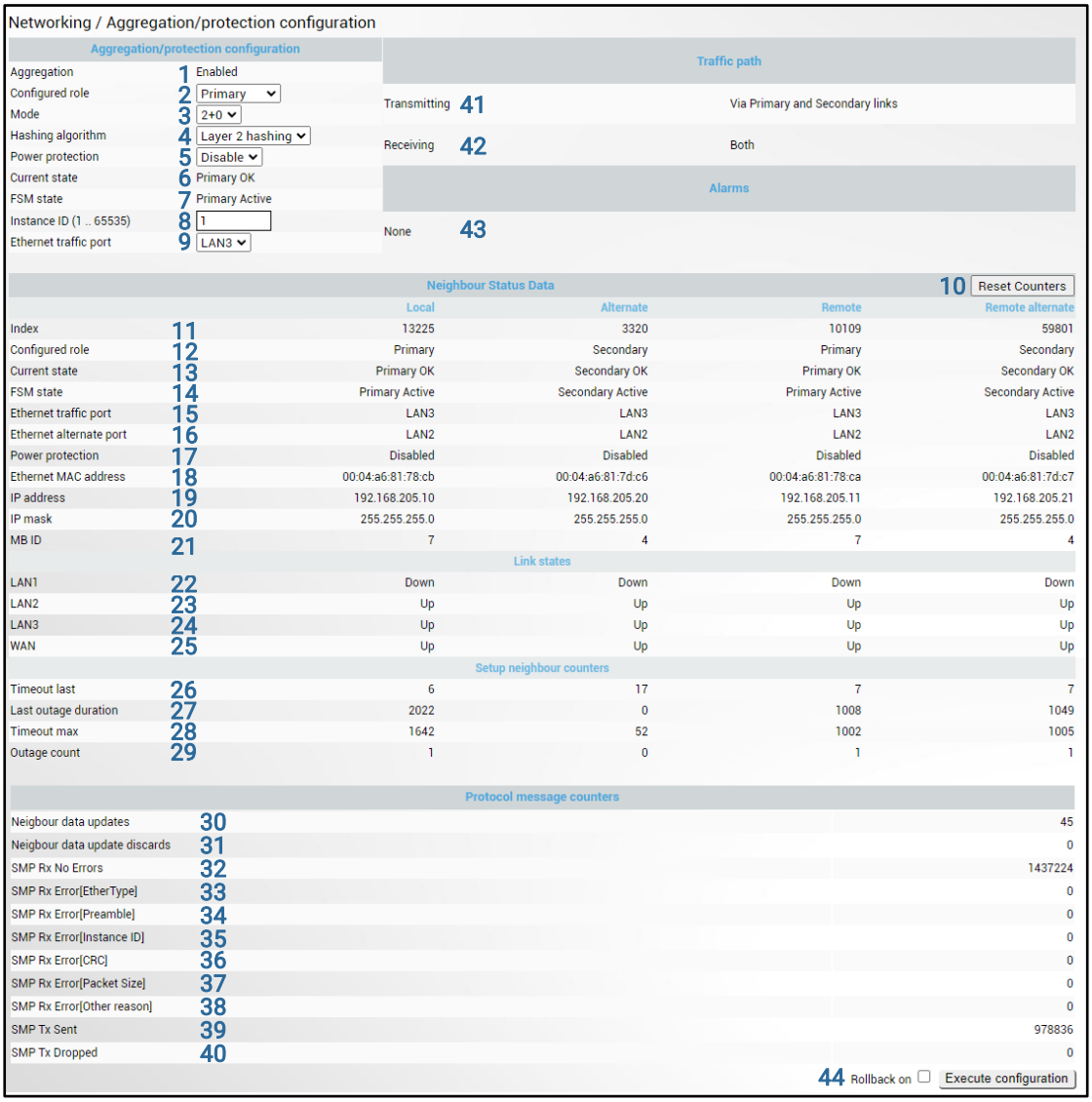


Figure 3-101 Primary aggregation/protection after enabling aggregation – modify mode

Secondary status mode after enabling aggregation

Networking / Aggregation/protection configuration

Aggregation/protection configuration		
Aggregation	1	Enabled
Configured role	2	Secondary
Mode	3	2+0
Hashing algorithm	4	Layer 2
Power protection	5	Disabled
Current state	6	Secondary OK
FSM state	7	Secondary Active
Instance ID	8	1
Ethernet traffic port	9	LAN3

Traffic path		
Transmitting	41	From Alternate port to Radio
Receiving	42	Radio port

Alarms	
None	43

Neighbour Status Data		Local	Alternate	Remote	Remote alternate
Index	11	805	10710	57285	7593
Configured role	12	Secondary	Primary	Secondary	Primary
Current state	13	Secondary OK	Primary OK	Secondary OK	Primary OK
FSM state	14	Secondary Active	Primary Active	Secondary Active	Primary Active
Ethernet traffic port	15	LAN3	LAN3	LAN3	LAN3
Ethernet alternate port	16	LAN2	LAN2	LAN2	LAN2
Power protection	17	Disabled	Disabled	Disabled	Disabled
Ethernet MAC address	18	00:04:a6:81:7d:c6	00:04:a6:81:78:cb	00:04:a6:81:7d:c7	00:04:a6:81:78:ca
IP address	19	192.168.205.20	192.168.205.10	192.168.205.21	192.168.205.11
IP mask	20	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
MB ID	21	4	7	4	7
Link states					
LAN1	22	Down	Down	Down	Down
LAN2	23	Up	Up	Up	Up
LAN3	24	Up	Up	Up	Up
WAN	25	Up	Up	Up	Up
Setup neighbour counters					
Timeout last	26	8	14	11	15
Last outage duration	27	45	2051	1031	1029
Timeout max	28	20	611828	182370	611828
Outage count	29	0	3	1	2

Protocol message counters		
Neigbour data updates	30	80
Neigbour data update discards	31	0
SMP Rx No Errors	32	1485886
SMP Rx Error[EtherType]	33	0
SMP Rx Error[Preamble]	34	0
SMP Rx Error[Instance ID]	35	0
SMP Rx Error[CRC]	36	0
SMP Rx Error[Packet Size]	37	0
SMP Rx Error[Other reason]	38	0
SMP Tx Sent	39	1051784
SMP Tx Dropped	40	0

Figure 3-102 Secondary aggregation/protection after enabling aggregation – status mode

Press MODIFY button.

Secondary Modify mode after enabling aggregation

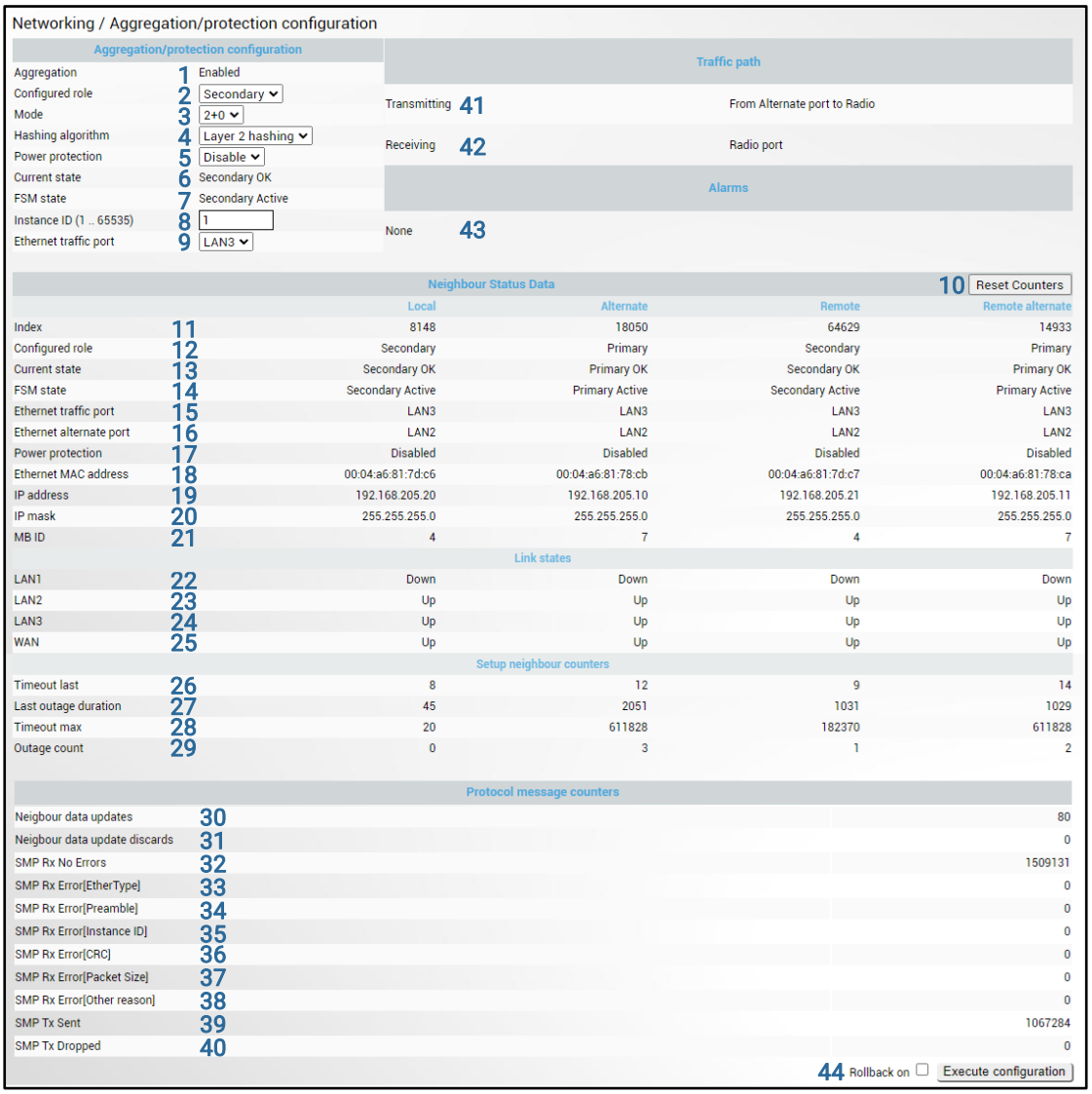


Figure 3-103 Secondary aggregation/protection after enabling aggregation – modify mode

Aggregation/protection configuration

1) *Aggregation* – indicates whether aggregation is enabled or disabled.
2) **Configurated role** – indicates the configured role (status mode); allows specifying aggregation role (modify mode).
3) *Mode* – "2+0" for 4+0 aggregation.
4) *Hashing algorithm* – indicates the configured hashing algorithm (status mode); allows specifying a hashing algorithm (modify mode).
5) *Power protection* – indicates whether power protection is enabled or disabled (status mode); allows enabling or disabling power protection (modify mode).
6) *Current state* – indicates current state. It may differ from the configured role in case the alternate device is or was not available, and reconfiguration to a 1+0 configuration took place.
7) *FSM state* – indicates the current Finite State Machine's state.
   5 states are possible – Primary Active, Secondary Active, Secondary Protect, Broken Primary, Broken Secondary.

8) *Instance ID (1…65535)* – indicates configured instance ID (status mode); allows entering instance ID (modify mode).

Instance ID should be the same on all 4 devices in a single link.

Instance ID should differ for the other 4+0 (aggregated) and 2+0 (aggregated) links in the network.

9) *Ethernet traffic port* – indicates which LAN port is configured as the traffic/management port (status mode); allows setting LAN1 or LAN3 port as the traffic/management port (modify mode).

The aggregated link capacity is limited to the speed of the Ethernet traffic port (i.e., 10 Gbps if LAN3 port is used, or 1 Gbps if LAN1 is used) or to the actual capacity of the Primary link.

Neighbour Status Data

The status of all four units is shown. Local – the unit you are currently connected to; Alternate – unit interconnected with the local unit; Remote – unit on the remote side of the link synchronized to the local unit; Remote alternate – unit interconnected with the remote unit.

The section is visible when aggregation is enabled.

If no data is available, "N/D" will be displayed in red color.

10) *Reset Counters* – allows resetting neighbour refresh time data and message protocol counters. The button is available only in modify mode.
11) *Index* – aggregation data identifier. Value sequentially increments to 65535 and resets to 0.
12) *Configured role* – indicated configured role.
13) *Current state* – indicates current state. It may differ from the configured role, the alternate device is or was not available, and reconfiguration to a 1+0 configuration took place.
14) *FSM state* – indicates the current Finite State Machine's state.
15) Ethernet traffic port – indicates which LAN port is configured as the traffic/management port.
16) *Ethernet alternate port* – indicates which LAN port is used as the aggregation port (will always be a LAN2 port).
17) *Power protection* – indicates whether power protection is enabled or disabled.
18) *Ethernet MAC address* – shows the MAC address of a specific Integra-X/-X2/-FIDU/-FIDU+ radio unit.
19) *IP address* – shows the IP address of a specific Integra-X/-X2/-FIDU/-FIDU+ radio unit.
20) *IP mask* – shows the IP address mask of a specific Integra-X/-X2/-FIDU/-FIDU+ radio unit.
21) MB ID – indicates the main PCB ID of a specific Integra-X/-X2/-FIDU/-FIDU+ radio unit.
22) *LAN1* – indicates link status of LAN1 port – up or down.
23) *LAN2* – indicates link status of LAN2 port – up or down.
24) *LAN3* – indicates link status of LAN3 port – up or down.
25) *WAN* – indicates link status of WAN port – up or down.
26) *Timeout last* – indicates the most recent refresh time of protection data in milliseconds.
27) *Last outage duration* – indicates the duration of the last outage in milliseconds.
28) *Timeout max* – indicates the maximum refresh time of protection data in milliseconds.
29) *Outage count* – indicates the number of outages.

Protocol message counters

30) *Neighbour data updates* – indicates the number of neighbour data updates.
31) *Neighbour data update discards*– indicates the number of neighbour data update discards.
32) *SMP Rx No Errors* – indicates the number of received SMP packets with an aggregation payload without errors.

33) SMP Rx Error [EtherType] – indicates the number of SMP packets dropped due to an error with EtherType.
34) SMP Rx Error [Preamble] – indicates the number of SMP packets dropped due to an error with Preamble.
35) SMP Rx Error [Instance ID] – indicates the number of SMP packets dropped due to an error with Instance ID.
36) SMP Rx Error [CRC] – indicates the number of SMP packets dropped due to an error with CRC.
37) SMP Rx Error [Packet Size] – indicates the number of SMP packets dropped due to an error with packet size.
38) SMP Rx Error [Other reason] – indicates the number of SMP packets dropped due to an error with another reason.
39) SMP Tx Sent – indicates the number of sent SMP packets to neighbours.
40) SMP Tx Dropped – indicates the number of dropped SMP packets to be transmitted.

Traffic path

41) Transmitting – indicates whether Primary, Secondary, or both are transmitting traffic.
42) Receiving – indicates whether WAN, LAN2, or both are receiving traffic.

Alarms

43) Indicates which alarms are active. If none, "None" is shown.

Aggregation port link is down – the link status of the aggregation port (LAN2) of the local device is down.
Traffic port link is down – the incorrect Ethernet traffic port was selected.
Power Protection configuration asymmetry – Power protection is not enabled/disabled on all radios in the aggregation topology.

44) By pressing „*Execute configuration*", changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If „*Rollback on*" is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network aggr status	Use to show full aggregation/protection statistics.
network aggr status neighbour_info	Use to show information on all device statuses in this setup.
network aggr status info	Use to show aggregation alarms and protocol statistics.
network aggr status reset_stats	Use to reset the aggregation statistics.
network aggr role disable	Use to disable aggregation functionality.
network aggr role primary	Use to specify 4+0 aggregation role to Primary.
network aggr role secondary	Use to specify 4+0 aggregation role to Secondary.
network aggr mode 2+0	Use to enable the 4+0 aggregation mode.
network aggr mode 2+0 mprot enable	Use to enable Power protection in 4+0 mode.
network aggr mode 2+0 mprot disable	Use to disable Power protection in 4+0 mode.
network aggr hash layer-2	Use to set Layer 2 hashing for aggregation.
network aggr hash layer-3	Use to set Layer 3 hashing for aggregation.
network aggr instance-id <id>	Use to specify a unique instance ID for the current setup of 4 radios.

network aggr traffic_port <port>	Use to specify the traffic port – LAN1 or LAN3.

Networking → Ethernet → Spanning Tree

The Spanning Tree page provides the configuration of Rapid Spanning Tree Protocol (RSTP) and Multiple Spanning Tree Protocol (MSTP).

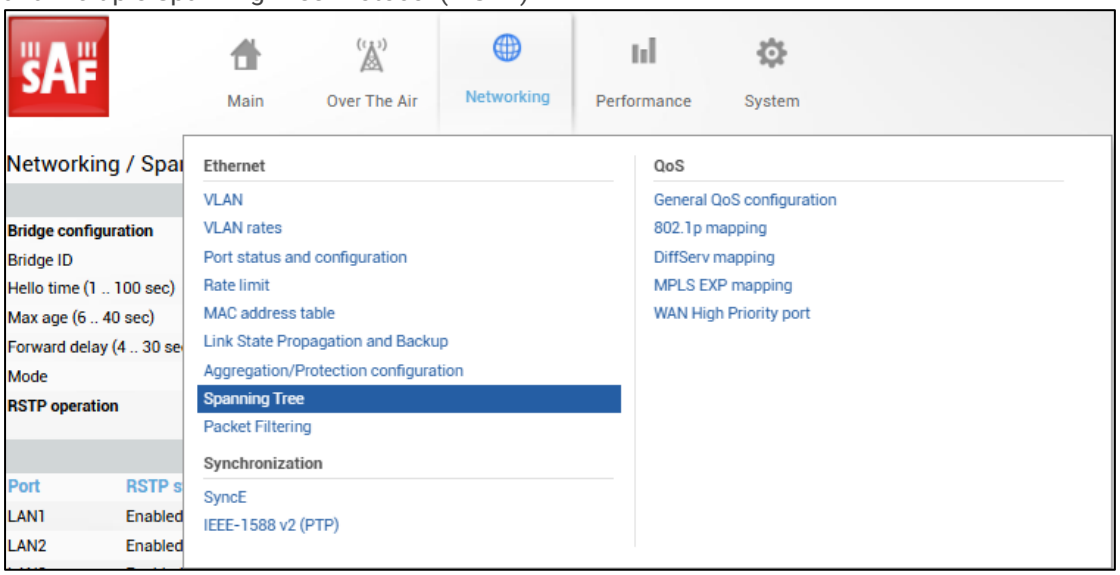


Figure 3-104 Accessing Spanning Tree page

Rapid Spanning Tree Protocol (RSTP)

Status mode

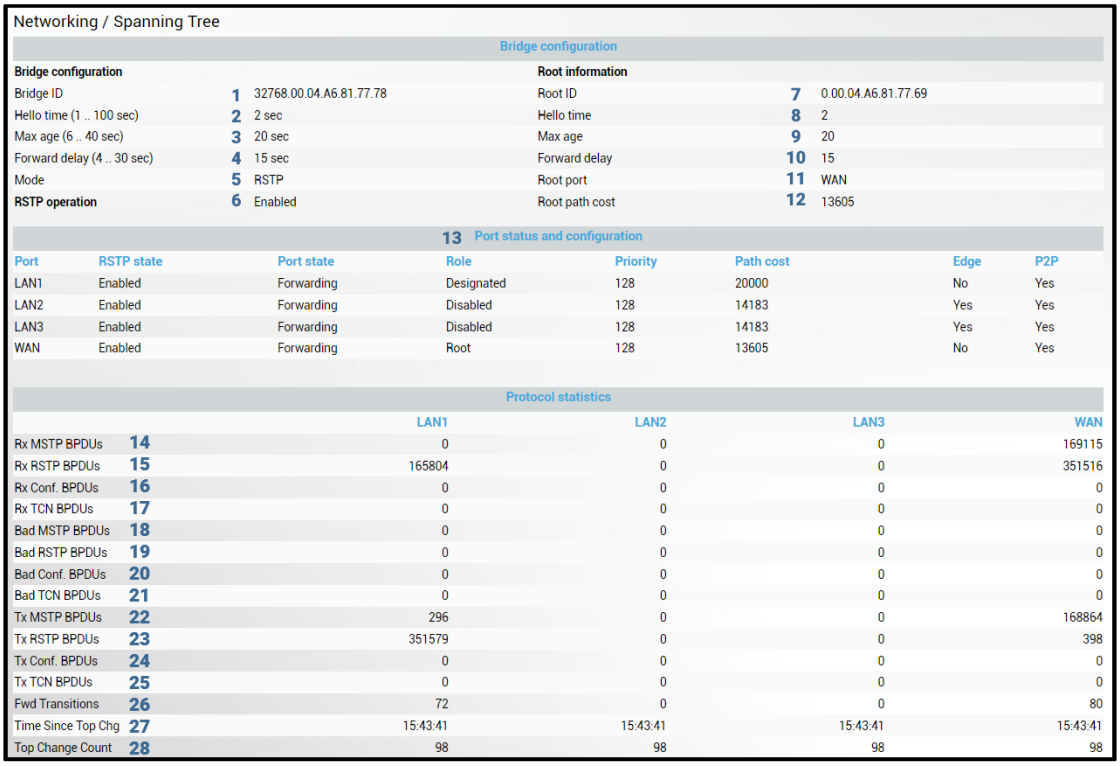


Figure 3-105 Spanning Tree status page

Press MODIFY button to access configuration mode.

Modify mode

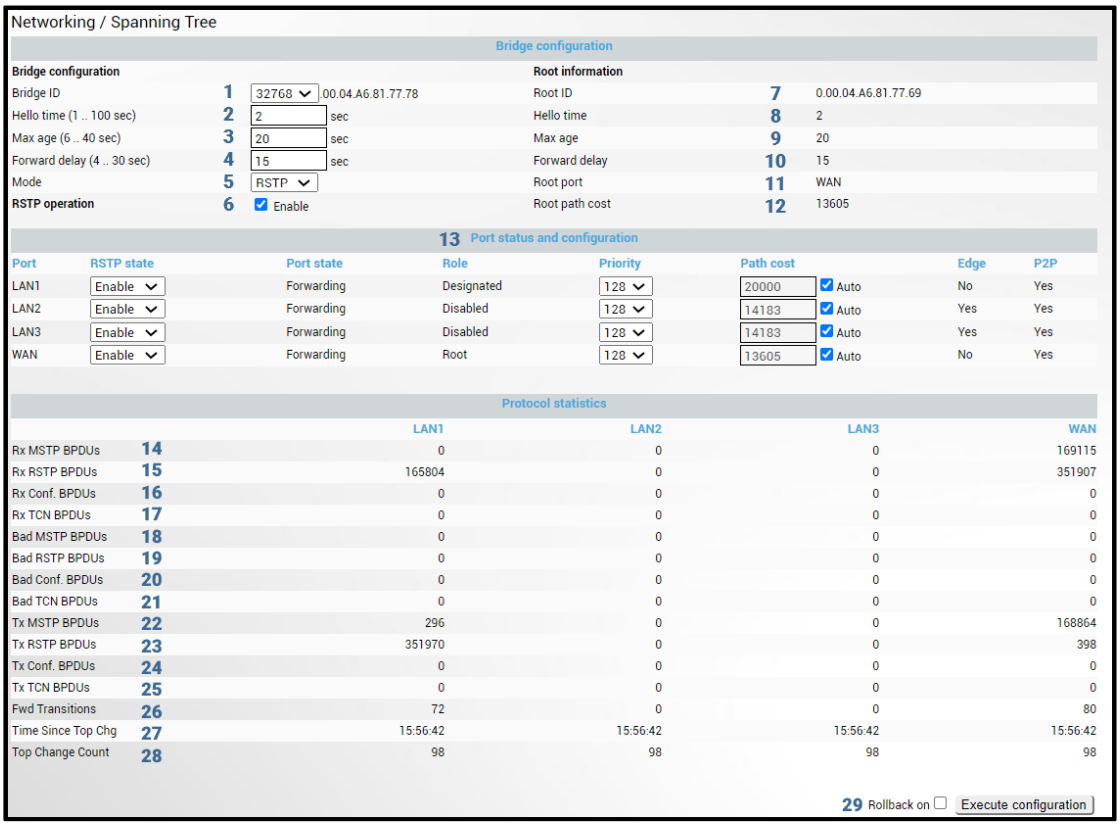


Figure 3-106 Spanning Tree configuration page

1) *Bridge ID* – Indicates the configured value of Bridge ID (status mode); allows specifying the value of Bridge ID (modify mode). This parameter and the MAC address determine whether a given Bridge is Root Bridge. The advantage is given to the combination of Priority and Address, which is numerically smaller.
2) *Hello Time (1 – 100 sec)* – Indicates configured time gap between which the BPDU packets are being sent (status mode); allows specifying the value of Hello Time in seconds (modify mode).
3) *Max Age (6 – 40 sec)* – Indicates configured time, during which the received BPDU packets' information is stored for a separate port (status mode); allows specifying the value of Max Age in seconds (modify mode).
4) *Forward Delay (4 – 30 sec)* – Indicates the configured period that determines the time a separate port stays in Listening and Learning conditions (status mode); allows specifying the value of Forward Delay in seconds (modify mode).
5) *Mode* – Indicates chosen mode of STP configuration; allows changing the mode to RSTP or MSTP.
6) *RSTP operation* – Indicates configured status of RSTP (status mode); allows enabling or disabling RSTP operation (modify mode).

Root information – displays the data only when RSTP is enabled:

7) *Root ID* – Indicates the Bridge ID of the current Root bridge.
8) *Hello Time* – Indicates the current hello time.
9) *Max Age* – Indicates the current max-age time.
10) *Forward Delay* – Indicates the current forward delay.

11) Root Port – Indicates the elected root port is being shown.

12) Root Path Cost – Indicates the path cost from the current bridge to the root bridge.

13) Port status and configuration – STP parameters of every port:

- ***RSTP state*** – Indicates RSTP state of the particular port (status mode); allows enabling or disabling RSTP operation for the particular port (modify mode).
- ***Port state*** – Indicates port condition. Can be one of the following: *Disabled, Blocking, Listening, Learning,* or *Forwarding*.
- ***Role*** – the role of the particular port. Can be one of the following: *Root, Designated, Alternate, Backup,* or *Disabled*.
- ***Priority*** – Indicates Port Priority (status mode); allows specifying Port Priority (modify mode). A combination of Priority, Port number, and Path Cost determines whether the port will be selected as the root port or will be blocked in the event of a loop, etc..
- ***Path cost*** – Indicates Path cost of the particular port (status mode); allows specifying Path cost for the particular port by setting Path cost value or by selecting the *Auto* mode (modify mode). This parameter setting depends on the capacity of a separate port.
- ***Edge*** – displays that this particular port is Edge port.
- ***Point-to-point*** – displays whether there is a point-to-point connection from the particular port or not.

14) Rx MSTP BPDUs – Indicates how many MSTP BPDUs packets were received.

15) Rx RSTP BPDUs – Indicates how many RSTP BPDUs packets were received.

16) RX Conf BPDUs – Indicates how many STP BPDUs packets were received.

17) RX TCN BPDUs – Indicates how many topology change notification BPDUs packets were received.

18) Bad MSTP BPDUs – Indicates how many bad MSTP BPDUs packets were received.

19) Bad RSTP BPDUs – Indicates how many bad RSTP BPDUs packets were received.

20) Bad Conf BPDUs – Indicates how many bad STP BPDUs packets were received.

21) Bad TCN BPDUs – Indicates how many bad topology change notifications BPDUs packets were received.

22) Tx MSTP BPDUs – Indicates how many MSTP BPDUs packets were sent.

23) Tx RSTP BPDUs – Indicates how many RSTP BPDUs packets were sent.

24) Tx Conf BPDUs – Indicates how many STP BPDUs packets were sent.

25) Tx TCN BPDUs – Indicates how many topology change notification BPDUs packets were sent.

26) Fwd Transitions – Indicates how many times the port has been changed to forward status.

27) Time Since Top Chg - Indicates how much time has passed since the last topology change.

28) Top Change Count - Indicates how many times the topology has changed.

29) By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

Multiple Spanning Tree Protocol (MSTP)

Status mode

Networking / Spanning Tree

Bridge configuration

Bridge configuration			Root information		
Bridge ID	1	32768.00.04.A6.81.77.78	Root ID	7	0.00.04.A6.81.77.69
Hello time (1 .. 100 sec)	2	2 sec	Hello time	8	2
Max age (6 .. 40 sec)	3	20 sec	Max age	9	20
Forward delay (4 .. 30 sec)	4	15 sec	Forward delay	10	15
Mode	5	MSTP	Root port	11	WAN
RSTP operation	6	Enabled	Root path cost	12	13140

13 Port status and configuration

Port	RSTP state	Port state	Role	Priority	Path cost	Edge	P2P
LAN1	Enabled	Forwarding	Designated	128	20000	No	Yes
LAN2	Enabled	Forwarding	Disabled	128	14183	Yes	Yes
LAN3	Enabled	Forwarding	Disabled	128	14183	Yes	Yes
WAN	Enabled	Forwarding	Root	128	13140	No	Yes

MSTP Config

Region	14	WWW
Revision	15	333
Digest	16	0x8D0D3583ABF2D8F6F4CD1141B77F53D7

Instance ID		VLAN	
1	17	10 - 19	18

21 Protocol statistics

	LAN1	LAN2	LAN3	WAN
Rx MSTP BPDUs	0	0	0	0
Rx RSTP BPDUs	22	0	0	1922
Rx Conf. BPDUs	0	0	0	0
Rx TCN BPDUs	0	0	0	0
Bad MSTP BPDUs	0	0	0	0
Bad RSTP BPDUs	0	0	0	0
Bad Conf. BPDUs	0	0	0	0
Bad TCN BPDUs	0	0	0	0
Tx MSTP BPDUs	2028	26	28	157
Tx RSTP BPDUs	40	2	2	6
Tx Conf. BPDUs	0	0	0	0
Tx TCN BPDUs	0	0	0	0
Fwd Transitions	67	23	24	66
Time Since Top Chg	00:29:11	00:29:11	00:29:11	00:29:11
Top Change Count	14	14	14	14

22 Instance 1

Bridge configuration

	Bridge configuration		Root information
Bridge ID	32768.00.04.A6.81.77.78	23	32768.00.04.A6.81.77.78
Regional Root Port		24	N/A
Reg. Root Path Cost		25	0

13 Port status and configuration

Port	Port state	Role	Priority	Path cost
LAN1	Forwarding	Designated	128	20000
LAN2	Forwarding	Disabled	128	14183
LAN3	Forwarding	Disabled	128	14183
WAN	Forwarding	Master	128	13140

26 Protocol statistics

	LAN1	LAN2	LAN3	WAN
Rx BPDUs	0	0	0	0
Bad BPDUs	0	0	0	0
Tx BPDUs	1972	1	2	89
Fwd Transitions	44	1	2	43
Time Since Top Chg	00:29:40	00:29:40	00:29:40	00:29:40
Top Change Count	9	9	9	9

Figure 3-107 MSTP status page

Modify mode

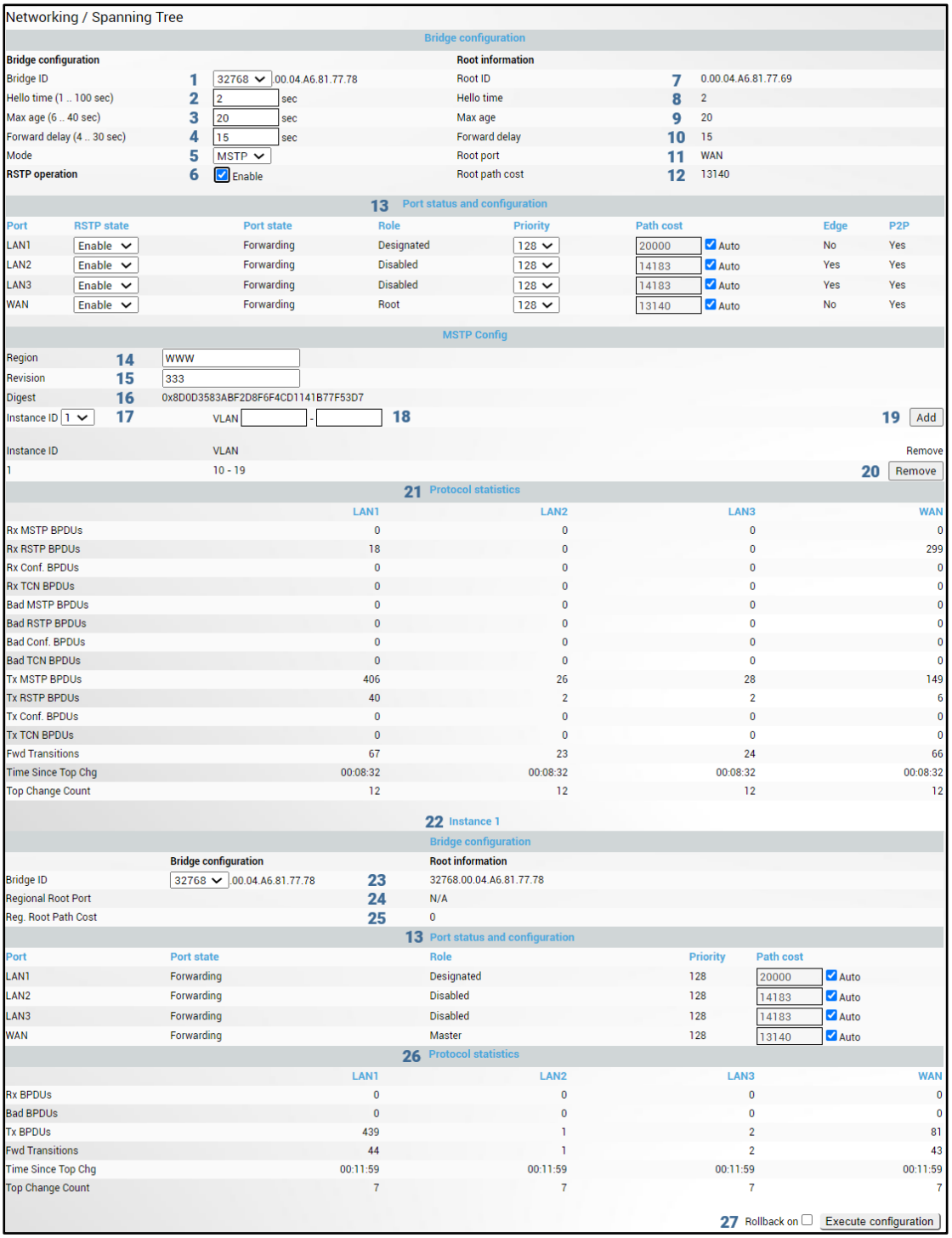


Figure 3-108 MSTP configuration page

1) ***Bridge ID*** – Indicates the configured value of Bridge ID (status mode); allows specifying the value of Bridge ID (modify mode). This parameter and MAC address determine whether a given Bridge is Root Bridge. The advantage is given to the combination of Priority and Address, which is numerically smaller.
2) ***Hello Time (1 – 100 sec)*** – Indicates configured time gap between which the BPDU packets are being sent (status mode); allows specifying the value of Hello Time in seconds (modify mode).

3) ***Max Age (6 – 40 sec)*** **–** Indicates the configured period, during which the received BPDU packets' information is stored for a separate port (status mode); allows specifying the value of Max Age in seconds (modify mode).
4) ***Forward Delay (4 – 30 sec)*** **–** Indicates the configured period that determines the time a separate port stays in Listening and Learning conditions (status mode); allows specifying the value of Forward Delay in seconds (modify mode).
5) ***Mode*** **–** Indicates chosen mode of STP configuration (status mode); allows changing the mode to RSTP or MSTP (modify mode).
6) ***RSTP operation*** **–** Indicates configured status of RSTP (status mode); allows enabling or disabling RSTP operation (modify mode).

Root information **–** displays the data only when RSTP is enabled:

7) ***Root ID*** **–** Indicates the Bridge ID of the current Root bridge.
8) ***Hello Time*** **–** Indicates the current hello time.
9) ***Max Age*** **–** Indicates the current max-age.
10) ***Forward Delay*** **–** Indicates the current forward delay.
11) ***Root Port*** **–** Indicates the elected root port is being shown.
12) ***Root Path Cost*** **–** Indicates the path cost from the current bridge to the root bridge.
13) ***Port status and configuration*** **–** STP parameters of every port:
    - ***RSTP state*** **–** Indicates RSTP state of the particular port (status mode); allows enabling or disabling RSTP operation for the particular port (modify mode).
    - ***Port state*** **–** Indicates port condition. Can be one of the following: *Disabled, Blocking, Listening, Learning,* or *Forwarding*.
    - ***Role*** **–** the role of the particular port. Can be one of the following: *Root, Designated, Alternate, Backup,* or *Disabled*.
    - ***Priority*** **–** Indicates Port Priority (status mode); allows specifying Port Priority (modify mode). A combination of Priority, Port number, and Path Cost determines whether the port will be selected as the root port or will be blocked in the event of a loop, etc.
    - ***Path cost*** **–** Indicates Path cost of the particular port (status mode); allows specifying Path cost for the particular port by setting Path cost value or by selecting the *Auto* mode (modify mode). This parameter setting depends on the capacity of a separate port.
    - ***Edge*** **–** displays that this particular port is Edge port.
    - ***Point-to-point*** **–** displays whether there is a point-to-point connection from the particular port or not.
14) ***Region*** **–** Indicates MSTP region that defines a logical domain where multiple spanning-tree instances can be administered (status mode); Allows user-defined name for the region (modify mode).
15) ***Revision*** **–** Indicates the current revision of the configuration of MSTP (status mode); Allows configuring numbered values to keep track of configuration changes (modify mode).
16) ***Digest*** **–** Indicates a digest of the VLANs-to-instance mapping table.
17) ***Instance (1-6)*** **–** Indicates Instance ID and VLAN mapping for each instance (status mode); allows configuration up to six instances and VLAN mapping for each instance (modify mode).
18) ***VLAN (Range: 1 - 4094)*** **–** Indicates configured VLAN IDs and/or VLAN ID ranges (status mode); allows entering individual VLAN IDs or VLAN ID ranges, e.g., "10-19", "20-29", "30-39", etc. (modify mode);
19) ***Add*** **-** Press "Add" to add the entered individual VLAN ID or VLAN ID range.
20) ***Remove*** **-** Removes configured VLAN IDs and/or VLAN ID ranges.

21) Protocol statistics - Shows combined STP statistics.

- *Rx MSTP BPDUs* – Indicates how many MSTP BPDUs packets were received.
- *Rx RSTP BPDUs* – Indicates how many RSTP BPDUs packets were received.
- *RX Conf BPDUs* – Indicates how many STP BPDUs packets were received.
- *RX TCN BPDUs* – Indicates how many topology change notification BPDUs packets were received.
- *Bad MSTP BPDUs* – Indicates how many bad MSTP BPDUs packets were received.
- *Bad RSTP BPDUs* – Indicates how many bad RSTP BPDUs packets were received.
- *Bad Conf BPDUs* – Indicates how many bad STP BPDUs packets were received.
- *Bad TCN BPDUs* – Indicates how many bad topology change notifications BPDUs packets were received.
- *Tx MSTP BPDUs* – Indicates how many MSTP BPDUs packets were sent.
- *Tx RSTP BPDUs* – Indicates how many RSTP BPDUs packets were sent.
- *Tx Conf BPDUs* – Indicates how many STP BPDUs packets were sent.
- *Tx TCN BPDUs* – Indicates how many topology change notification BPDUs packets were sent.
- *Fwd Transitions* – Indicates how many times the port has been changed to forward status.
- *Time Since Top Chg* – Indicates how much time has passed since the last topology change.
- *Top Change Count* – Indicates how many times the topology has changed.

22) Instance ID - Indicates each MSTP instance's parameters.

23) Bridge ID - Indicates the configured value of the MSTP instance Bridge ID (status mode); allows specifying the value of each MSTP instance Bridge ID (modify mode). This parameter and the MAC address determine whether a given Bridge is Root Bridge. The advantage is given to the combination of Priority and Address, which is numerically smaller.

24) Regional Root Port - Indicates the elected root port for the configured MSTP region.

25) Reg. Root Path Cost - Indicates the root path cost of the configured MSTP region.

26) Protocol statistics - Shows each MSTP instance's statistics.

- *Rx MSTP BPDUs* - Indicates how many MSTP BPDUs packets were received.
- *Bad MSTP BPDUs* - Indicates how many bad MSTP BPDUs packets were received.
- *Tx MSTP BPDUs* - Indicates how many MSTP BPDUs packets were sent.
- *Fwd Transitions* - Indicates how many times the port has been changed to forward status.
- *Time Since Top Chg* - Indicates how much time has passed since the last topology change.
- *Top Change Count* - Indicates how many times the topology has changed.

By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network stp bridgeID {0 | 4096 | 8192 | 12288 | 16384| 20480 | 24576 | 28672 | 32768 | 36864 | 40960 | 45056 | 49152 | 53248 | 57344 | 61440}	Use to set the value of Bridge ID.

network stp forwardDelay <4..30>	Use to set the time in seconds that determines how long a separate port stays in Listening and Learning conditions.
network stp helloTime <1..100>	Use to set the value of the time gap in seconds between which the BPDU packets are being sent.
network stp log {enable | disable}	Use to enable or disable STP log.
network stp maxAge <6..40>	Use to set the time in seconds, during which the received BPDU packets' information is stored for a separate port.
network stp mode {mstp | rstp}	Use to change the mode to RSTP or MSTP.
network stp mstp_bridge_id <instance ID {1..6}> {0 | 4096 | 8192 | 12288 | 16384| 20480 | 24576 | 28672 | 32768 | 36864 | 40960 | 45056 | 49152 | 53248 | 57344 | 61440}	Use to set the value of each MSTP instance Bridge ID.
network stp mstp_path_cost {LAN1 | LAN2 | LAN3 | WAN} <instance ID {1..6}> {<1 - 200000000> | auto}	Use to set MSTP path cost for the particular port and instance by setting the value or by selecting the *Auto* mode.
network stp path_cost {LAN1 | LAN2 | LAN3 | WAN} {<1 - 200000000> | auto}	Use to set RSTP path cost for the particular port by setting the value or by selecting the *Auto* mode.
network stp region	Use to set the MSTP region. Allows a user-defined name for the region.
network stp revision	Use to set MSTP revision. Allows for the configuration of user-defined numbered values to keep track of configuration changes.
network stp state {enable | disable}	Use to enable or disable RSTP operation.
network stp status	Use to show STP status.
network stp vlan map <instance ID {1..6}> <vlan range {1..4096}>	Use to map a VLAN or VLAN range to MSTP instances. First, you must provide the instance ID, and then the VLAN or VLAN range you want to map with this instance.
network stp vlan status	Use to show MSTP VLAN mapping.
network stp vlan unmap <instance ID {1..6}> <vlan range {1..4096}>	Use to unmap a VLAN or VLAN range from MSTP instances. First, you must provide the instance ID and then the VLAN or VLAN range you want to unmap from this instance.

Networking → Ethernet → Packet Filtering

The Packet Filtering page provides the configuration of Layer 2 Control Protocol (L2CP) for ingress and egress traffic on each radio port.

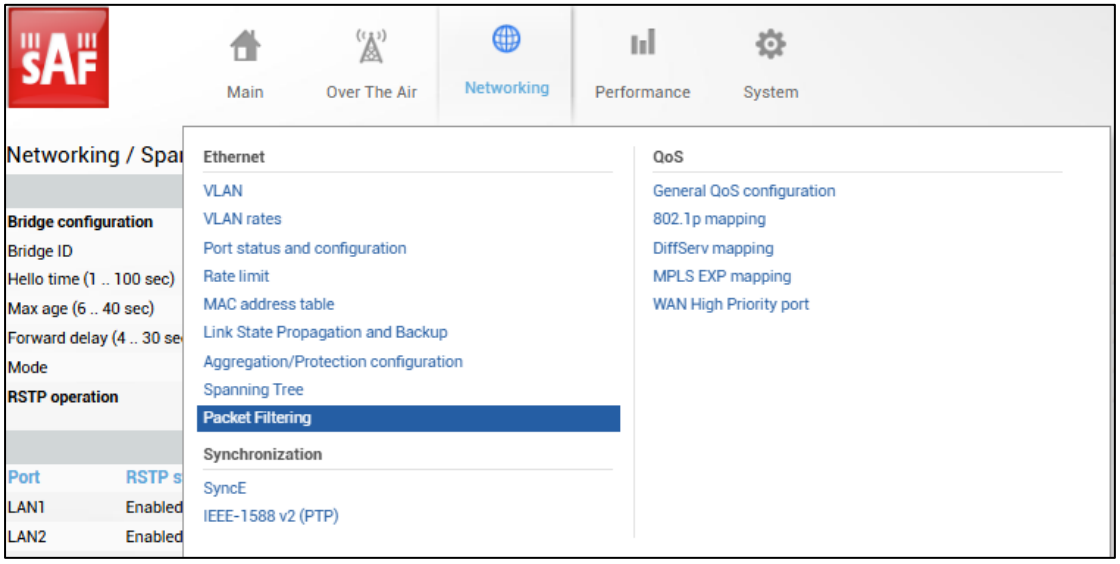


Figure 3-109 Accessing Packet Filtering page

Status mode

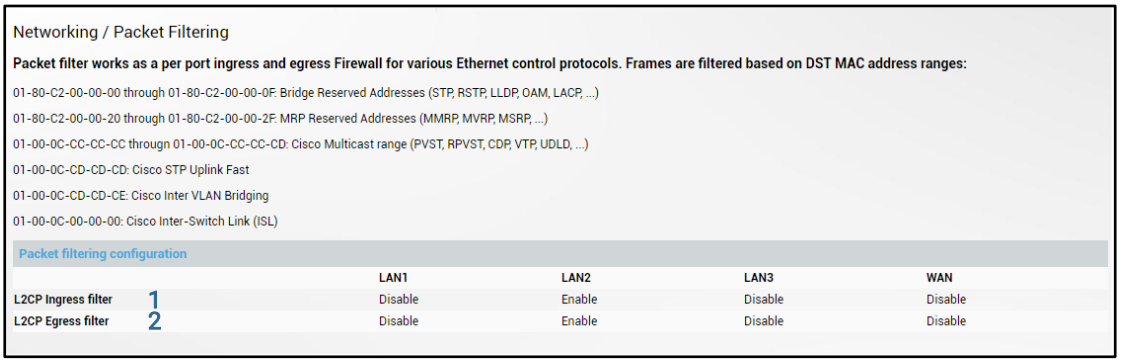


Figure 3-110 Packet Filtering – status mode

Press MODIFY button.

Modify mode

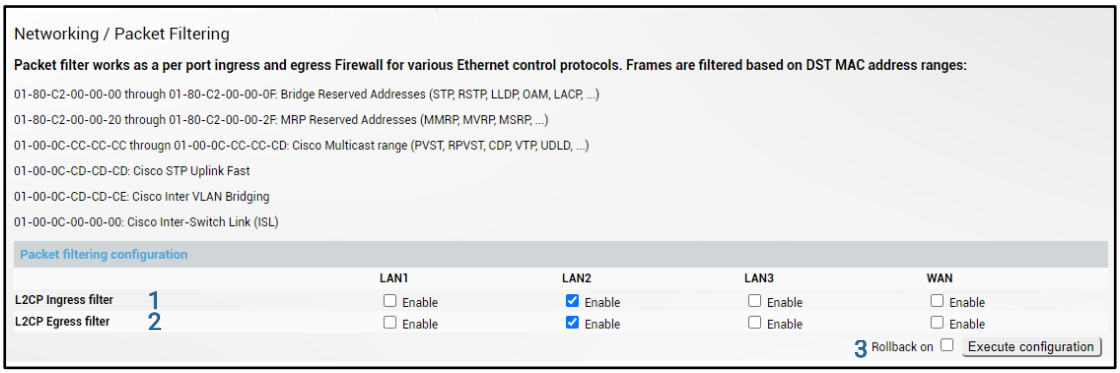


Figure 3-111 Packet Filtering – modify mode

1) *L2CP Ingress filter* – indicates whether L2CP packet filtering is enabled or disabled for ingress traffic on each port (status mode); allows enabling ☑ or disabling ☐ L2CP packet filtering for ingress traffic on each port (modify mode).
2) *L2CP Egress filter* – indicates whether L2CP packet filtering is enabled or disabled for egress traffic on each port (status mode); allows enabling ☑ or disabling ☐ L2CP packet filtering for egress traffic on each port (modify mode).
3) By pressing „*Execute configuration*", changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+ radio unit. If „*Rollback on*" is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network filter l2cp_egress add <port>	Use to enable L2CP packet filtering for egress traffic on the selected port.
network filter l2cp_egress remove <port>	Use to disable L2CP packet filtering for egress traffic on the selected port.
network filter l2cp_ingress add <port>	Use to enable L2CP packet filtering for ingress traffic on the selected port.
network filter l2cp_ingress remove <port>	Use to disable L2CP packet filtering for ingress traffic on the selected port.

Networking → Synchronization → SyncE

Synchronous Ethernet (SyncE) configuration allows synchronizing the Ethernet switch clock of the Integra-X/-X2/-FIDU/-FIDU+ device to an external clock by specifying the source port for such synchronization signals.

⚠ Incorrect SyncE configuration may result in a loss of connectivity.

Auto-negotiation ***will not*** work properly when the source ports for the SyncE external clock signals on both Integra-X/-X2/-FIDU/-FIDU+ devices are configured on the same ports that connect the devices (e.g., WAN-WAN in a link or LAN-LAN in a back-to-back connection).

SyncE will work properly on LAN2 and LAN3 ports only when compatible SFP modules are used on these ports.

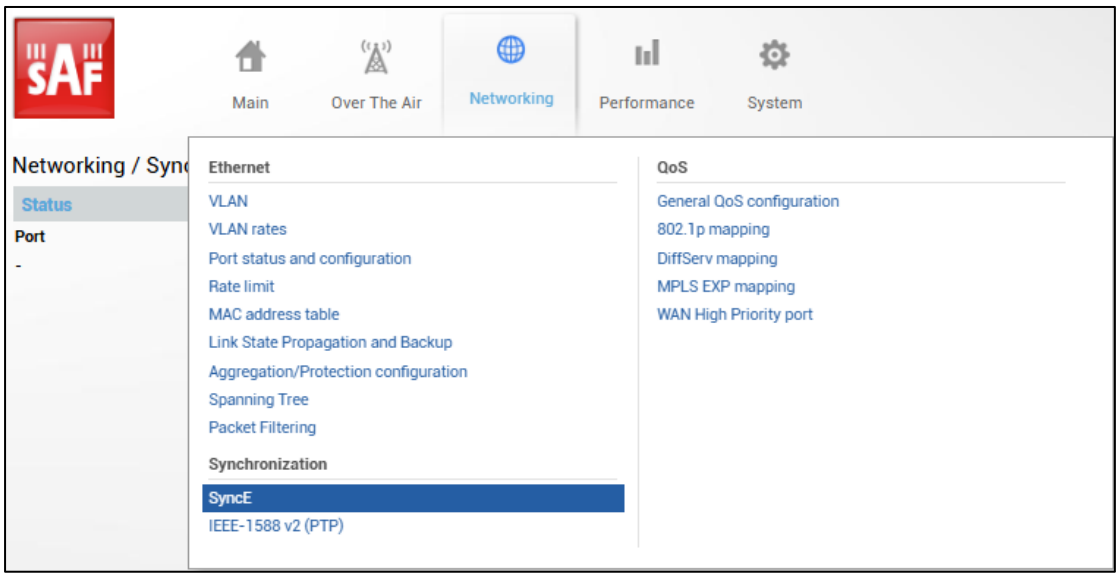


Figure 3-112 Accessing the SyncE page

Status mode

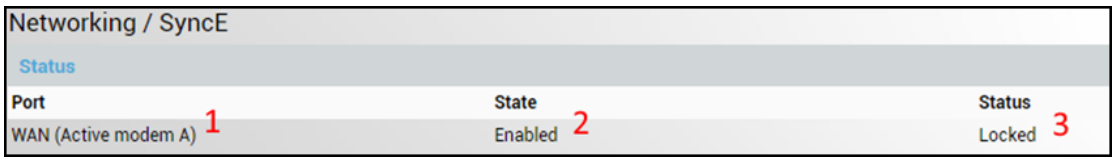


Figure 3-113 SyncE status page

Modify mode

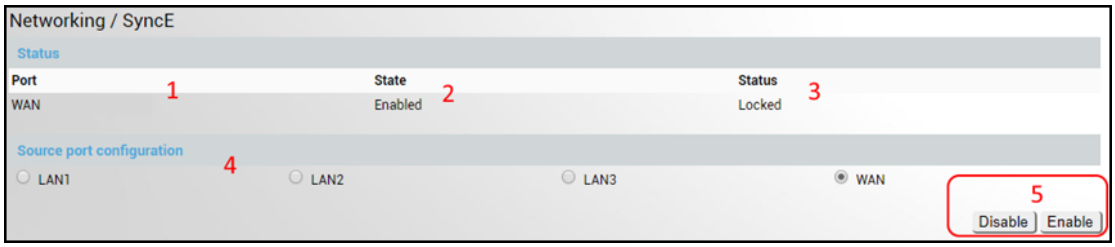


Figure 3-114 SyncE configuration page

1) ***Port*** – shows which port is used for external clock synchronization signals when SyncE is enabled.
2) ***State –*** shows whether SyncE is enabled or disabled on the device.
3) ***Status*** – will show the status of the SyncE operation on the device. The message "Locked" will be shown when SyncE is operating correctly.
4) ***Source port configuration*** - allows selection of the Ethernet source port that will be used for SyncE synchronization signal reception.
5) ***Disable/Enable*** - allows enabling or disabling SyncE on the device.

SyncE configuration examples

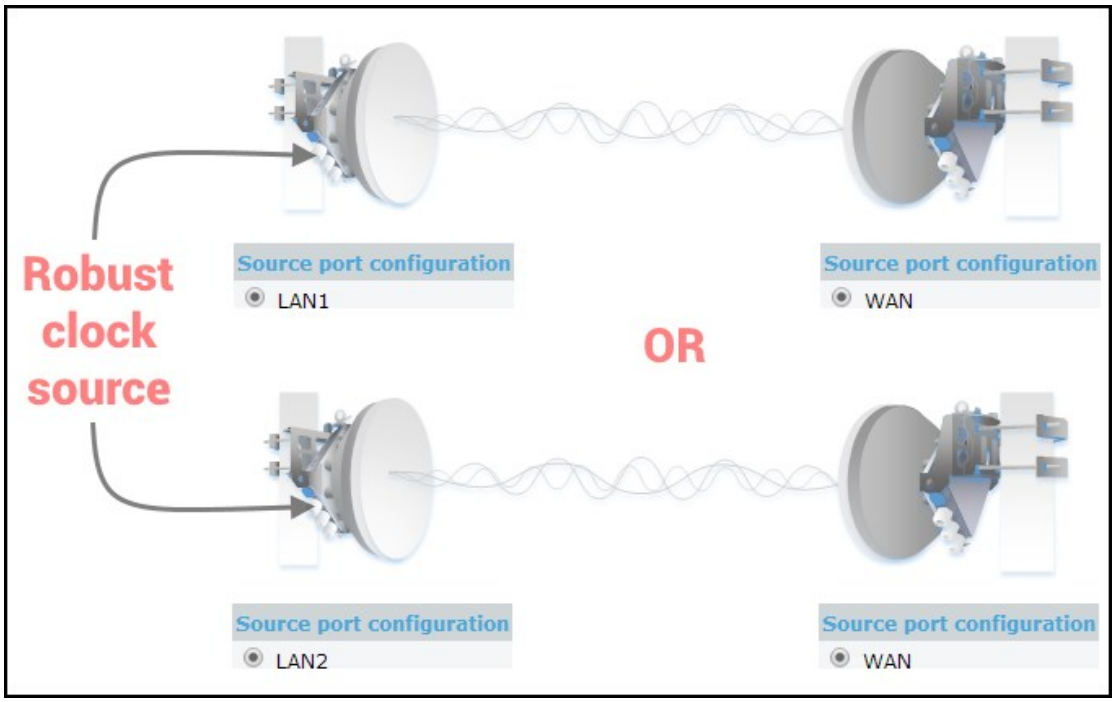


Figure 3-115 Integra-X/-X2/-FIDU/-FIDU+ link with an external clock source

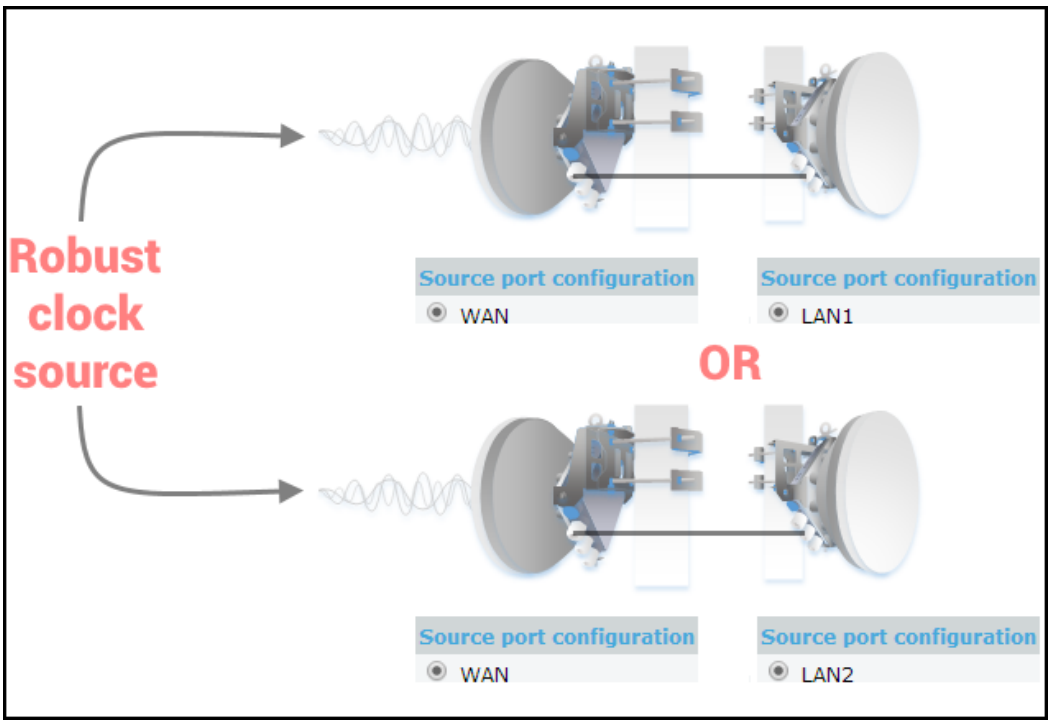


Figure 3-116 Integra-X/-X2/-FIDU/-FIDU+ back-to-back interconnection with an external clock source

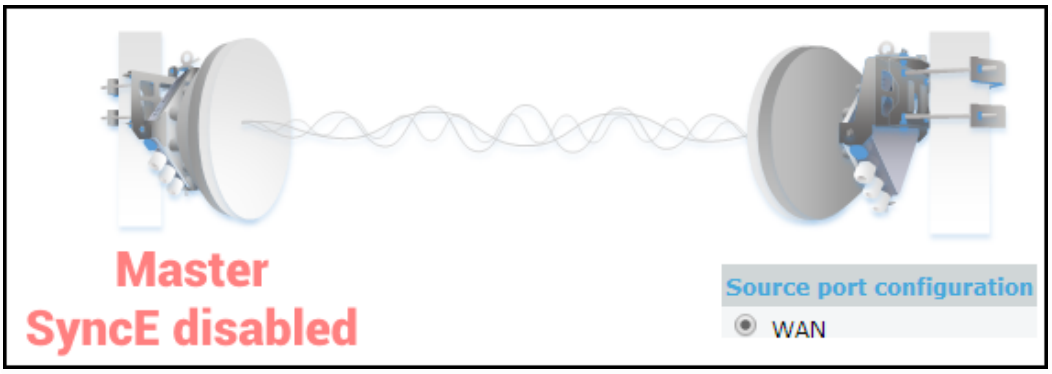


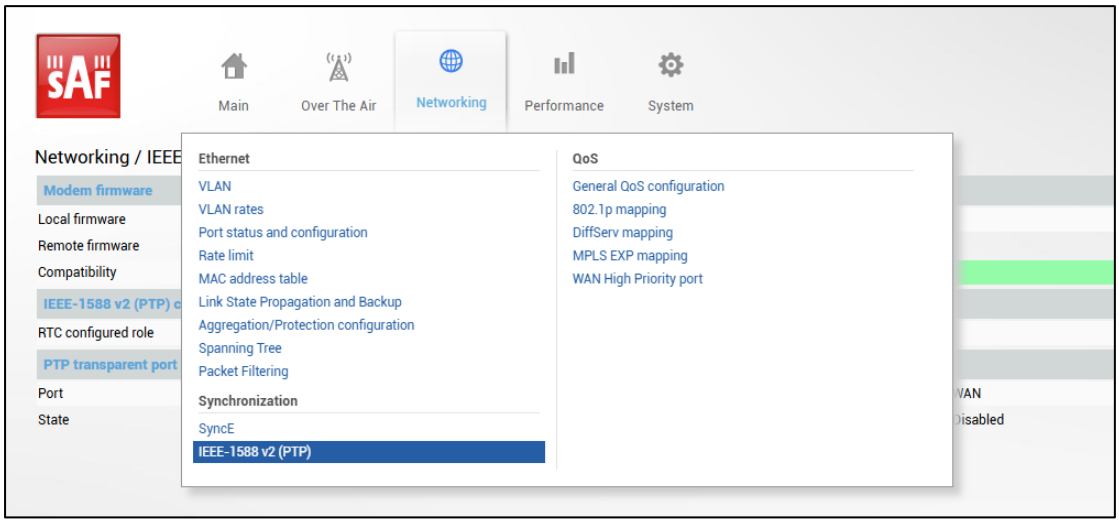
Figure 3-117 Integra-X/-X2/-FIDU/-FIDU+ as a master clock source

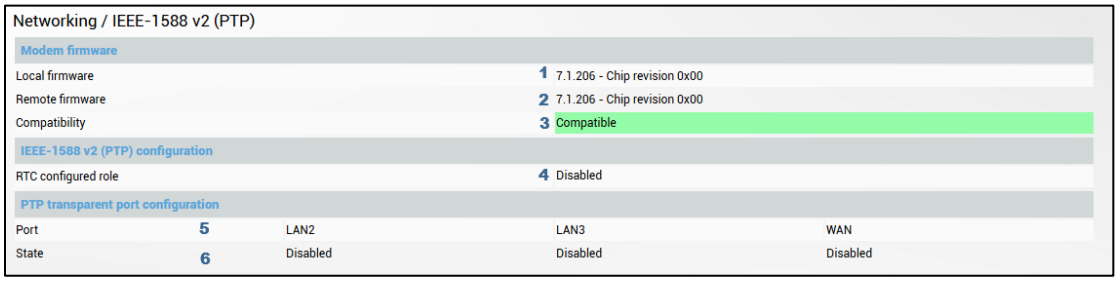
CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network sync	Shows SyncE status and configuration.
network sync status	Shows SyncE status and configuration.
network sync enable {LAN1|LAN2|LAN3|WAN}	Enables SyncE; the port must be specified.
network sync disable	Disables SyncE.

Networking → Synchronization → IEEE-1588 v2 (PTP)

Allows synchronization of clocks throughout a computer network.





1) ***Local firmware*** - Shows the version of the local modem firmware
2) ***Remote firmware*** - Indicates the version of the remote modem firmware

Modem firmware versions must be the same on both sides of the link for IEEE 1588 PTP v2 functionality.

3) *Compatibility* - Shows whether the hardware version is compatible with IEEE 1588 v2 PTP functionality.
4) *RTC configured role* - This is a dropdown menu that allows you to select the role of the Real-Time Clock (RTC) in the PTP network
   a) *Disable* - Turns off the RTC role configuration. The device will not participate in PTP time synchronization in a defined RTC role.
   b) *Primary* - Configures the device to act as the primary time source (Grandmaster) in the PTP network, providing the reference clock for synchronization.
   c) *Secondary* - Configures the device to act as a secondary (slave) clock in the PTP network, synchronizing its time with the primary clock.
5) *Port* - (LAN2, LAN3, WAN) network interfaces
6) *State* - indicates the current state of the PTP transparent clock functionality for each corresponding port.

Networking → QoS → General QoS configuration

The General QoS configuration page allows defining QoS queueing rules.

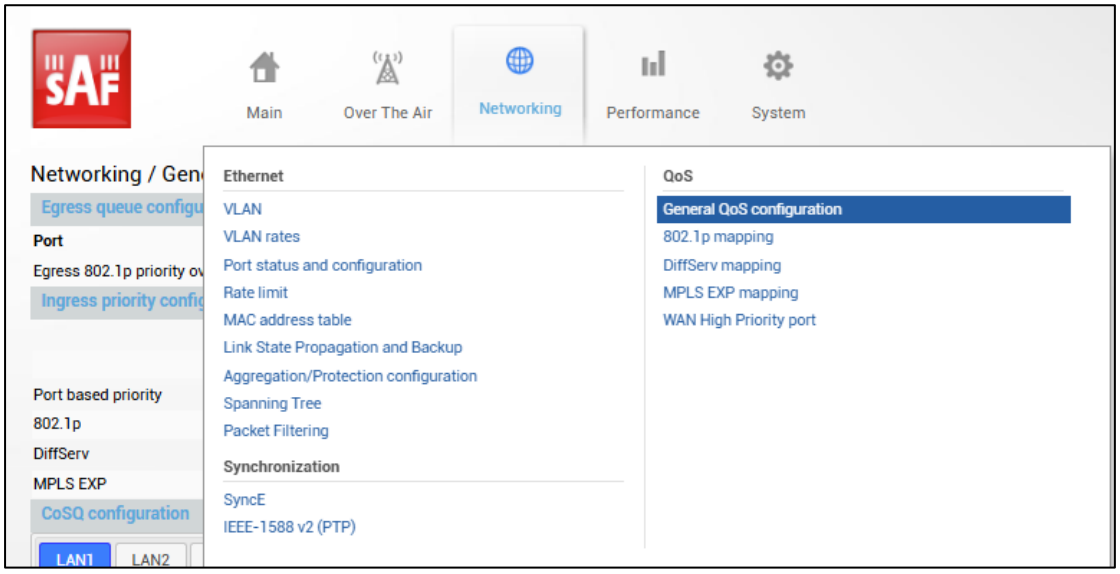


Figure 3-118 Accessing General QoS configuration page

Status mode

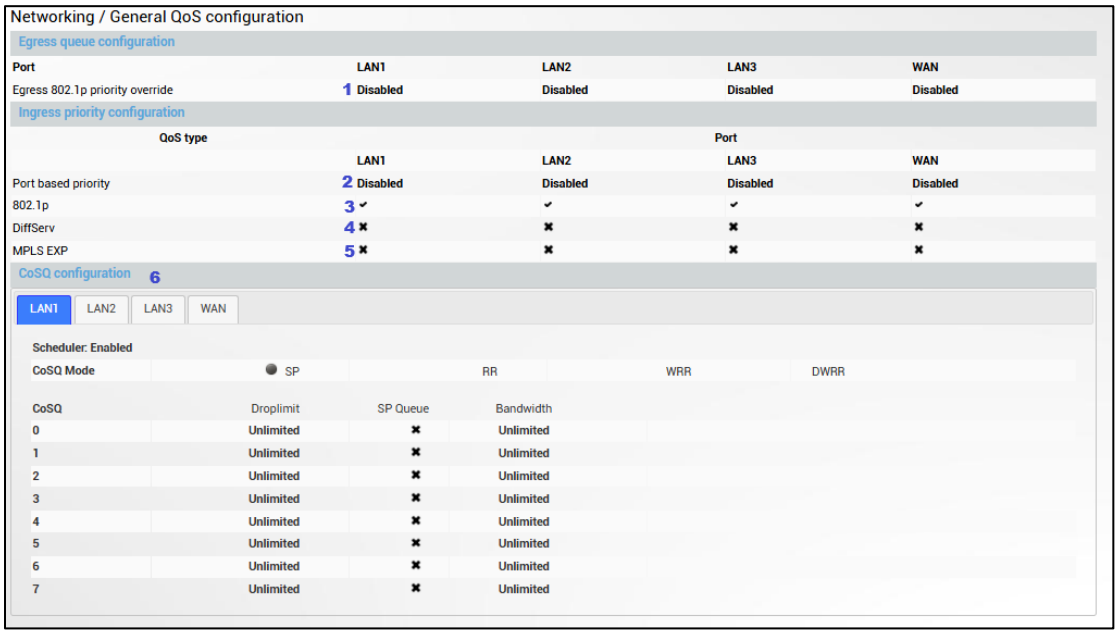


Figure 3-119 General QoS configuration – status mode

Modify mode

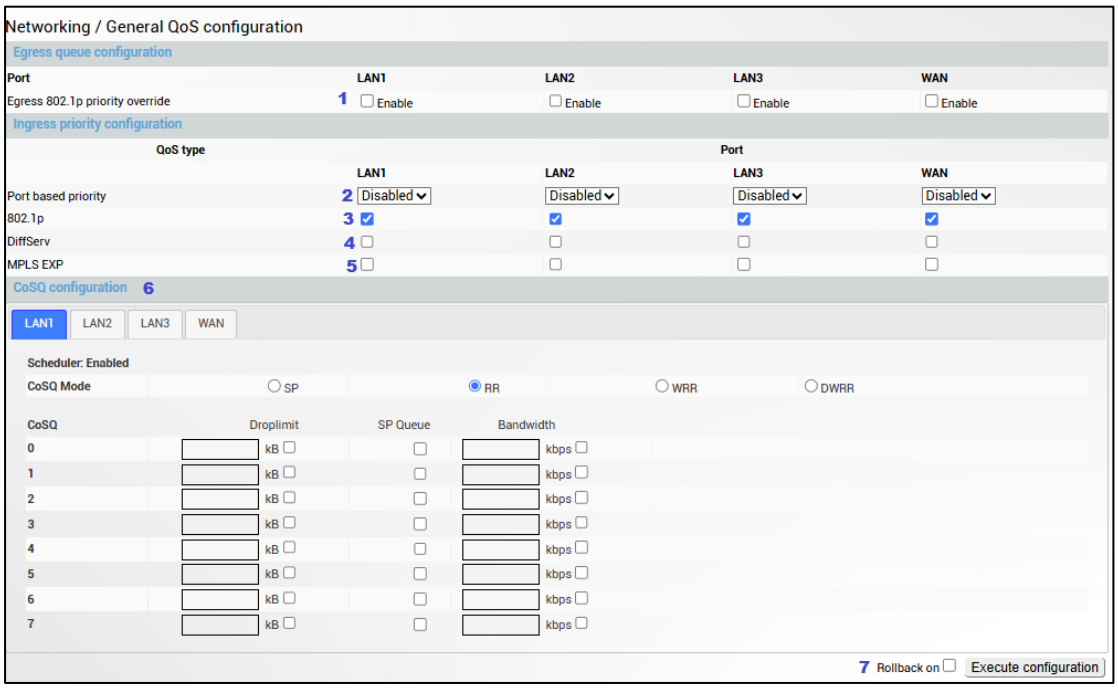


Figure 3-120 General QoS configuration – modify mode

1) *Egress 802.1p priority override* – indicates whether egress 802.1p priority override is enabled in the egress direction of a particular port (status mode); allows enabling egress 802.1p priority override on available ports (modify mode).
2) *Port based priority* – indicates whether port-based prioritization is enabled (status mode); allows enabling or disabling port-based prioritization on available ports (modify mode). If enabled, all packets on the egress of a port are put in a specified queue.

802.1p (PCP) and DiffServ (DSCP) values are ignored. Available values are 0…7 according to eight available priority queues from the lowest to the highest.

3) *802.1p* – indicates whether the 802.1p prioritization is enabled (status mode); allows enabling or disabling 802.1p prioritization on available ports (modify mode). If enabled, configured mapping is taken into account. 802.1p prioritization is enabled by default on all ports.
4) *DiffServ* – indicates whether DiffServ prioritization is enabled (status mode); allows enabling or disabling DiffServ prioritization on available ports (modify mode). If enabled DSCP value is taken into account according to configured mapping.
5) *MPLS EXP* - indicates whether MPLS EXP prioritization is enabled (status mode); allows enabling or disabling MPLS EXP prioritization on available ports (modify mode). If enabled DSCP value is taken into account according to configured mapping
6) *CoSQ Mode* – indicates selected scheduler type SP/RR/WRR/DWRR – strict Priority/Round Robin/Weighted Round Robin/Deficit Weighted Round Robin (status mode); allows selecting scheduler type (modify mode). CoSQ configuration differs for each selected scheduler type:
   - *SP* – scheduler drains all packets queued in the highest priority queue before continuing to service lower priority queues. Such an approach can be used for latency-sensitive traffic.
   - *RR* – scheduler drains all queues consecutively with the same ratio (1:1:1:1:1:1:1:1). Such an approach allows utilizing drop limit buffers of all available queues.
   - *WRR* – scheduler drains all queues consecutively according to the specified ratio (queue weights) specified in a number of frames. Default ratio is equal for all queues (1:1:1:1:1:1:1:1). Such an approach allows for minimizing stacking delay for high priority traffic and at the same time retaining traffic flow at lower priority queues.
   - *DWRR* – scheduler drains all queues consecutively according to the specified ratio (Weight) specified in kilobytes (kB). Compared to WRR excess bandwidth used in the current pass is remembered and subtracted from the allocated weight in the next pass and as a result statistically over time bandwidth used by each queue will be closer to the configured value. The default ratio is 5:5:5:10:15:15:20:25 kB.

   CoSQ configuration is explained for each scheduler type below.
7) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CoSQ configuration – SP (Strict Priority)

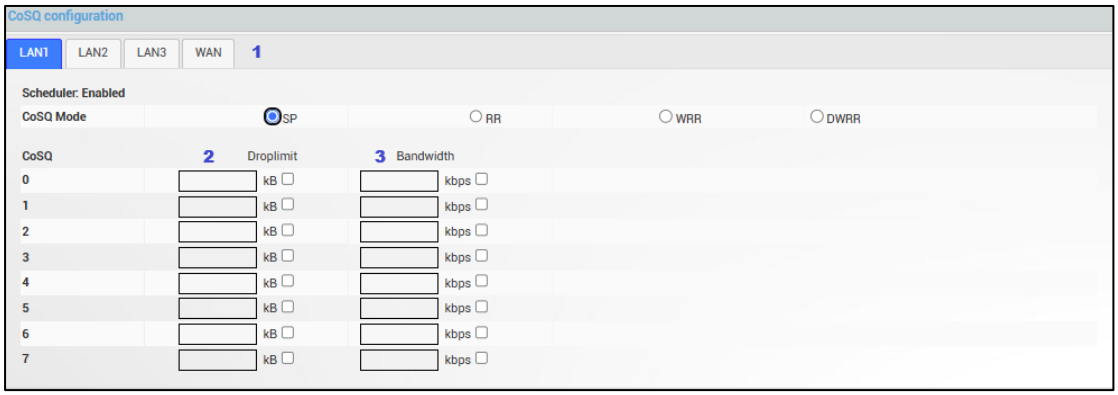


Figure 3-121 CoSQ configuration – SP & RR

1) *LAN1/LAN2/LAN3/WAN* – tabs allow selecting a particular port;
2) *Droplimit* – indicates droplimit buffer size assigned for each queue (status mode); allows modifying droplimit buffer size for each queue (modify mode);

Increasing buffer size increases data transmission latency.

3) *Bandwidth* - allows configuring bandwidth in kbps for each queue separately.

CoSQ configuration – RR (Round Robin)

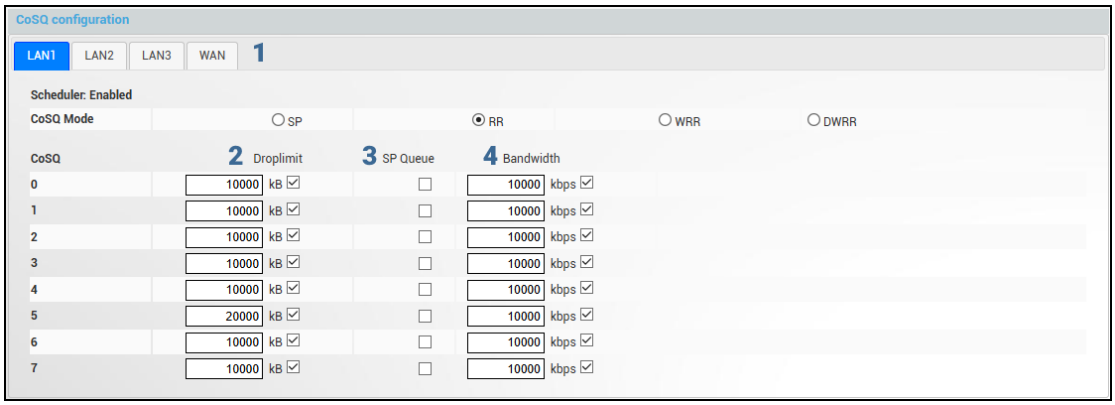


Figure 3-122 CoSQ configuration – RR

1) *LAN1/LAN2/LAN3/WAN* – tabs allow selecting a particular port;
2) *Droplimit* – indicates droplimit buffer size assigned for each queue (status mode); allows modifying droplimit buffer size for each queue (modify mode);

Increasing buffer size increases data transmission latency.

3) *Strict Priority queue* - ensures that network traffic with higher CoS priority levels is always transmitted before traffic with lower CoS priority levels on that port.
4) *Bandwidth* - allows configuring bandwidth in kbps for each queue separately.

CoSQ configuration – WRR (Weighted Round Robin)

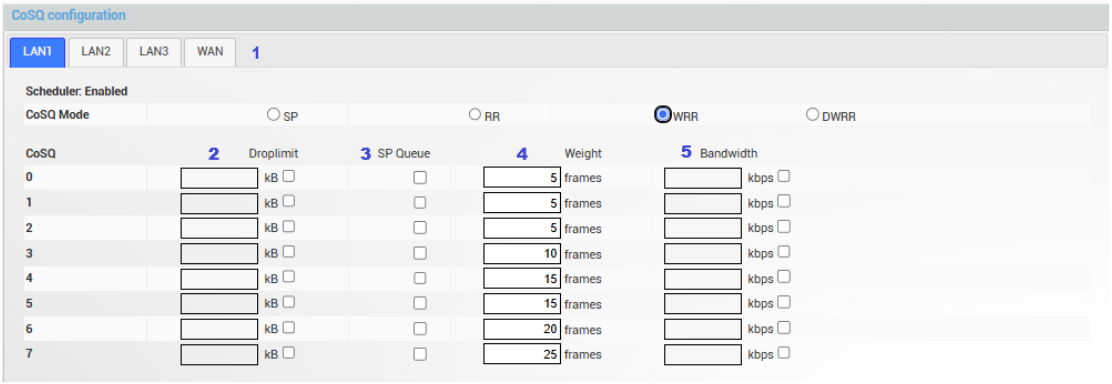


Figure 3-123 CoSQ configuration - WRR

1) *LAN1/LAN2/LAN3/WAN* – tabs allow selecting a particular port.
2) *Droplimit* – indicates droplimit buffer size assigned for each queue (status mode); allows modifying droplimit buffer size for each queue (modify mode).

Increasing buffer size increases data transmission latency.

3) *Strict Priority queue* - ensures that network traffic with higher CoS priority levels is always transmitted before traffic with lower CoS priority levels on that port.
4) *Weight* - allows configuring weight in frames for each queue and port separately.
5) *Bandwidth* - allows configuring bandwidth in kbps for each queue and port separately.

CoSQ configuration – DWRR (Deficit Weighted Round Robin)

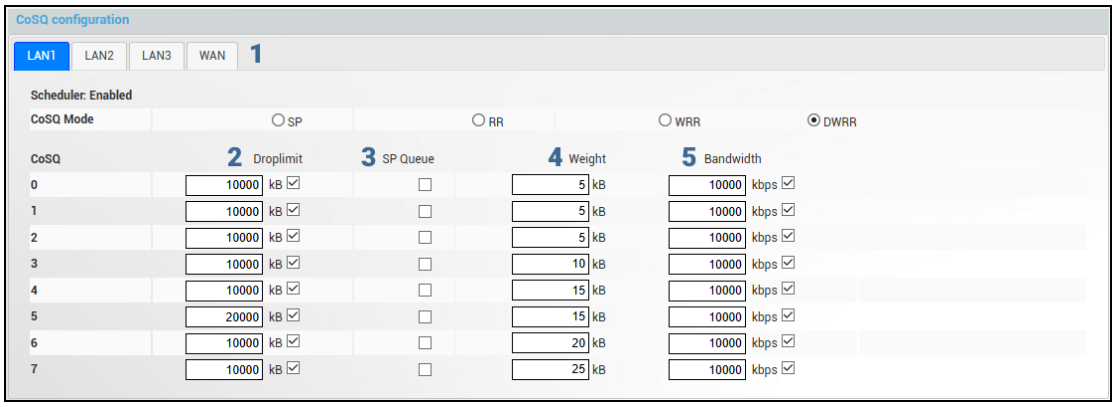


Figure 3-124 CoSQ configuration – DWRR

1) *LAN1/LAN2/LAN3/WAN* – tabs allow selecting a particular port.
2) *Droplimit* – indicates droplimit buffer size assigned for each queue (status mode); allows modifying droplimit buffer size for each queue (modify mode).

Increasing buffer size increases data transmission latency.

3) *Strict Priority queue* - ensures that network traffic with higher CoS priority levels is always transmitted before traffic with lower CoS priority levels on that port.
4) *Weight* - allows configuring weight in frames for each queue and port separately.
5) *Bandwidth* - allows configuring bandwidth in kbps for each queue and port separately.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network qos set <port> **base state** {enable|disable}	Use to configure base port priority - ingress packets processing.
network qos set <port> **base priority** {0…7}	Use to set port-based priority for all ingress packets.
network qos set <port> **cosq override-priority** {enable|disable}	Use to enable/disable override priority tag with internal priority in egress packet on a defined port.
network qos set <port> cosq scheduler mode {dwrr|rr|sp|wrr}	Use to set the scheduler packet service mode.
network qos set <port> **cosq scheduler weight** {1…127}	Use to set the weight for a queue in kB. The weight parameter will become configurable only when the scheduler is set to DWRR.
network qos set <port> **cosq bandwidth** {1-10000000|unlimited}	Use to set the maximum bandwidth in kB allowed for a CoS queue or reset to unlimited.
network qos set <port> **cosq droplimit** {1-1564|unlimited}	Use to set droplimit (size) in kB of a CoS queue or reset to unlimited.
network qos reset statistics {LAN1|LAN2|LAN3|WAN|all}	Use to reset QoS statistics on a particular port or all ports simultaneously.
network qos reset config {LAN1|LAN2|LAN3|WAN|all}	Use to reset QoS configuration on a particular port or all ports simultaneously.
network qos show config {LAN1|LAN2|LAN3|WAN|all} ingress-map	Use to show QoS ingress priority mapping configuration.
network qos show config {LAN1|LAN2|LAN3|WAN|all} egress-map	Use to show QoS egress priority mapping configuration.
network qos show info {LAN1|LAN2|LAN3|WAN|all} ingress-cosq	Use to show the ingress priority mapping HW status.
network qos show info {LAN1|LAN2|LAN3|WAN|all} egress-cosq	Use to show the egress priority mapping HW status.
network qos show statistics {LAN1|LAN2|LAN3|WAN|all}	Use to show QoS statistics.

Networking → QoS → 802.1p mapping

The 802.1p mapping page allows customizing the mapping of IEEE 802.1p priority tags and available QoS queues.

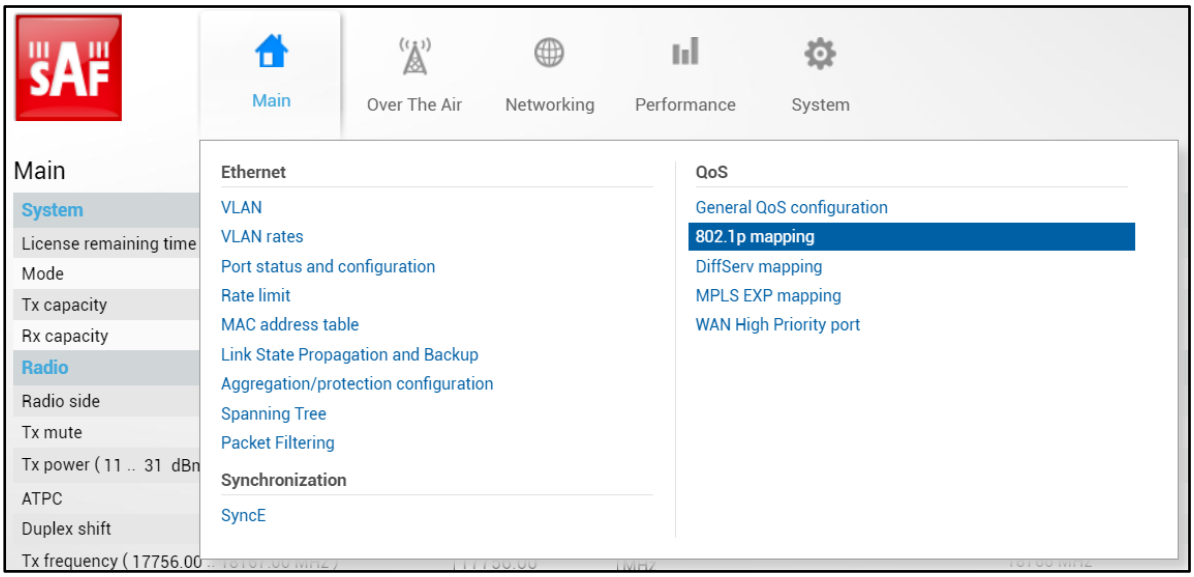


Figure 3-125 Accessing 802.1p mapping page-Status mode

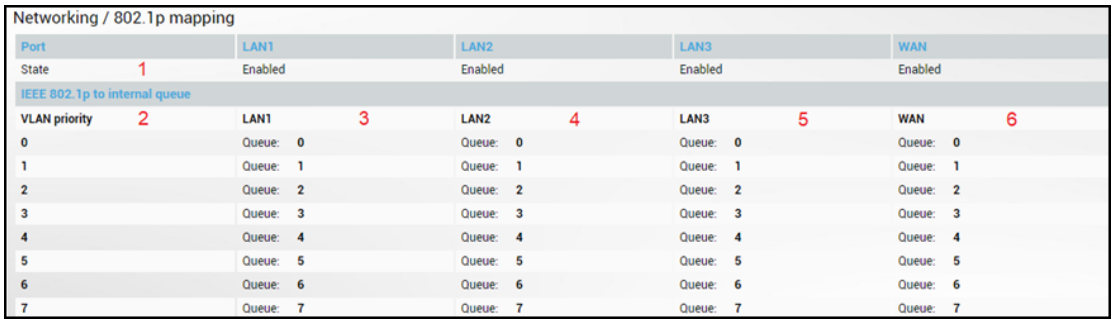


Figure 3-126 802.1p mapping – status mode

Modify mode

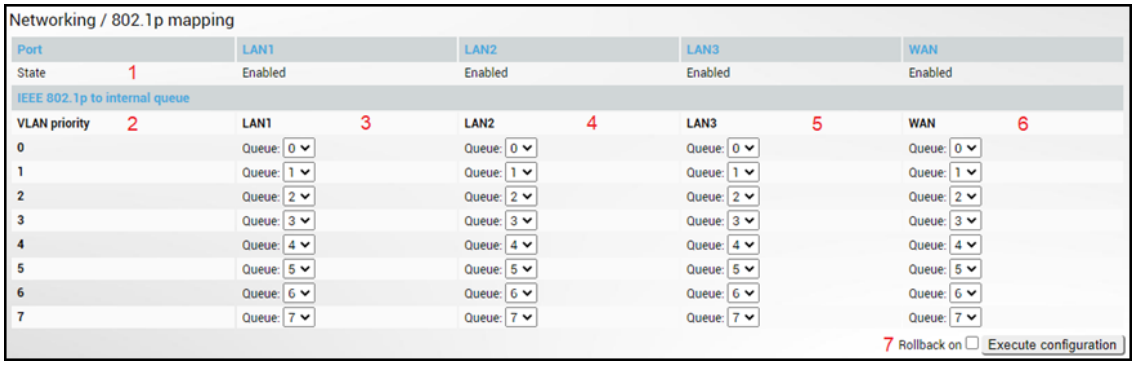


Figure 3-127 802.1p mapping – modify mode

1) ***State*** – indicates whether 802.1p mapping is enabled or disabled on each port.
2) ***VLAN priority*** – indicates PCP (Priority Code Point) values 0 – 7.

3) *LAN1* – indicates to which egress queue packets will, according to 802.1p priority, be put in if 802.1p QoS prioritization is enabled on LAN1 port (status mode); allows modifying default mapping of priority values and queues (modify mode).
4) *LAN2* – indicates to which egress queue packets will, according to 802.1p priority, be put in if 802.1p QoS prioritization is enabled on LAN2 port (status mode); allows modifying default mapping of priority values and queues (modify mode).
5) *LAN3* – indicates to which egress queue packets will, according to 802.1p priority, be put in if 802.1p QoS prioritization is enabled on LAN3 port (status mode); allows modifying default mapping of priority values and queues (modify mode).
6) *WAN* – indicates to which egress queue packets will, according to 802.1p priority, be put in if 802.1p QoS prioritization is enabled on WAN port (status mode); allows modifying default mapping of priority values and queues (modify mode).
7) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If ***„Rollback on"*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network qos set <port> **vlan state** {enable|disable}	Use to enable or disable ingress 802.1p mapping on a particular port.
network qos set <port> **vlan pcp** {0…7} **priority** {0…7}	Use to set VLAN (802.1p) priority mapping.

Networking → QoS → DiffServ mapping

The DiffServ mapping page allows customizing the mapping of DSCP priority tags and available QoS queues.

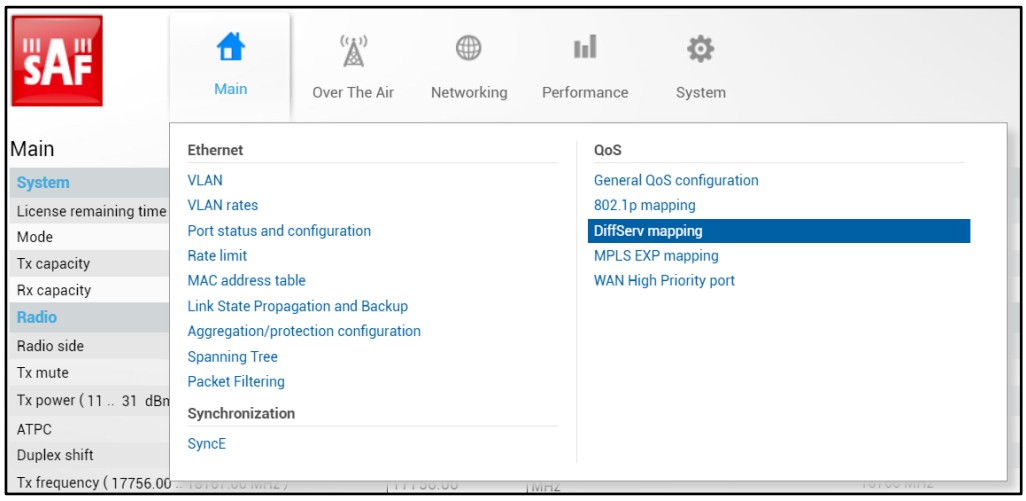


Figure 3-128 Accessing DiffServ mapping page

Status mode

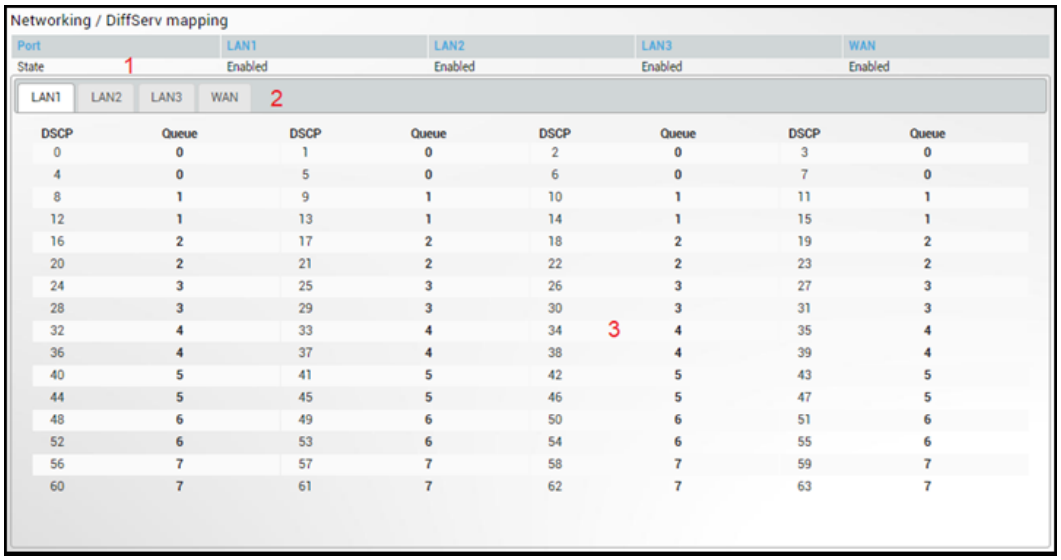


Figure 3-129 DiffServ mapping – status mode

Modify mode

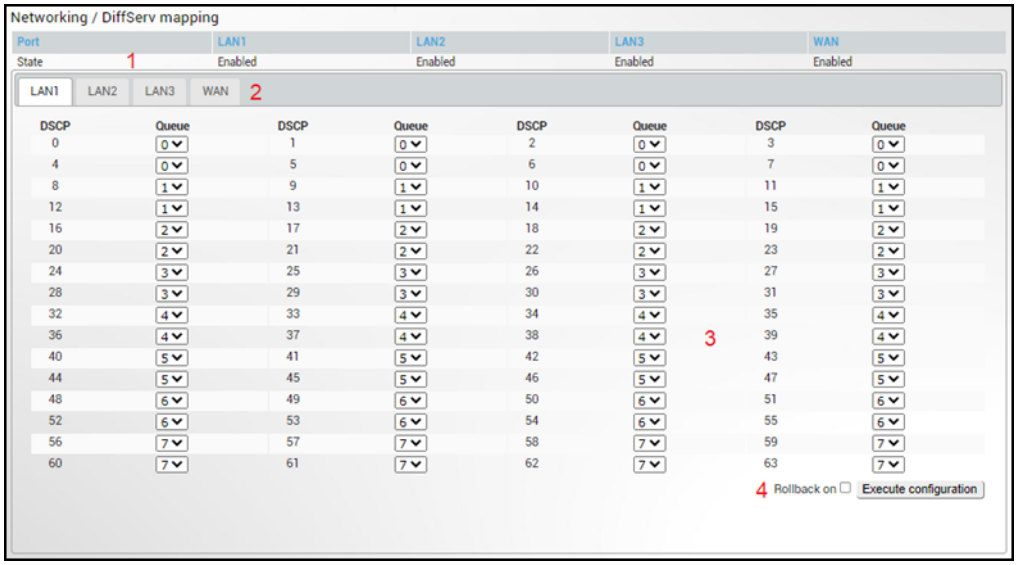


Figure 3-130 DiffServ mapping – modify mode

1) ***State*** – indicates whether DiffServ mapping is enabled or disabled on each port.
2) ***LAN1/LAN2/LAN3/WAN*** – tabs allow selecting a particular port.
3) The table shows the mapping between DSCP values and CoS queues (status mode); it allows modifying the default mapping of DSCP priority values and queues (modify mode).
4) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If ***„Rollback on"*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network qos set <port> **diffserv state** {enable|disable}	Use to enable or disable ingress DiffServ mapping (DSCP) on a particular port.

network qos set <port> diffserv dscp {0…63} **priority** {0…7}	Use to change the default DiffServ priority (DSCP) mapping.

Networking → QoS → MPLS EXP mapping

The MPLS EXP mapping page allows customizing the mapping of MPLS EXP priority bits and available QoS queues.

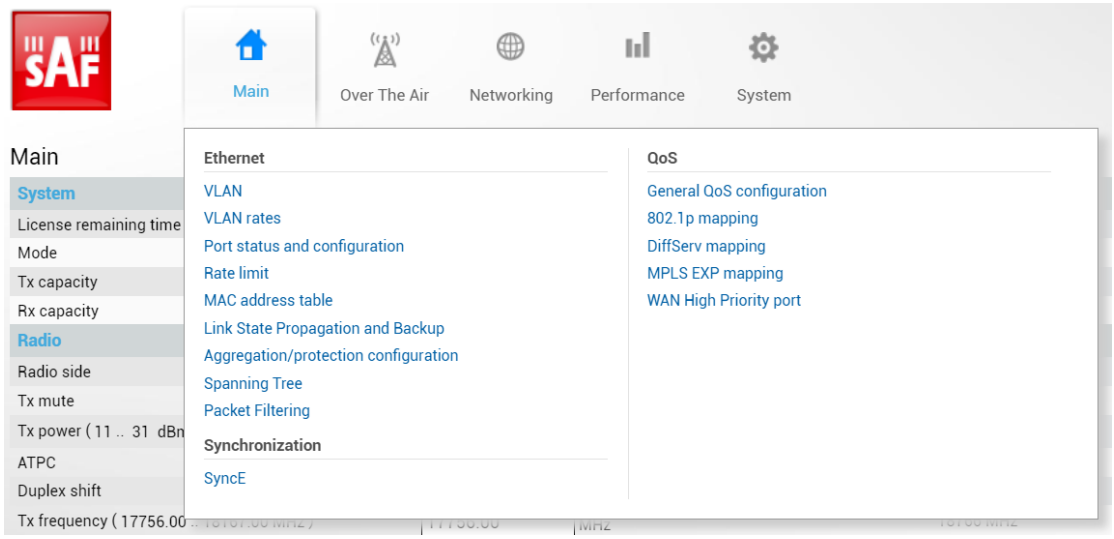


Figure 3-131 Accessing the MPLS EXP mapping page

Status mode

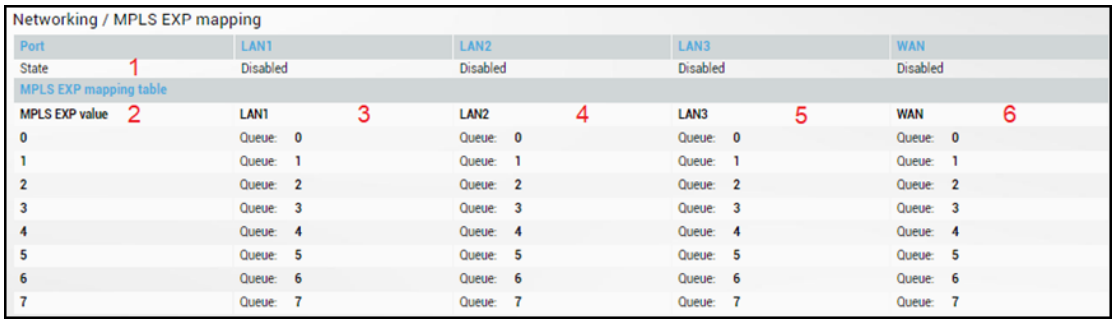


Figure 3-132 MPLS EXP mapping – status mode

Modify mode

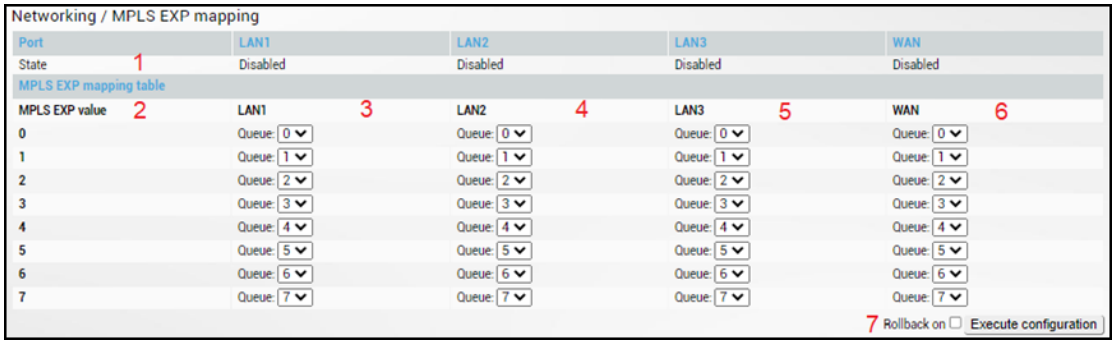


Figure 3-133 MPLS EXP mapping – modify mode

1) ***State*** – indicates whether MPLS EXP mapping is enabled or disabled on each port.
2) ***MPLS EXP value*** – indicates MPLS EXP values 0 – 7.

3) ***Queue*** – indicates to which egress queue will packets for LAN1 port with according MPLS EXP value be put (status mode); allows modifying default mapping of MPLS EXP values for LAN1 port and queues (modify mode).
4) ***Queue*** – indicates to which egress queue will packets for LAN2 port with according MPLS EXP value be put (status mode); allows modifying default mapping of MPLS EXP values for LAN2 port and queues (modify mode).
5) ***Queue*** – indicates to which egress queue will packets for LAN3 port with according MPLS EXP value be put (status mode); allows modifying default mapping of MPLS EXP values for LAN3 port and queues (modify mode).
6) ***Queue*** – indicates to which egress queue will packets for WAN port with according MPLS EXP value be put (status mode); allows modifying default mapping of MPLS EXP values for WAN port and queues (modify mode).
7) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If ***„Rollback on"*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network qos set <port> **mpls_exp state** {enable|disable}	Use to set MPLS EXP state.
network qos set <port> **mpls_exp exp** {0…7}	Use to set MPLS EXP mapping. Ingress packets EXP value to internal priority value.

Networking → QoS → WAN High Priority port

The WAN High Priority port configuration page allows splitting traffic between two WAN ports (High Priority and Low Priority) based on the assigned VLAN ID (or range). This provides for subsequent fragmentation and interleaving of low-priority bulk traffic and high-priority smaller frames as described in the chapter *WAN High Priority port (packet fragmentation)*.

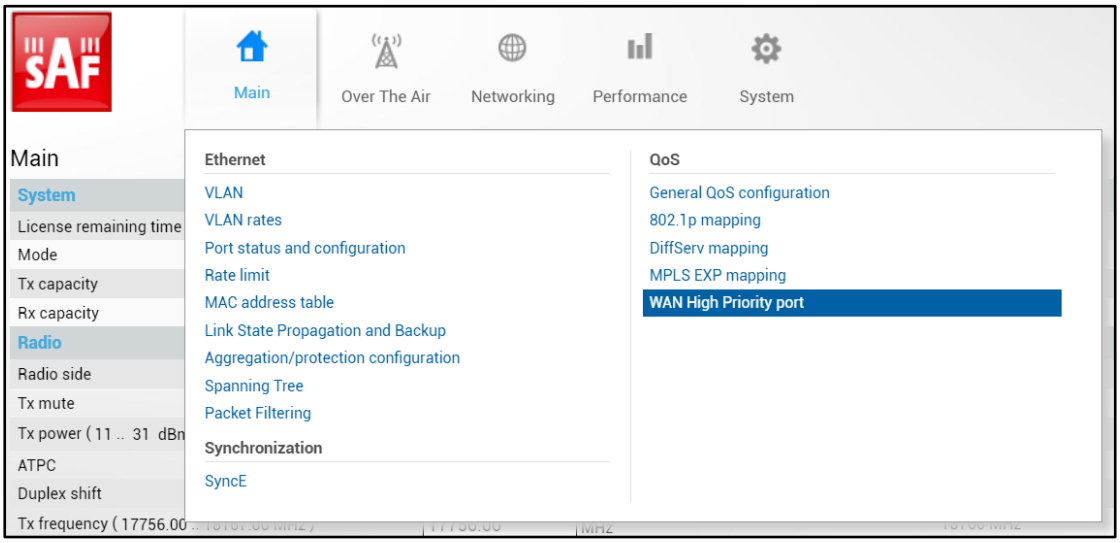


Figure 3-134 Accessing WAN High Priority port page

Status mode

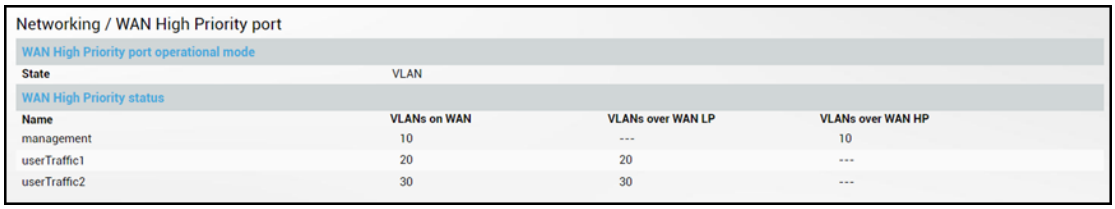


Figure 3-135 WAN High Priority port page – status mode

Press MODIFY button to get into modify mode.

Modify mode

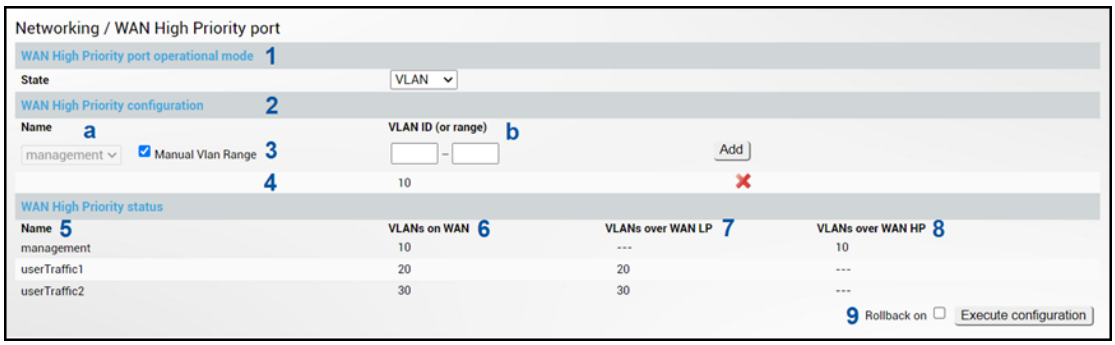


Figure 3-136 WAN High Priority port page – modify mode

1) ***Operational mode*** – enables "VLAN" operational mode for the configuration table to appear.
2) ***Configuration*** – allows adding new VLANs to the WAN HP status table or removing them from the table.
3) Adds new VLANs by selecting an existing range by its name or by entering a manual VLAN range:
   a. To select an existing range name – uncheck the ***"Manual Vlan Range"*** checkbox and select one of the existing names from the dropdown menu.
   b. To select by entering a range manually – check the ***"Manual Vlan Range"*** checkbox and enter a valid VLAN range.
4) List of the VLANs redirected to the WAN HP port. Press the cross on the right to delete a specific entry. If the row is highlighted in yellow, the entry is to be added after configuration execution. If in red – to be removed after configuration execution.
5) ***Name*** of a specific range configured for the WAN port in Tagged (Trunk) mode inside the status table.
6) ***VLANs in WAN*** – VLANs (or VLAN range) configured for the WAN port in Tagged (Trunk) mode.
7) ***VLANs over WAN LP*** – VLANs (or VLAN range) are currently forwarded over the WAN LP.
8) ***VLANs over WAN HP*** – VLANs (or VLAN range) are currently forwarded over the WAN HP.
9) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+. If ***„Rollback on"*** is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network wanhp show config	Use to show the configuration status table.
network wanhp mode disable	Use to disable the WAN HP port operation.
network wanhp mode vlan set name <name>	Use to enable VLAN mode and set the selected VLANs to the WAN HP by group name.
network wanhp mode vlan set range <first VLAN ID in range> <last VLAN ID in range>	Use to enable VLAN mode and set the selected range of VLANs to the WAN HP.
network wanhp mode vlan add name <name>	Use to set the selected VLANs to the WAN HP by group name in the existing status table.
network wanhp mode vlan add range <first VLAN ID in range> <last VLAN ID in range>	Use to set the selected range of VLANs to the WAN HP in the existing status table.
network wanhp mode vlan delete <first VLAN ID in range> <last VLAN ID in range>	Use to delete the selected range of VLANs from the WAN HP in the existing status table.

Performance

Performance → Alarm → Alarm status

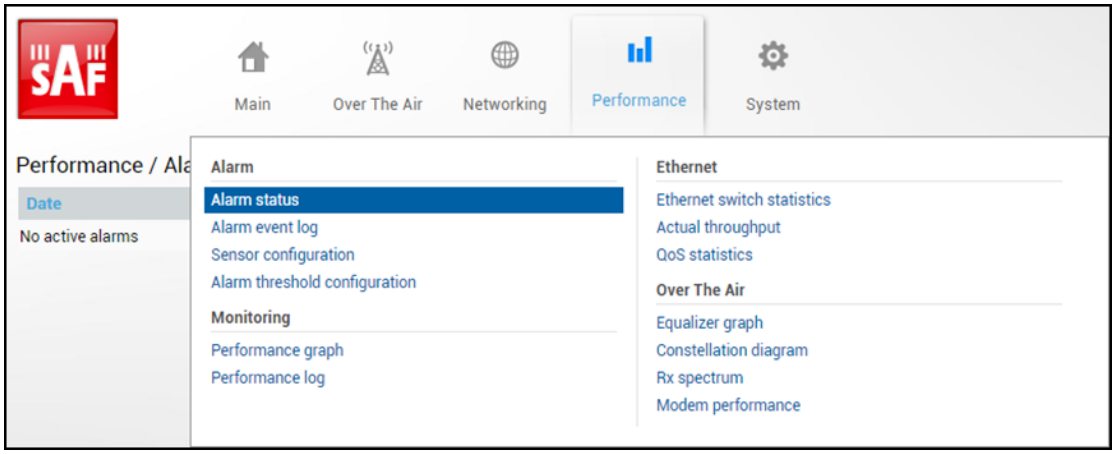


Figure 3-137 Accessing Performance Alarm page

Figure 3-138 Status page

This page summarizes current alarms by showing the date and time the alarm occurred and its name.

1) Date – shows the date when the alarm was initiated.
2) Time – shows the time when the alarm was initiated.
3) Alarm – shows the name of the alarm.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

log sensor setlist	Use to show the alarms' status.

Performance → Alarm → Alarm event log

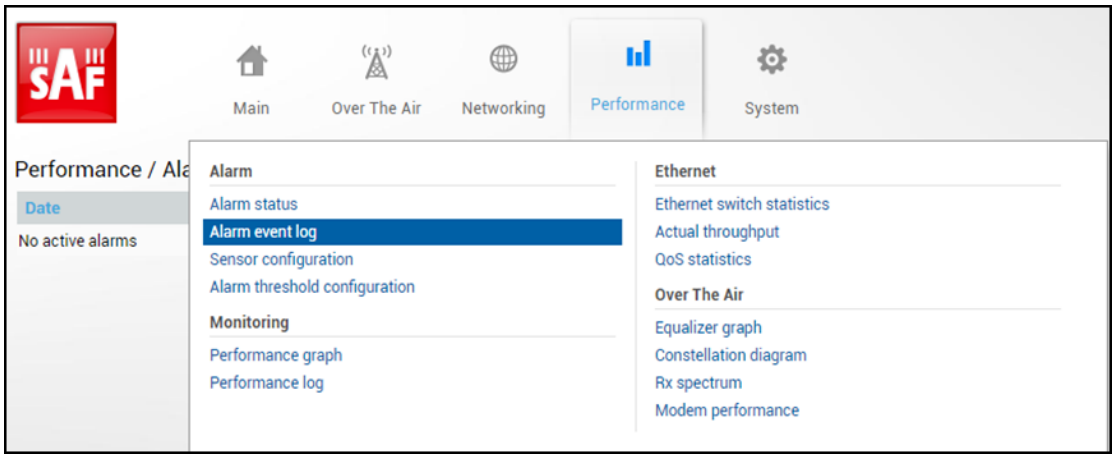


Figure 3-139 Accessing Alarm event log menu

The Alarm event log shows 20 alarm entries per page and about 5000 alarm entries in total. By default, the last page of log entries is shown. The full alarm log can be downloaded by pressing the “Alarm event log file”.

Alarm entries are mostly distributed in two groups – *“Set”* when the alarm appears and *“Reset”* when the alarm disappears.

You also have fast access to alarm filtering, where it is possible to choose which alarm groups you are willing to filter out of all log entries.

Status mode

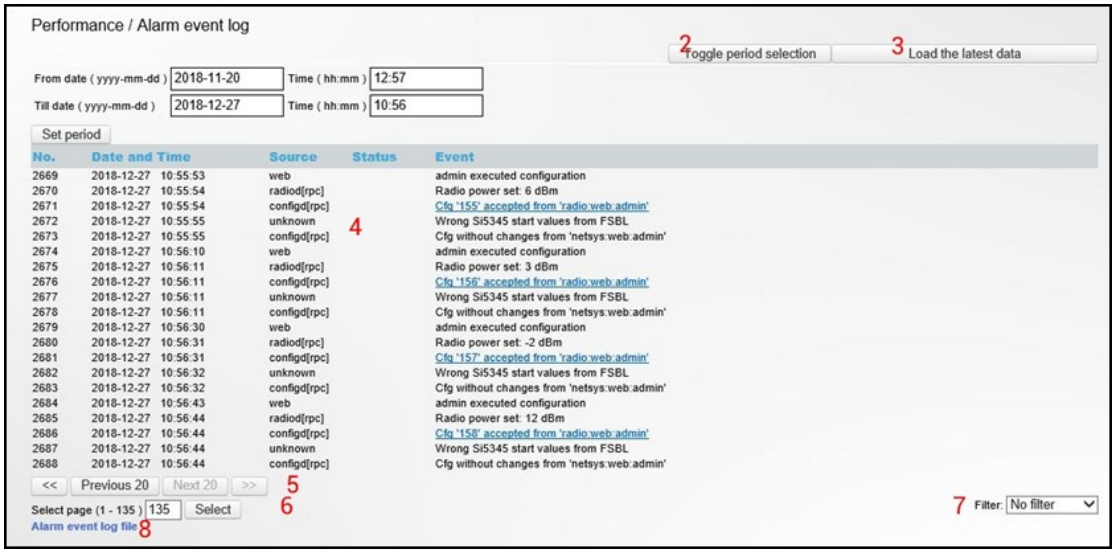


Figure 3-140 Alarm event log mode

Press MODIFY button.

Modify mode

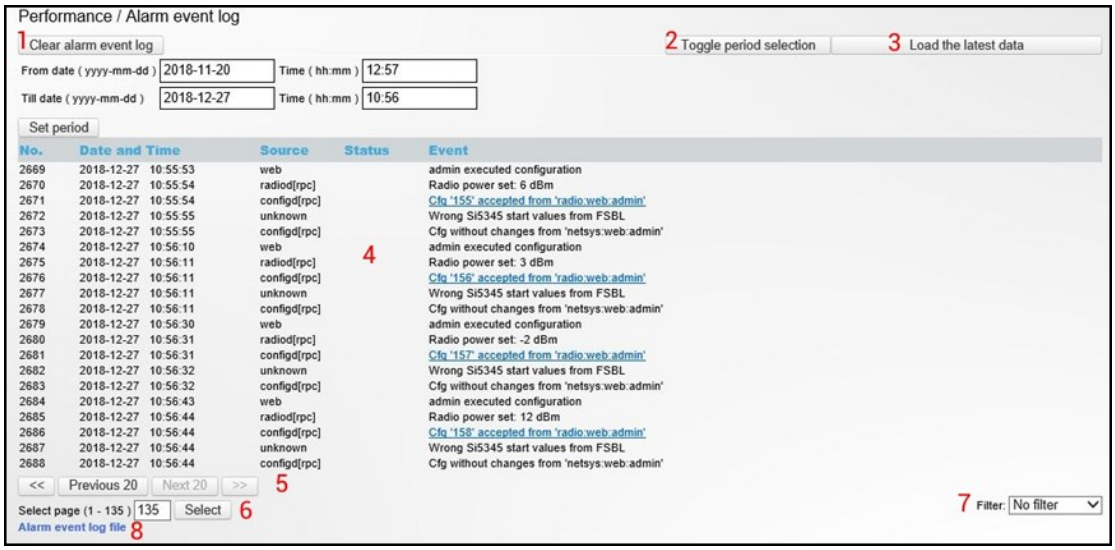


Figure 3-141 Modify Alarm log

1) *Clear alarm log* – deletes all alarm log entries.
2) *Toggle period selection* – opens/closes period selection controls:

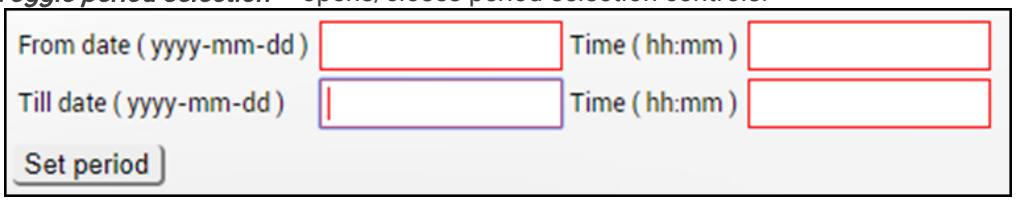


Figure 3-142 Period selection

3) *Load the latest data* – refreshes the alarm log and shows the last 20 log entries.
4) *List of alarm log entries* – entry number, date and time, source, status, and event name.
5) *Navigation controls*. "<<" navigates to the start of the alarm log, while ">>" – to the end; "Previous 20" navigates to the previous alarm log page showing 20 previous alarm log entries (if available), while "Next 20" – to next alarm log page showing 20 next alarm log entries (if available).
6) Shows the number of the currently viewed alarm log page. You can enter the specific page number to navigate to the required page.
7) *Filter* – press to filter alarms from a certain source node (e.g., Radio).
8) *Alarm event log file* – press the link to download the full alarm log text file.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

log event show last <#_of_entries>	Use to show a certain number of the last alarm log entries.
log event show time <starttime> [<endtime>]	Use to show entries from a certain time point. The following formats are supported: YYYY-MM-DD/hh:mm:ss; MM-DD/hh:mm:ss; MM-DD/hh:mm; hh:mm:ss; hh:mm
log event show sensor <sensor> [last <#_of_entries>] [time <starttime> [<endtime>]]	Use to show entries for a specific sensor. Regarding subcommands "last" and "time" please refer to the commands above.

log event show module {modem| psu | radio | system | alarm_only | iman} [last <#_of_entries>] [time <starttime> [<endtime]]	Use to show entries for a specific module. Regarding subcommands “last” and “time” please refer to the commands above.
log event clear	Use to clear the alarm log.
log event configure {enable|disable}	Use to enable or disable the event log filter.
log event configure dump <1…60>	Use to configure the duration in minutes during which the filter monitors repetitions.
log event configure pattern <1…10>	Use to configure a number of log entry repetitions to be monitored.
log event configure sn_hide_sev <0…7>	Use to set alarm severity levels (up to and including) to be excluded from logging; the levels are: 0 – emergency, 1 – alert, 3 – error, 4 – warning, 5 – notice, 6 – info, 7 – debug; the default value is “4”.
log event configure status	Use to display the current configuration of grouped repetitive alarm-event log entries (filter).
log event show last <#_of_entries>	Use to show a certain number of the last alarm log entries.

Performance → Alarm → Sensor configuration

The section allows specifying the behavior of available sensor parameters.

After the firmware upgrade, it is required to reset the sensor configuration to default using the “Set all to default” button and reconfigure sensors as required.

It is not recommended to add the “License remaining time” sensor parameter to performance (“PM log”) type parameters.

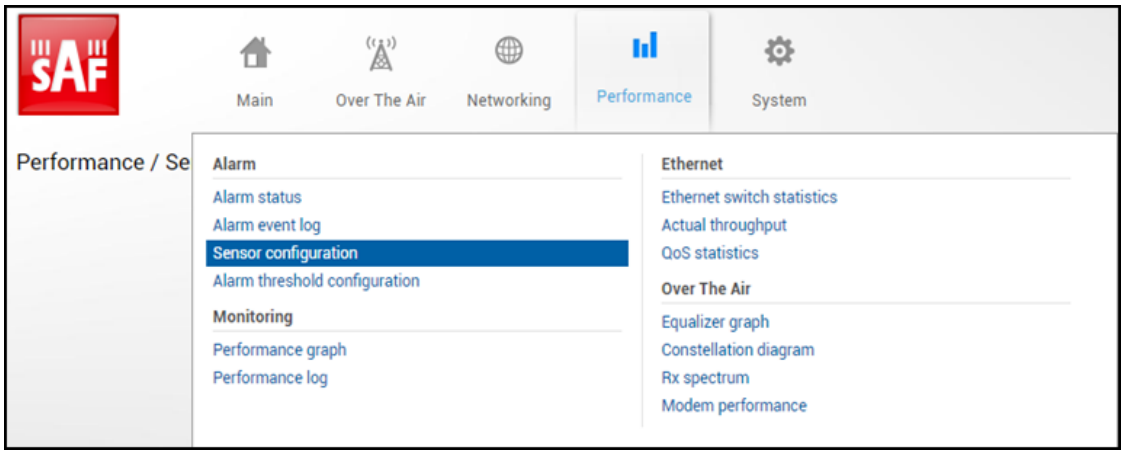


Figure 3-143 Accessing Sensor menu

Status mode

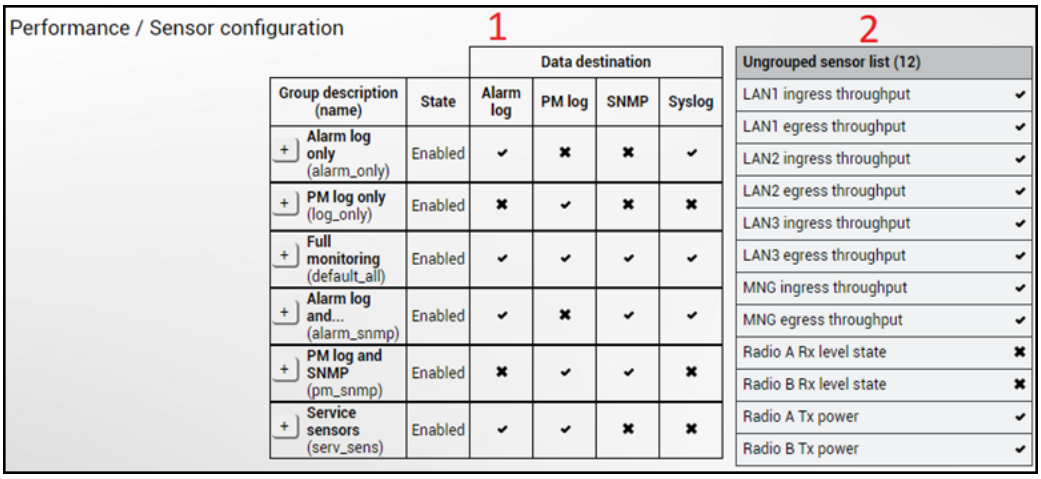


Figure 3-144 Sensor configuration page

Press MODIFY button.

Modify mode

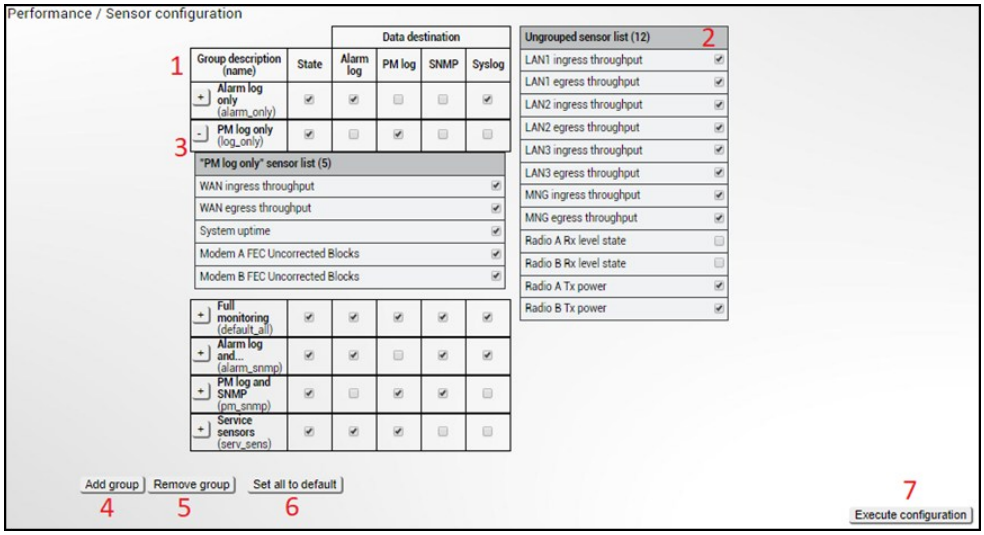


Figure 3-145 Sensor configuration

1) *Group description (name)* – By default, shows 5 groups of sensors divided by different group data destinations (event; perf; SNMP), as well as indicates whether the group is enabled (State);
2) *Ungrouped sensor list* – Shows the list of sensors not added to any of the existing groups (status mode); allows dragging to any of the existing groups, thus specifying how the sensor will be treated. Unchecking the checkbox next to the sensor disables the sensor (modify mode).
3) *+/-* opens the dropdown box with sensors in the group. Sensors from the ungrouped sensor list or other groups can be added to the group by dragging them in. Unchecking the checkbox next to the sensor disables the sensor in its corresponding group (modify mode).
4) *Add group* – Allows creating a new group with a custom name and description:

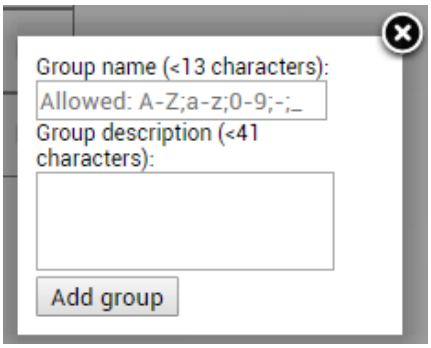


Figure 3-146

Afterward, sensors from the ungrouped sensor list or other groups can be added to the group by dragging them in.

5) Remove group – Allows deleting existing groups via a dialog window:

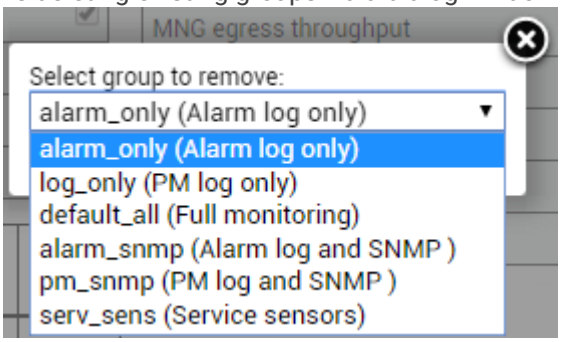


Figure 3-147

6) Set all to default – Restores default settings for all groups and sensors.

7) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

log group info	Use to show sensor group configuration.
log group create <name> <description>	Use to create a new group.
log group mgmt <name> **add destination** {event|perf|snmp|syslog}	Use to add a destination for a group.
log group mgmt <name> **add sensor** <sensor>	Use to add a sensor to a group.
log group mgmt <name> **config** {enable|disable}	Use to enable or disable a group.
log group mgmt <name> **delete**	Use to delete a group.
log group mgmt <name> **remove destination** {event|perf|snmp|syslog}	Use to remove a destination from a group.
log group mgmt <name> **remove sensor** <sensor>	Use to remove a sensor from a group.
log sensor info	Use to show the current sensor status.
log sensor list	Use to list all available sensors.

log sensor mgmt <sensor> **message** <event> <severity>	Use to set the severity for sensor event log messages
log default {all|group|sensors [<sensor>]}	Use to set the group, individual sensor, or all sensor configuration to default.

Performance → Alarm → Alarm threshold configuration

The page provides a summary of the parameters' alarm thresholds. All thresholds are predefined, and some change dynamically according to the system configuration. Thresholds can be modified if required.

The alarm activates when the current value exceeds (low-delta) or (high+delta) values. The alarm deactivates when the current value exceeds (low+delta) or (high-delta) values.

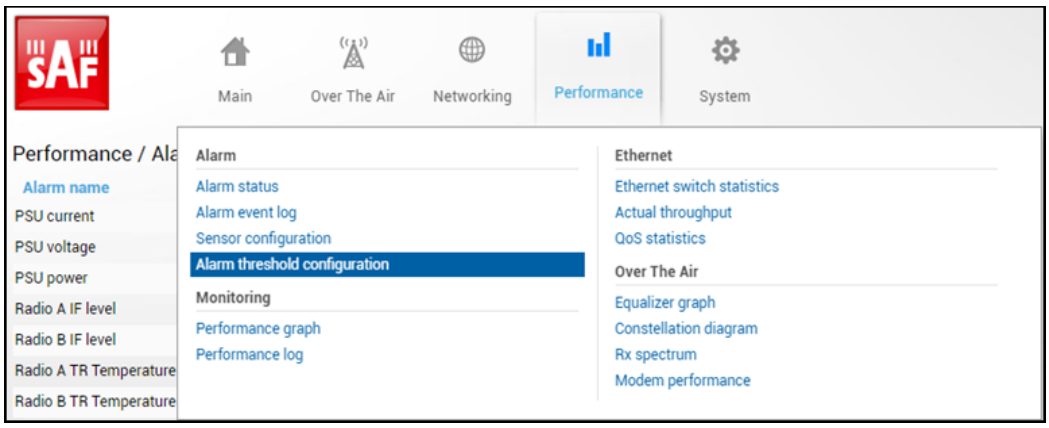


Figure 3-148 Accessing Alarm threshold configuration page

Status mode

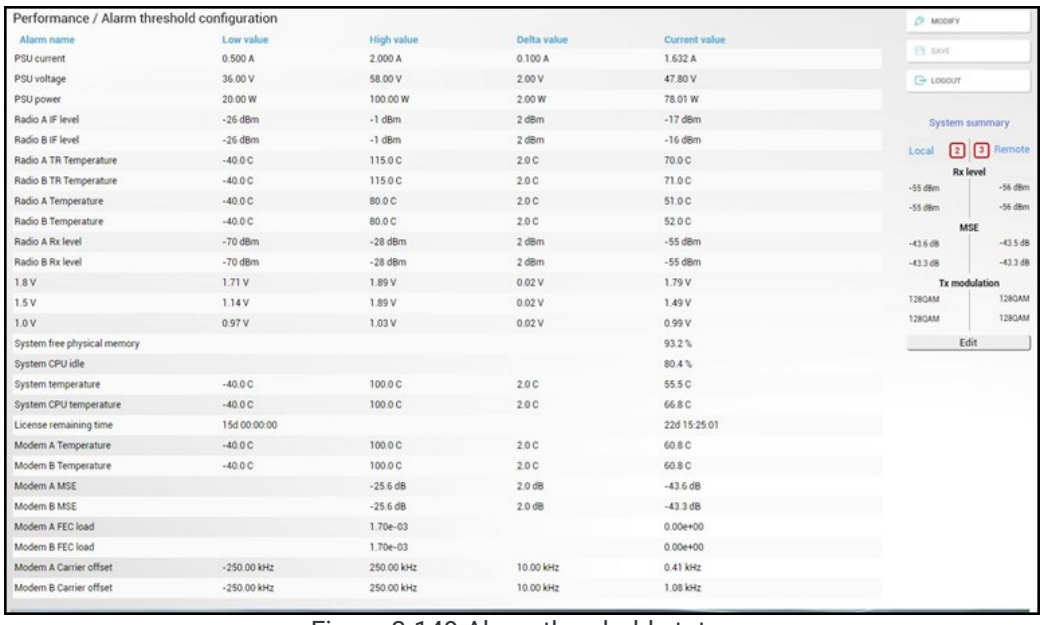


Figure 3-149 Alarm threshold status

Press MODIFY button to change values.

Modify mode

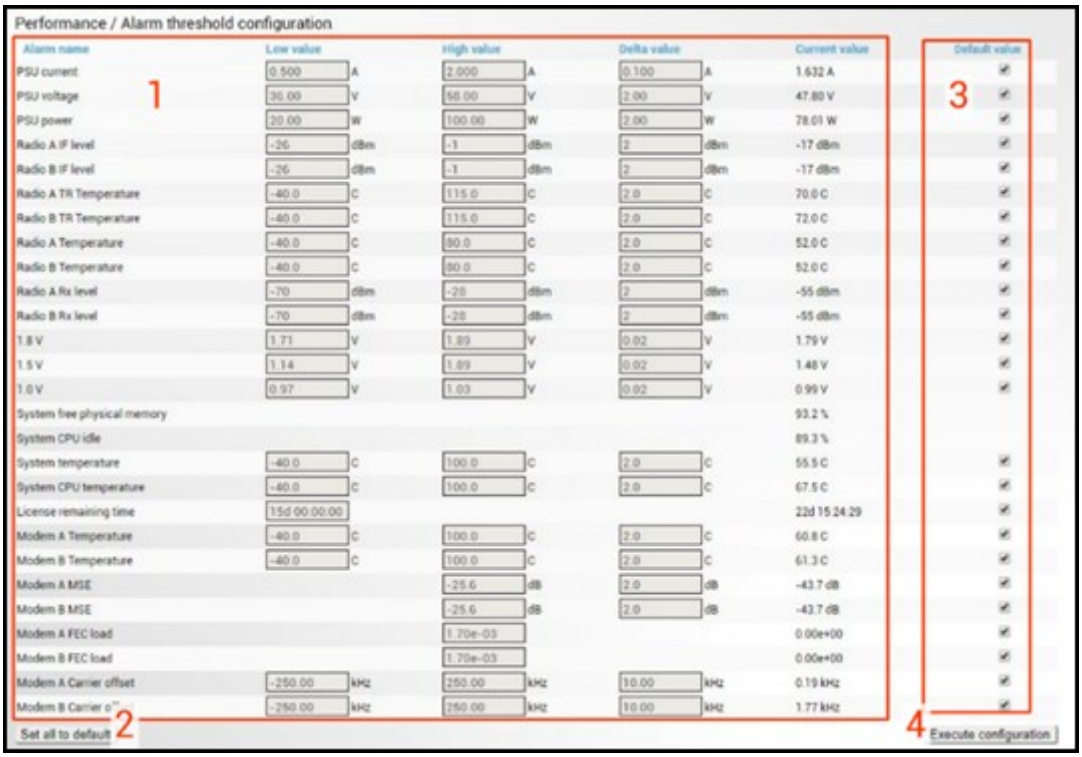


Figure 3-150 Modify alarm thresholds

1) Indicates low, high, and delta values of the parameters (status mode); "Low value", "High value", and "Delta value" fields for all parameters become editable when "Default value" is deselected (modify mode).
2) ***Set all to default*** – resets "Low value", "High value", and "Delta value" for all parameters to factory defaults.
3) ***Default value*** – deselect to activate manual threshold modification.
4) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

log sensor info	Use to show the configuration of sensor thresholds.
log sensor mgmt <sensor> **control {enable|disable}**	Use to enable or disable a sensor.
log sensor mgmt <sensor> **thold** <min> <max> <delta>	Use to set the sensor's min, max thresholds, and delta value manually.
log sensor mgmt <sensor> **time** <0…30>	Use to set sensor hysteresis time in seconds. It will be used to show value in orange color, indicating that the sensor value recently exceeded its thresholds.
log default {all| group| sensors [sensor]}	Use to set the group, individual sensor, or all sensor configuration to the default.
log sensor list	Use to list all available sensors.

Performance → Monitoring → Performance graph

The Performance graph allows visualizing various parameters on the Local side device over a chosen time period as curves. Available parameters will depend on the Sensor Configuration. Any two Local side device parameters can be shown at a time. By default, Local device Rx level (dBm) and MSE (dB) are selected and shown.

Not all sensors available in Sensor Configuration can be displayed in the Performance graph.

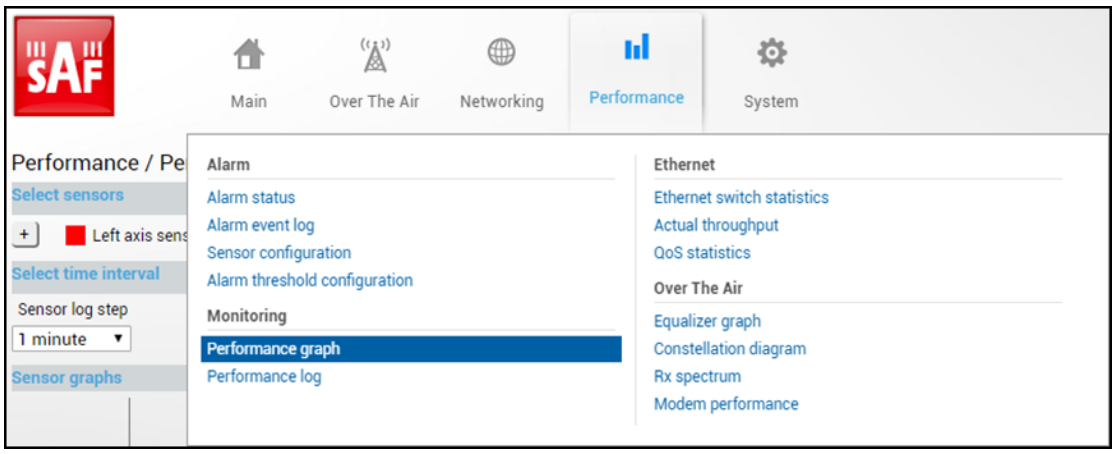


Figure 3-151 Accessing Performance graph

MODIFY button is deactivated on the Performance graph page.

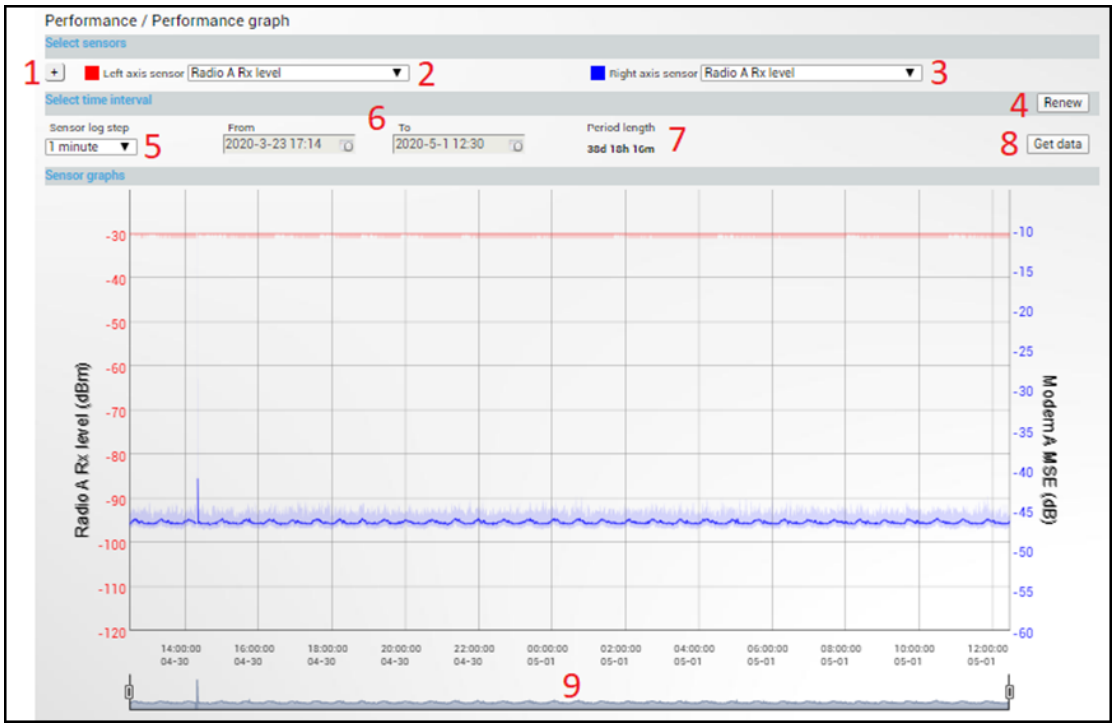


Figure 3-152 Performance graph page

1) ***+/-*** - allows (+) or denies (-) service sensor selection on the performance graph page.
2) ***Left axis sensor*** – allows choosing the sensor parameter colored in red and displayed on the left axis.
3) ***Right axis sensor*** – allows choosing the sensor parameter colored in blue and displayed on the right axis.

4) *Renew* – allows refreshing the sensor graph with the most recent data from the device.
5) *Sensor log step* – allows choosing graph granularity – 1, 15, or 60 minutes.
6) Indicates the start and end date/time of the period displayed and allows selecting a specific period to show.
7) *Period length* – shows the length of the currently displayed time period.
8) *Get data* – press to apply selected date/time period changes.
9) Left and right sliders allow to "zoom" the currently selected time period.

Performance → Monitoring → Performance log

Allows viewing and downloading the performance log.

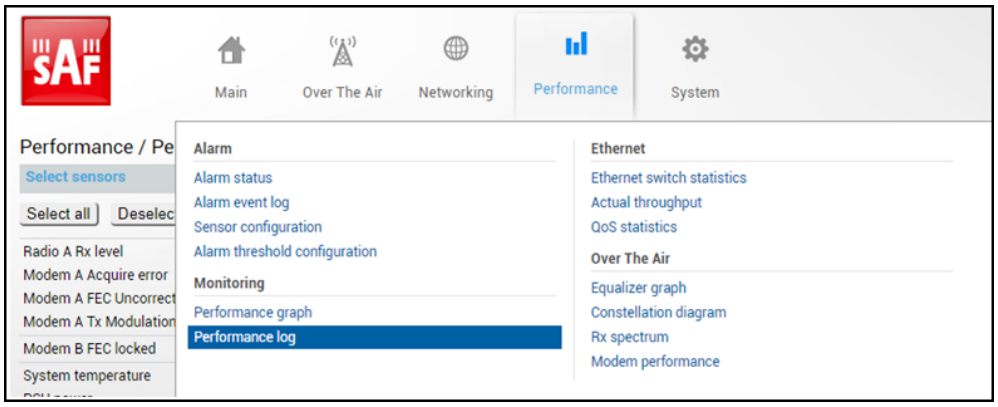


Figure 3-153 Accessing Performance log menu

MODIFY button is deactivated on the Performance log page.

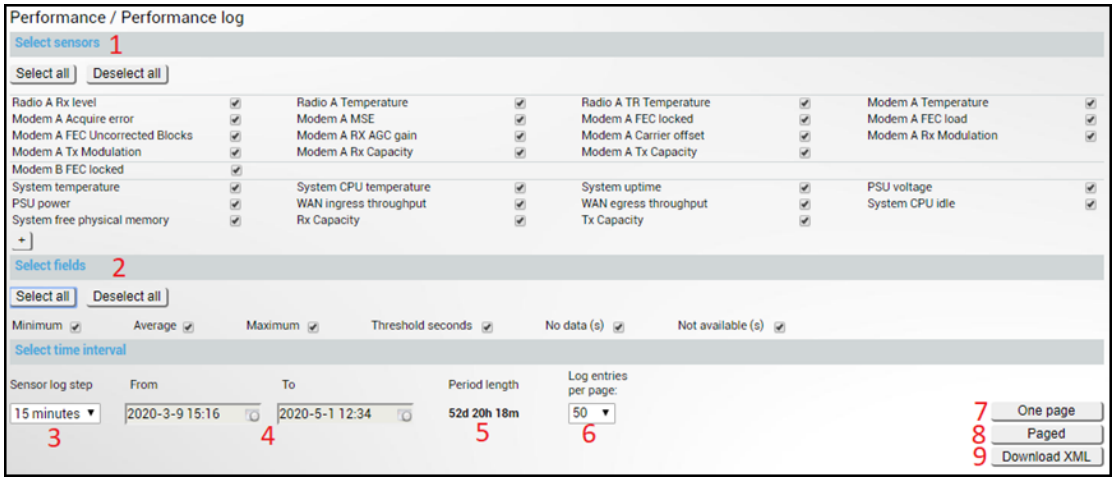


Figure 3-154 Performance log

1) *Select sensors* – allows choosing the sensor parameters to be displayed in the performance log.
2) *Select fields* – allows choosing the parameter fields to be displayed in the performance log. "Minimum" and "Maximum" represent minimum and maximum values in the specified sensor log step, while "Average" displays the average value; "Threshold seconds" will show the number amount of seconds in a chosen time interval when the parameter exceeds the minimum or maximum alarm thresholds; "No data (s)" and "Not available (s)" show respectively the time when there was no data of according to parameter and it was not available.
3) *Sensor log step* – allows choosing log step – 1, 15, or 60 minutes.
4) Indicates the start and end date/time of the period displayed and allows selecting a specific period to show.

5) *Period length* – indicates the length of the currently displayed period.
6) *Log entries per page* – allows choosing 20, 50, or 100 entries per page in paged representation.
7) *One page* –will display the performance log on a single page in a separate tab.
8) *Paged* – will display the performance log divided into pages in a separate tab.
9) *Download XML* – press to download the performance log in an extensible markup language (.xml) file.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

log perf show {1M|15M|60M} **last** <1…1440> <sensor>	Use to show a specified number of the last performance log entries with a specified sensor log step.
log perf show {1M|15M|60M} **time** <start_time> <end_time> <sensor>	Use to show entries for a certain time frame. Following formats are supported: YYYY-MM-DD/hh:mm:ss; MM-DD/hh:mm:ss; MM-DD/hh:mm; hh:mm:ss; hh:mm
log perf clear	Use to clear the performance log.

Performance → Ethernet → Ethernet switch statistics

Shows Ethernet switch statistics on all available switch ports.

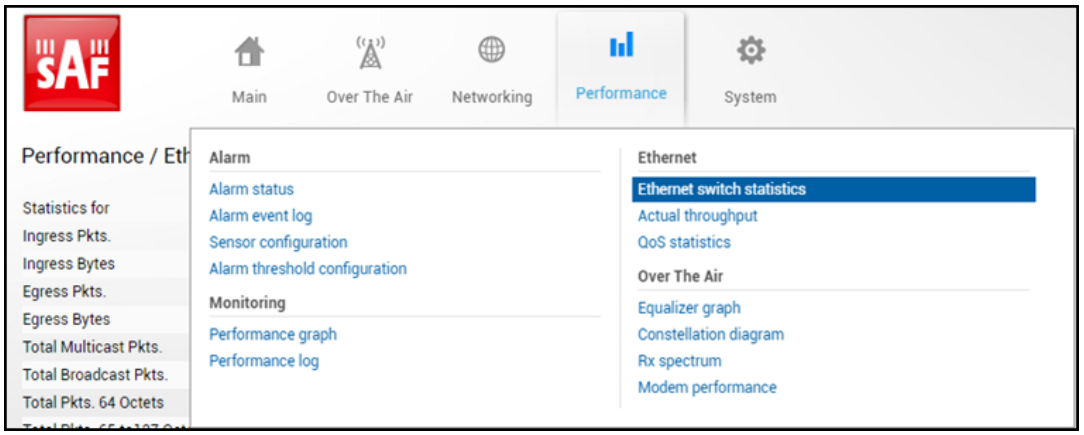


Figure 3-155 Accessing Ethernet switch statistics

Status mode

Performance / Ethernet switch statistics

		LAN1	LAN2	LAN3	WAN LP	WAN HP	MNG
Statistics for	1	0d 00:00:30	0d 00:00:30	0d 00:00:30	0d 00:00:30	0d 00:00:30	0d 00:00:30
Ingress Pkts.	2	104	0	0	282	0	311
Ingress Bytes	3	39219	0	0	334541	0	387515
Egress Pkts.	4	224	0	0	233	0	244
Egress Bytes	5	219468	0	0	264715	0	278096
Total Multicast Pkts.	6	4	0	0	4	0	4
Total Broadcast Pkts.	7	1	0	0	1	0	1
Total Pkts. 64 Octets	8	110	0	0	65	0	50
Total Pkts. 65 to127 Octets	9	1	0	0	0	0	1
Total Pkts. 128 to 255 Octets	10	28	0	0	15	0	18
Total Pkts. 256 to 511 Octets	11	10	0	0	0	0	10
Total Pkts. 512 to 1023 Octets	12	47	0	0	85	0	84
Total Pkts. 1024 to 1518 Octets	13	132	0	0	350	0	392
Total Oversize Pkts.	14	0	0	0	0	0	0
Rx Oversize Pkts.	15	0	0	0	0	0	0
Tx Oversize Pkts.	16	0	0	0	0	0	0
Total Octets	17	258687	0	0	599256	0	665611
Total Pkts.	18	328	0	0	515	0	555
Tx No Errors	19	224	0	0	233	0	244
Rx No Errors	20	104	0	0	282	0	311
Total Pkts. 1519 to 1522 Octets	21	0	0	0	0	0	0
In. Octets	22	39219	0	0	334541	0	387515
Out. Octets	23	219468	0	0	264715	0	278096
Dot1 Port In Frames	24	104	0	0	282	0	311
Dot1 Port Out Frames	25	224	0	0	233	0	244
Received Pkts. 64 Octets	26	59	0	0	34	0	20
Transmitted Pkts. 64 Octets	27	51	0	0	31	0	30
Received Pkts. 65 to 127 Octets	28	0	0	0	0	0	1
Transmitted Pkts. 65 to 127 Octets	29	1	0	0	0	0	0
Received Pkts. 128 to 255 Octets	30	5	0	0	10	0	13
Transmitted Pkts. 128 to 255 Octets	31	23	0	0	5	0	5
Received Pkts. 256 to 511 Octets	32	0	0	0	0	0	10
Transmitted Pkts. 256 to 511 Octets	33	10	0	0	0	0	0
Received Pkts. 512 to 1023 Octets	34	40	0	0	38	0	30
Transmitted Pkts. 512 to 1023 Octets	35	7	0	0	47	0	54
Received Pkts. 1024 to 1518 Octets	36	0	0	0	200	0	237
Transmitted Pkts. 1024 to 1518 Octets	37	132	0	0	150	0	155
In. Broadcast Pkts.	38	1	0	0	0	0	0
Out. Broadcast Pkts.	39	0	0	0	1	0	1
In. Multicast Pkts.	40	4	0	0	0	0	0
Out. Multicast Pkts.	41	0	0	0	4	0	4
Dot3 In. Pause Frames	42	0	0	0	0	0	0
Dot3 Out. Pause Frames	43	0	0	0	0	0	0
EtherStatsUndersize Pkts.	44	0	0	0	0	0	0
Fragments	45	0	0	0	0	0	0
CRC Align. Errors	46	0	0	0	0	0	0
Jabbers	47	0	0	0	0	0	0
Ingress BPS	48	1114	N/A	N/A	10124	0	15327
Ingress PPS	49	2	N/A	N/A	7	0	11
Egress BPS	50	7614	N/A	N/A	10124	0	10903
Egress PPS	51	6	N/A	N/A	7	0	8
All CoSQ out Pkts.	52	224	0	0	227	0	238
All CoSQ out bytes	53	219468	0	0	256479	0	269860
All CoSQ dropped Pkts.	54	0	0	0	0	0	0
All CoSQ dropped bytes	55	0	0	0	0	0	0

Figure 3-156 Ethernet switch statistics status

Press MODIFY button.

Modify mode (buttons appear at the bottom of the page)

Figure 3-157 Modify mode

1) *Statistics for* – time during which statistics have been gathered.
2) *Ingress Pkts.* – Packets that ingress on the port.
3) *Ingress Bytes* – Bytes that ingress on the port.
4) *Egress Pkts.* – Packets that egress on the port.
5) *Egress Bytes* – Bytes that egress on the port.
6) *Total Multicast Pkts.* – The total number of good packets received that were directed to a multicast address. Note that this number does not include packets directed to the broadcast address.
7) *Total Broadcast Pkts.* – The total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
8) *Total Pkts. 64 Octets* – The total number of packets (including bad packets) that were 64 octets in length (excluding framing bits but including FCS octets).
9) *Total Pkts. 65 to 127 Octets* –The total number of packets (including bad packets) that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets).
10) *Total Pkts. 128 to 255 Octets* – The total number of packets (including bad packets) that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets).
11) *Total Pkts. 256 to 511 Octets* – The total number of packets (including bad packets) that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets).
12) *Total Pkts. 512 to 1023 Octets* – The total number of packets (including bad packets) that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets).
13) *Total Pkts. 1024 to 1518 Octets* –The total number of packets (including bad packets) that were between 1024 and 1518 octets in length inclusive (excluding framing bits but including FCS octets).
14) *Total Oversize Pkts.* – The total number of packets that were longer than 1522 octets (excluding framing bits but including FCS octets) and were otherwise well formed.
15) *Rx Oversize Pkts.* – The total number of packets received that were longer than 1522 octets (excluding framing bits but including FCS octets) and were otherwise well formed.
16) *Tx Oversize Pkts.* – The total number of packets transmitted that were longer than 1522 octets (excluding framing bits but including FCS octets) and were otherwise well formed.
17) *Total Octets* – The total number of octets of data (including those in bad packets) received on the network (excluding framing bits but including FCS octets).
18) *Total Pkts.* – The total number of packets (including bad packets, broadcast packets, and multicast packets) received and transmitted.
19) *Tx No Errors* – The number of frames that have been transmitted by this port from its segment excluding fragmented and FCS error frames.
20) *Rx No Errors* – The number of frames that have been received by this port from its segment excluding fragmented and FCS error frames.
21) *Total Pkts. 1519 to 1522 Octets* – The total number of packets (including bad packets) that were between 1519 and 1522 octets in length inclusive (excluding framing bits but including FCS octets).
22) *In. Octets* – The total number of octets received on the interface, including framing characters.
23) *Out. Octets* – The total number of octets transmitted out of the interface, including framing characters.
24) *Dot1 Port In Frames* – The number of frames that have been received by this port from its segment.

Note that a frame received on the interface corresponding to this port is only counted by this object if and only if it is for a protocol being processed by the local bridging function, including bridge management frames.

25) *Dot1 Port Out Frames* – The number of frames that have been transmitted by this port to its segment.
Note that a frame transmitted on the interface corresponding to this port is only counted by this object if and only if it is for a protocol being processed by the local bridging function, including bridge management frames.
26) *Received Pkts. 64 Octets* – The total number of packets (including bad packets) received that were 64 octets in length (excluding framing bits but including FCS octets).
27) *Transmitted Pkts. 64 Octets* – The total number of packets (including bad packets) transmitted that were 64 octets in length (excluding framing bits but including FCS octets).
28) *Received Pkts. 65 to 127 Octets* – The total number of packets (including bad packets) received that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets).
29) *Transmitted Pkts. 65 to 127 Octets* – The total number of packets (including bad packets) transmitted that were between 65 and 127 octets in length inclusive (excluding framing bits but including FCS octets).
30) *Received Pkts. 128 to 255 Octets* – The total number of packets (including bad packets) received that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets).
31) *Transmitted Pkts. 128 to 255 Octets* – The total number of packets (including bad packets) transmitted that were between 128 and 255 octets in length inclusive (excluding framing bits but including FCS octets).
32) *Received Pkts. 256 to 511 Octets* – The total number of packets (including bad packets) received that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets).
33) *Transmitted Pkts. 256 to 511 Octets* – The total number of packets (including bad packets) transmitted that were between 256 and 511 octets in length inclusive (excluding framing bits but including FCS octets).
34) *Received Pkts. 512 to 1023 Octets* – The total number of packets (including bad packets) received that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets).
35) *Transmitted Pkts. 512 to 1023 Octets* – The total number of packets (including bad packets) transmitted that were between 512 and 1023 octets in length inclusive (excluding framing bits but including FCS octets).
36) *Received Pkts. 1024 to 1518 Octets* – The total number of packets (including bad packets) received that were between 1024 and 1518 octets in length inclusive (excluding framing bits but including FCS octets).
37) *Transmitted Pkts. 1024 to 1518 Octets* – The total number of packets (including bad packets) transmitted that were between 1024 and 1518 octets in length inclusive (excluding framing bits but including FCS octets).
38) *In. Broadcast Pkts.* – The number of packets, delivered by this sub-layer to a higher (sub-) layer, which was addressed to a broadcast address at this sub-layer.
39) *Out. Broadcast Pkts.* – The total number of packets that higher-level protocols requested to be transmitted, and which were addressed to a broadcast address at this sub-layer, including those that were discarded or not sent.
40) *In. Multicast Pkts.* – The number of packets, delivered by this sub-layer to a higher (sub-) layer, which was addressed to a multicast address at this sub-layer. For a MAC layer protocol, this includes both Group and Functional addresses.
41) *Out. Multicast Pkts.* – The total number of packets that higher-level protocols requested to be transmitted, and which were addressed to a multicast address at this sub-layer, including those that were discarded or not sent. For a MAC layer protocol, this includes both Group and Functional addresses.
42) *Dot3 In. Pause Frames* – A count of MAC Control frames received on this interface with an opcode indicating the PAUSE operation. This counter does not increment when the interface is operating in half-duplex mode. Discontinuities in the value of this counter can occur at re-

initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime.

43) ***Dot3 Out. Pause Frames*** – A count of MAC Control frames transmitted on this interface with an opcode indicating the PAUSE operation. This counter does not increment when the interface is operating in half-duplex mode. Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime.
44) ***EtherStatsUndersize Pkts.*** – The total number of packets received that were less than 64 octets long (excluding framing bits but including FCS octets) and were otherwise well formed.
45) ***Fragments*** – The total number of packets received that were less than 64 octets in length (excluding framing bits but including FCS octets) and had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error).
Note that it is entirely normal for etherStatsFragments to increment. This is because it counts both runts (which are normal occurrences due to collisions) and noise hits.
46) ***CRC Align. Errors*** – The total number of packets received that had a length (excluding framing bits but including FCS octets) of between 64 and 1518 octets, inclusive, but had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error).
47) ***Jabbers*** – The total number of packets received that were longer than 1518 octets (excluding framing bits but including FCS octets) and had either a bad Frame Check Sequence (FCS) with an integral number of octets (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error).
Note that this definition of jabber is different than the definition in IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These documents define jabber as the condition where any packet exceeds 20 ms. The allowed range to detect jabber is between 20 ms and 150 ms.
48) ***Ingress BPS*** – Indicates byte per second rate on the input of the port.
49) ***Ingress PPS*** – Indicates packet per second rate on the input of the port.
50) ***Egress BPS*** – Indicates byte per second rate on the exit of the port.
51) ***Egress PPS*** – Indicates packet per second rate on the exit of the port.
52) ***All CoSQ out Pkts.*** - total packet count with QoS transmitted.
53) ***All CoSQ out bytes*** - total byte count with QoS transmitted.
54) ***All CoSQ dropped Pkts.*** – total packet count with QoS dropped.
55) ***All CoSQ dropped bytes*** - total byte count with QoS dropped.
56) ***Clear all data*** – Clears statistics on all switch ports.
57) ***Clear*** – Clears statistics on a particular port.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network port show statistics	Use to show Ethernet statistics on all ports.
network port reset statistics {LAN1|LAN2|LAN3|MNG|WAN|all}	Use to reset Ethernet statistics for a particular port or all ports.

Performance → Ethernet → Actual throughput

Shows ingress and egress traffic statistics on all available switch ports.

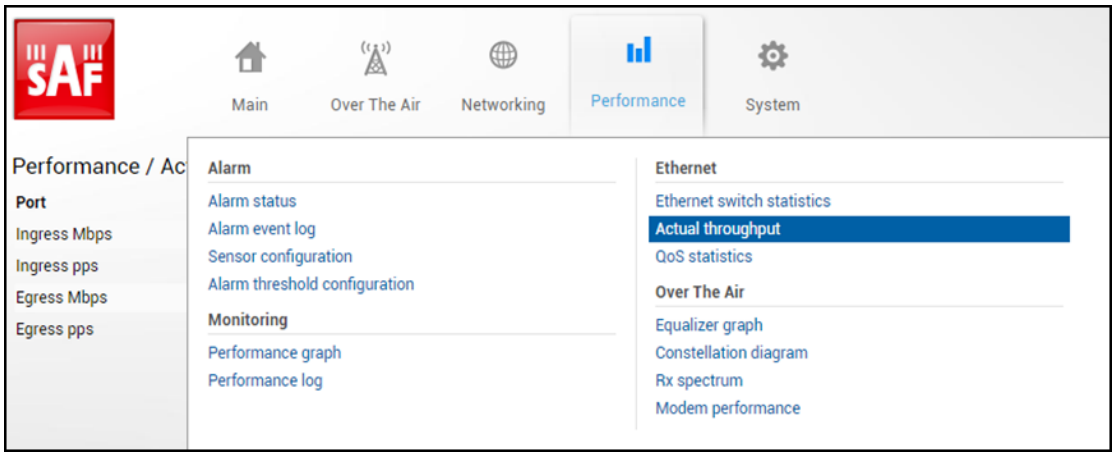


Figure 3-158 Accessing Actual throughput page

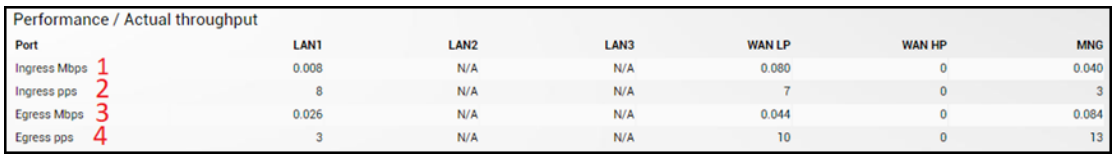


Figure 3-159 Actual throughput page

MODIFY button is deactivated on this page.

1) Ingress Mbps – indicates megabit per second rate on the input of the port.
2) Ingress pps – indicates packet per second rate on the input of the port.
3) Egress Mbps – indicates megabit per second rate on the exit of the port
4) Egress pps – indicates packet per second rate on the exit of the port.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

network port show throughput	Use to show the current throughput on all ports.

Performance → Ethernet → QoS statistics

Shows QoS statistics for 8 priority queues, indicating passed and dropped packets and bytes. Elapsed time is indicated as well.

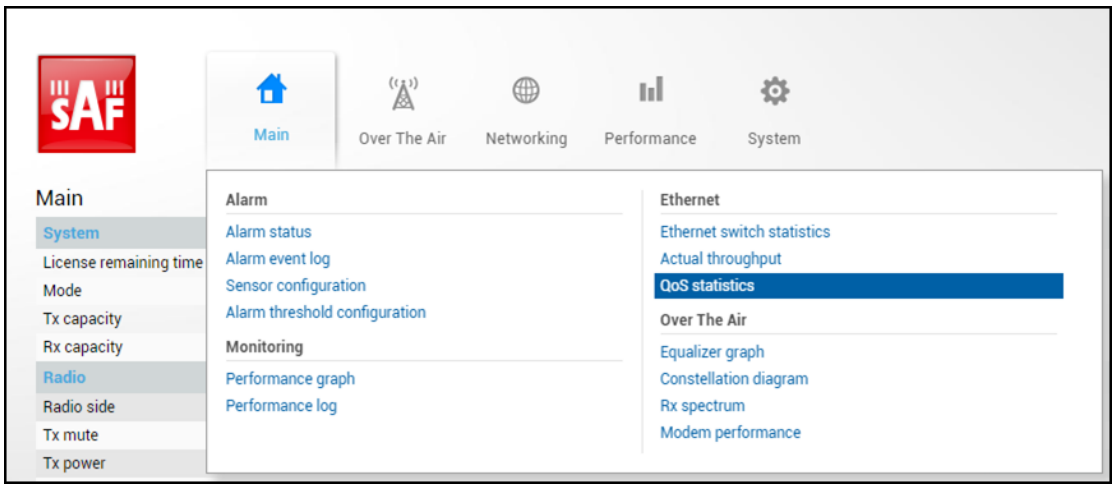


Figure 3-160 Accessing the QoS statistics page

Status mode

Performance / QoS statistics

Queue		Port					
Statistics for		LAN1 12d 06:13:08 Bytes / packets	LAN2 12d 06:13:08 Bytes / packets	LAN3 12d 06:13:08 Bytes / packets	WAN LP 12d 06:13:08 Bytes / packets	WAN HP 12d 06:13:08 Bytes / packets	MNG 12d 06:13:08 Bytes / packets
0	Passed	17.23 k / 152	0 / 0	0 / 0	9.91 G / 59437615	0 / 0	9.91 G / 59437523
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
1	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
2	Passed	1.71 M / 28007	0 / 0	0 / 0	375.87 M / 6157873	64 / 1	377.56 M / 6185989
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
3	Passed	1.41 G / 1883234	0 / 0	0 / 0	8.12 G / 6373079	0 / 0	8.35 G / 7697025
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
4	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
5	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
6	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
7	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

Figure 3-161 QoS statistics page in status mode

Press MODIFY button.

Modify mode (buttons appear at the bottom of the page)

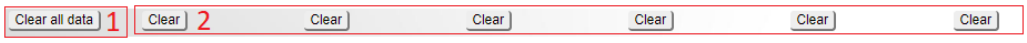


Figure 3-162 Bottom of QoS statistics page in modify mode

1) ***Clear all data*** – allows clearing QoS statistics on all switch ports.
2) ***Clear*** – allows clearing QoS statistics on individual switch ports.

Performance → Over The Air → Equalizer graph

The Equalizer graph window shows adaptive equalizer 'taps' coefficients, which at a set time moment minimize the multipath fading effect in the channel. For more details, see the chapter *Adaptive equalizer*.

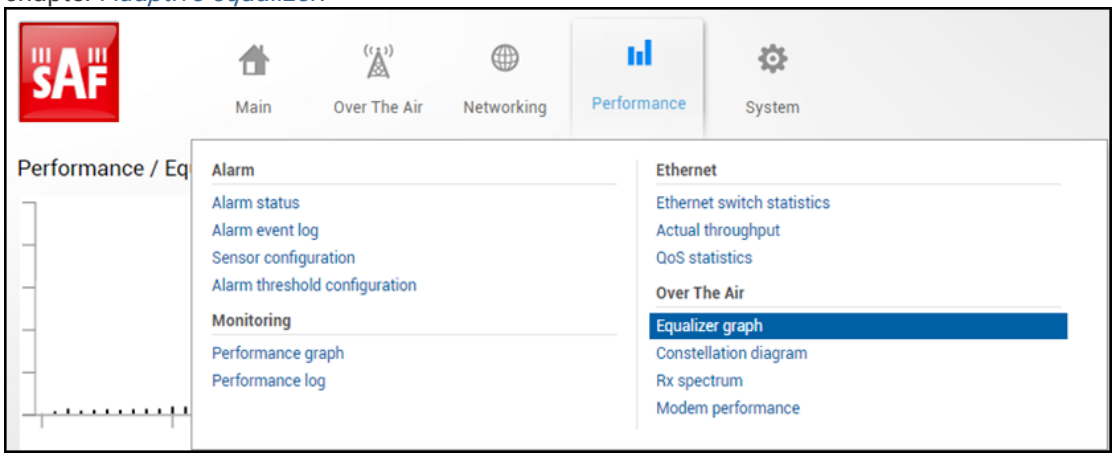


Figure 3-163 Accessing Equalizer graph

MODIFY button is deactivated on the Equalizer graph page.

Equalizer graph page is not available when AES encryption is enabled.

An example of equalizer 'taps' coefficients and its frequency response in the case of normal operation is shown in

Figure *3-164*.

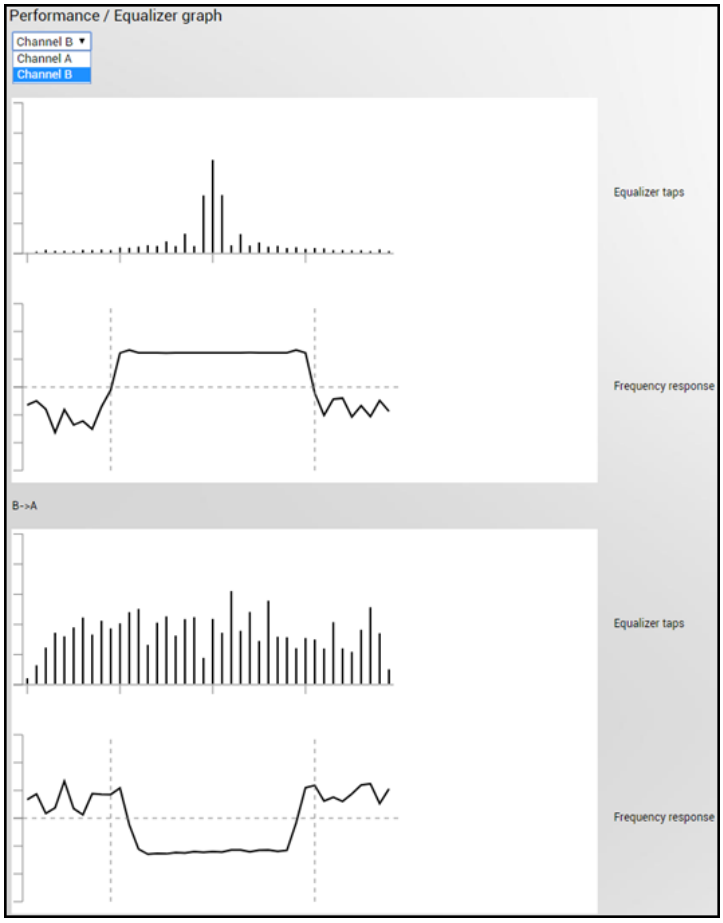


Figure 3-164 Equalizer taps and frequency response

You can choose between Channel A and Channel B graphs, and see also the cross-discrimination graph. During normal operation, the frequency response curve is smooth at the center, and the central equalizer tap is higher, while the side towers evenly decrease. If equalizer taps and frequency response curve significantly differ from the one above, it may be an indication of multipath issues, which must be inspected with the use of precise and accurate path profiling. Higher taps mainly on the right side indicate a weaker reflected signal compared to the main signal, while higher taps mainly on the left side indicate a stronger reflected signal.

Below is an example of an Equalizer graph in a link aligned to the reflected signal, see *Figure 3-165*.

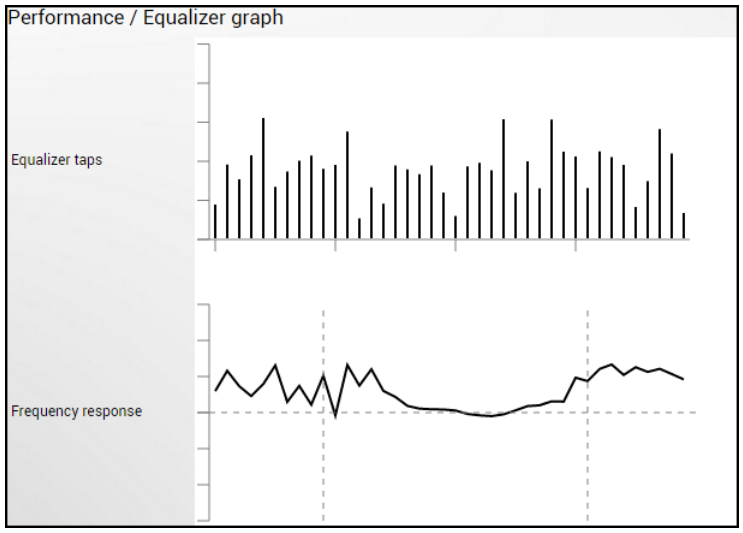


Figure 3-165 Equalizer graph for reflected signal

Performance → Over The Air → Constellation diagram

A constellation diagram is a representation of a signal modulated by the digital modulation schemes 4096QAM, 2048QAM, 1024QAM, 512QAM, 256QAM, 128QAM, 64QAM, 32QAM, 16QAM, and 4QAM. It displays the signal as a two-dimensional scatter diagram in the complex plane at symbol sampling instants. A measured constellation diagram can be used to recognize the type of interference and distortion in a signal.

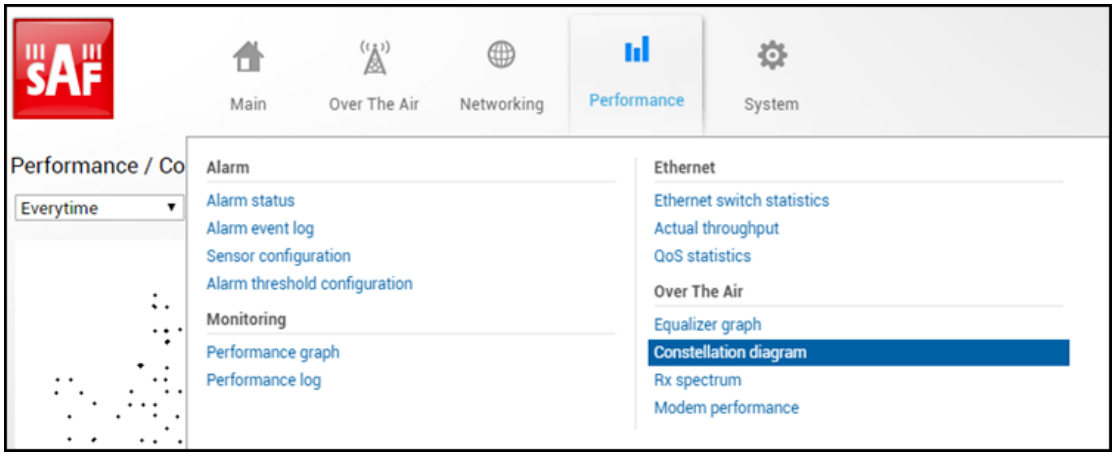


Figure 3-166 Accessing Constellation diagram page

The MODIFY button is deactivated on the Constellation diagram page.

Only a single user can see Constellation at a time.

The constellation diagram page is not available when AES encryption is enabled (applies only to Integra-X2/-FIDU+).

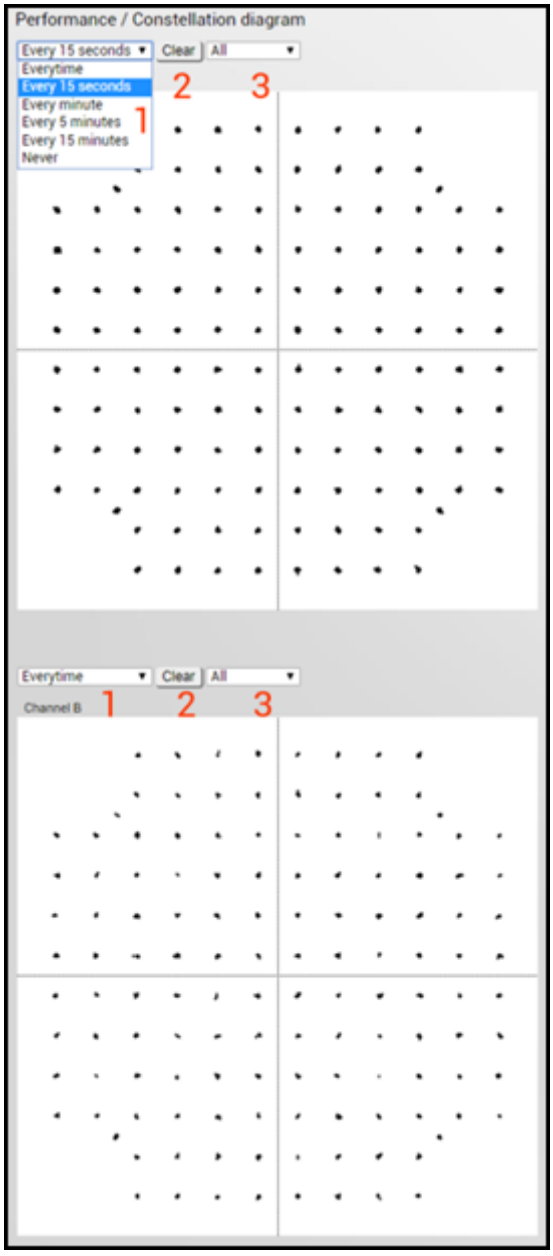


Figure 3-167 Constellation diagram page

1) Allows choosing how often the constellation is automatically cleared.
2) Manually clear the current constellation.
3) Allows zooming to one of 4 constellation quadrants.

To analyze the received signal quality, some types of corruption are evident in the constellation diagram. For example, for 4QAM see *Figure 3-168*, *Figure 3-169,* and *Figure 3-170*.

Gaussian noise is displayed as fuzzy constellation points, *Figure 3-168*.

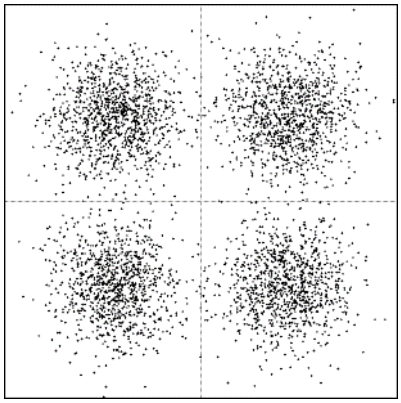


Figure 3-168

Non-coherent single-frequency interference is displayed as circular constellation points, *Figure 3-169*.

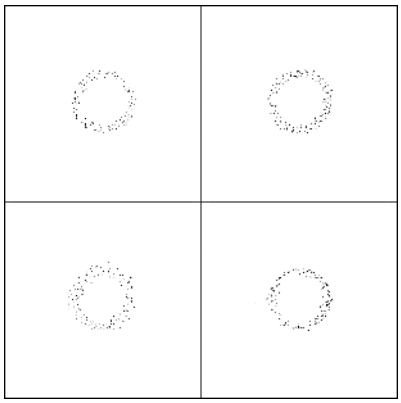


Figure 3-169

Phase noise is displayed as rotationally spreading constellation points, *Figure 3-170*.

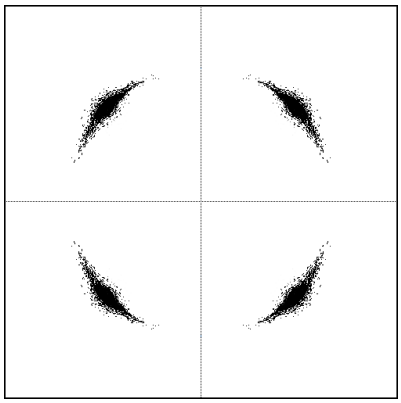


Figure 3-170

Performance → Over The Air → Rx spectrum

A spectrum curve is a representation of the received signal at the input of the modem. For this reason, spectrum signal levels will not correspond to the actual radio receiver's signal level. The signal appearance will depend on the configured channel bandwidth. A measured spectrum curve can be used to recognize in-band interference or very powerful out-of-band interference (due to filters applied).

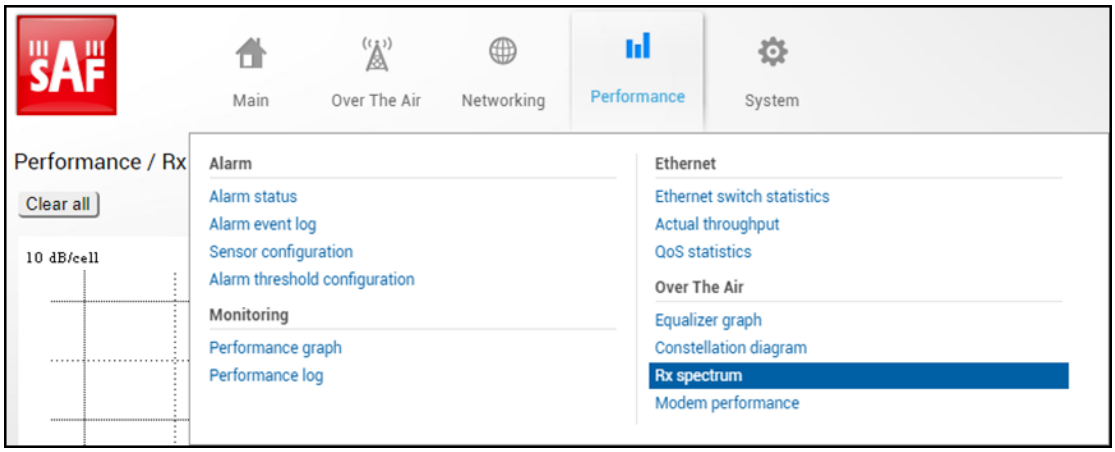


Figure 3-171 Accessing RX spectrum page

The MODIFY button is deactivated on the Rx spectrum page.

Only a single user can see Rx Spectrum at a time.

The Rx spectrum page is not available when AES encryption is enabled (applies only to Integra-X2/-FIDU+).

As an example, see *Figure 3-172* for 112MHz bandwidth:

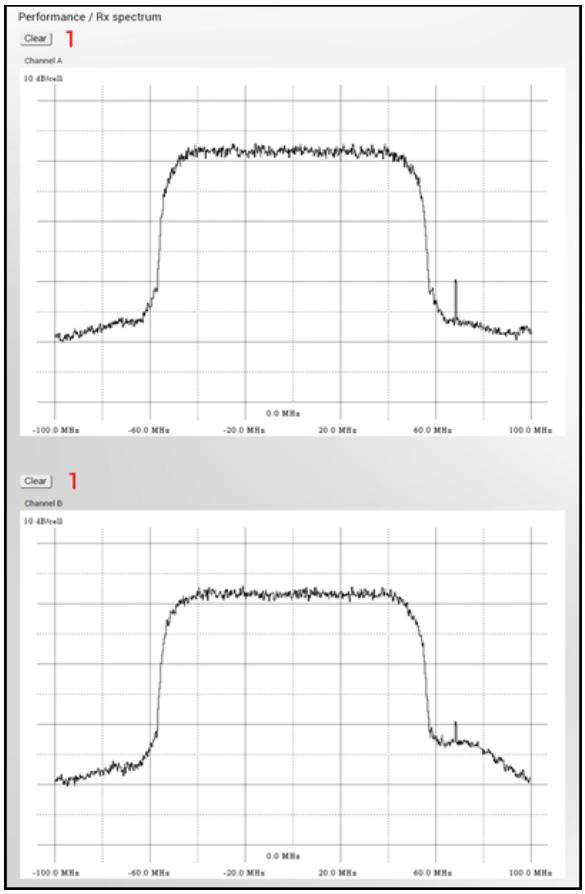


Figure 3-172 RX spectrum for 112MHz

1) "Clear" button cleans the current averaged Rx spectrum. The Rx spectrum is averaged over the period from when the button "clear" was pressed or the page was opened. There are no other modification possibilities for the page.

Performance → Over The Air → Modem performance

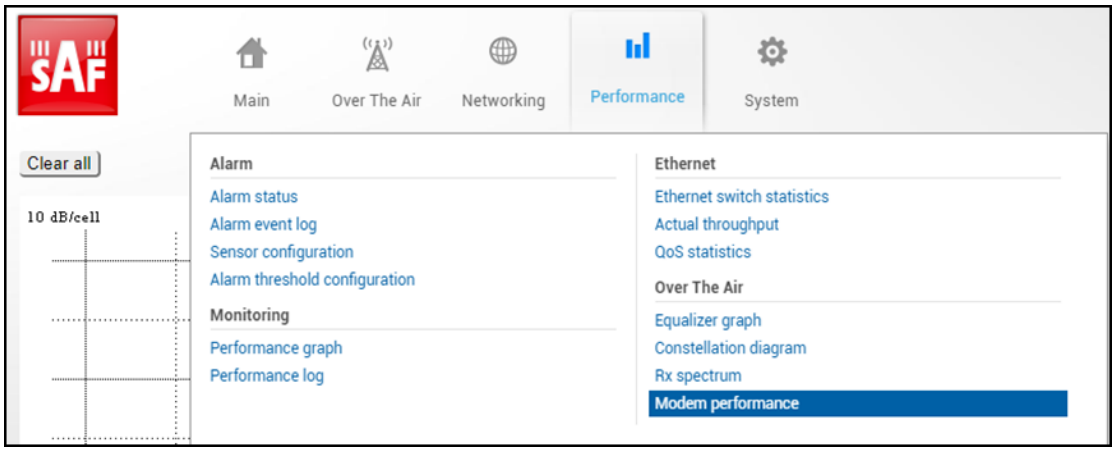


Figure 3-173 Accessing Modem Performance page

Status/clear mode

On Modem Performance page, there are both modem statistics presented for XPIC mode and the corresponding modem (Local A or Local B) for single polarization.

Figure 3-174 Status window

1) ***Modify*** – by pressing the button, you can access button 13 for clearing the modem statistics, there are no other modification possibilities for the page.
2) ***Count Time*** – a current period of modem statistics measuring.
3) ***Errored Block*** – errored blocks in the current measurement period.
4) ***Errored Second*** – errored seconds in the current measurement period.
5) ***Severely Errored Second*** - severely errored seconds (SES) in the current measurement period.
6) ***Background Block Error*** – BBE in the current measurement period.
7) ***Total Block Number*** – number of blocks received that are not part of SES.
8) ***Errored Second Ratio*** –Errored seconds ratio to total measurement count time.
9) ***Severely Errored Seconds Ratio*** – severely errored seconds ratio to total measurement count time.
10) ***Background Block Error Ratio*** – BBE ratio to the total current measurement time.
11) ***Uptime*** – time in seconds during which the link was synchronized.
12) ***Unavailtime*** – time in seconds during which the link was not synchronized.
13) ***Clear*** –Clears current modem measurement statistics, counts for data above starting from zero.

System

System → FW → Firmware upgrade

How to access “Firmware upgrade” page in Integra-X/-X2/-FIDU/-FIDU+ web GUI see *Figure 3-175*. For the upgrade process through Web GUI see *Integra series firmware upgrade via Web GUI* section.

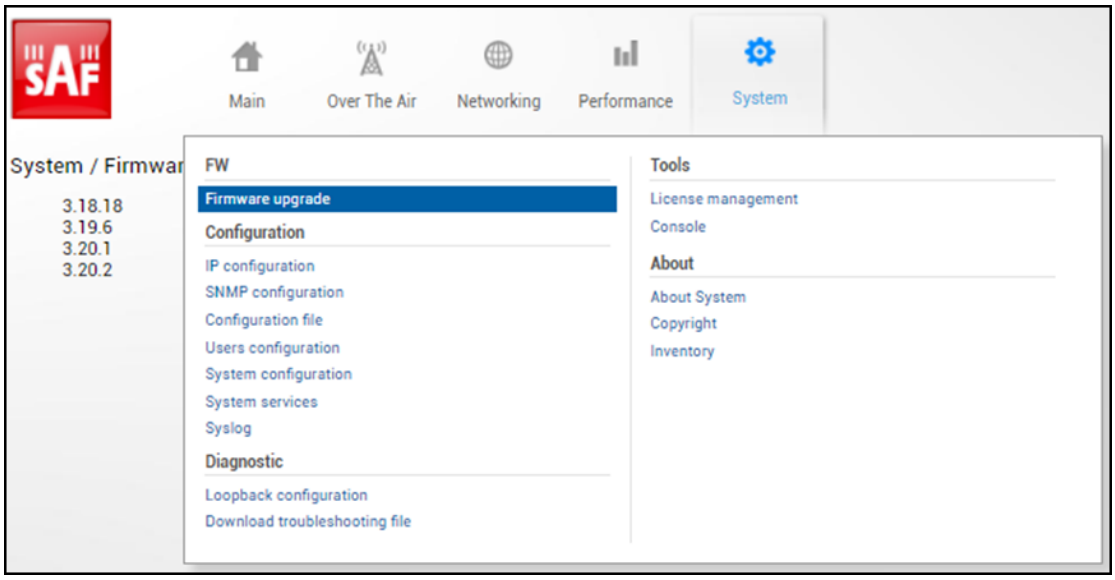


Figure 3-175 Accessing Firmware upgrade page

Status mode

Figure 3-176 List of available FW files

Press MODIFY button.

Modify mode

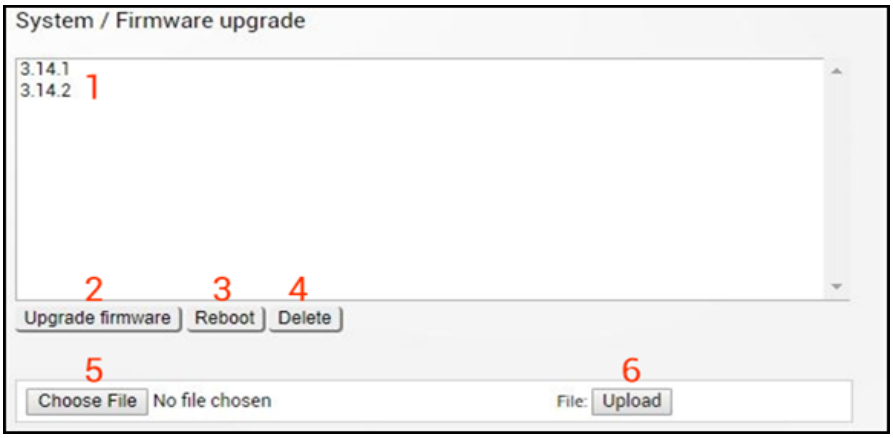


Figure 3-177 Firmware upgrade page

1) Shows a list of available firmware files.
2) ***Upgrade firmware*** – click on the preferred firmware in the list and press the "Upgrade firmware" button to initiate the firmware upgrade process.

The remote side must be upgraded first.

The latest Integra-X/-X2/-FIDU/-FIDU+ firmware can be downloaded at *https://saftehnika.com/en/downloads* in the "Firmwares" section. Registration and login are required.

3) ***Reboot*** – Reboots Integra-X/-X2/-FIDU/-FIDU+ (cold restart).
4) ***Delete*** – Deletes selected firmware files from the list.
5) ***Browse*** or ***Choose File*** (depending on the used web browser) – Press to browse for Integra-X/-X2/-FIDU/-FIDU+ firmware file on your hard disk drive.
6) ***Upload*** – Press to upload a firmware file to Integra-X/-X2/-FIDU/-FIDU+. Up to 5 FW could be stored in Integra-X/-X2/-FIDU/-FIDU+, you can delete unnecessary ones by "Delete" 4) button.

Integra series firmware upgrade via Web GUI

The firmware update package contains a firmware file (.bin extension), release notes, and firmware upgrade instructions.

The latest Integra-X/-X2/-FIDU/-FIDU+ firmware update package can be downloaded at the following URL: *https://www.saftehnika.com/en/downloads* (registration required). Before firmware upgrade via Web GUI downloaded firmware update package should be unzipped on the local computer's hard disk.

The main method for firmware upgrade is to upload via Web GUI, which automates the whole firmware upgrade process. To perform a software upgrade from Web GUI, please follow these steps:

1) Go to "System → FW → Firmware upgrade".
2) Press the "MODIFY" button on the right side of the page.
3) Press the "Browse" button, locate the *.bin firmware file on your hard disk (extracted from the firmware update package), and press the "Open" button.
4) Press the "Upload" button, there could be up to 5 FW stored in Integra-X/-X2/-FIDU/-FIDU+, you can delete unnecessary ones by the "Delete" button.
5) Select the uploaded firmware from the firmware list, press "Upgrade firmware" button, and confirm the upgrade:

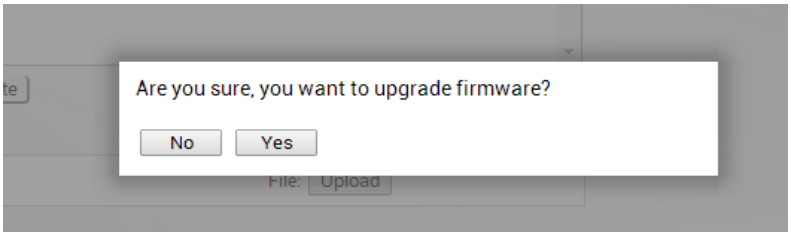


Figure 3-178 FW upgrade prompt (1)

6) After the prompt informing about successful installation appears, confirm the reboot of the system:

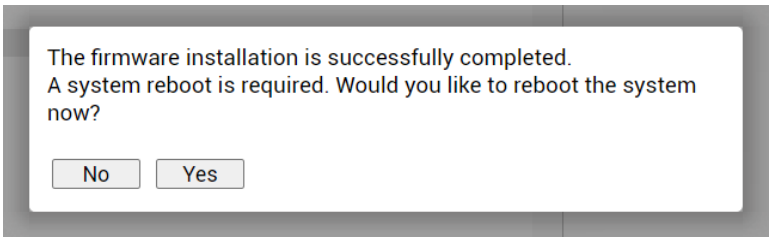


Figure 3-179 FW upgrade prompt (2)

Please do not unplug the power until the firmware upgrade procedure is finished - Web GUI will automatically reconnect, and a login page will appear.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

firmware info [<version>]	Use to show detailed information on current or specific Integra-X/-X2/-FIDU/-FIDU+ firmware.
firmware install <version>	Use to install firmware version uploaded. Note that the exact version name needs to be entered. Check available firmware versions using the command “firmware list”.
firmware list	Use to list uploaded firmware versions.
firmware remove <version>	Use to remove firmware version uploaded. Note that the exact version name needs to be entered. Check available firmware versions using the command “firmware list”.
firmware remove.list	Use to remove all uploaded firmware versions.
firmware switch	Use to check running firmware bank and bank that will be used at the next boot.
firmware upload <file>	Use to upload firmware file from the FTP directory.
firmware switch {fs|fw1|fw2|toggle}	Use to define the bank that will be used at the next boot. “fw1” and “fw2” subcommands set appropriate bank, “toggle” forces to set another bank than the running one, “fs” is factory defined emergency bank, which is used if both “fw1” and “fw2” fail.
system reboot	Use to reboot the radio unit.

System -> Configuration -> IP configuration

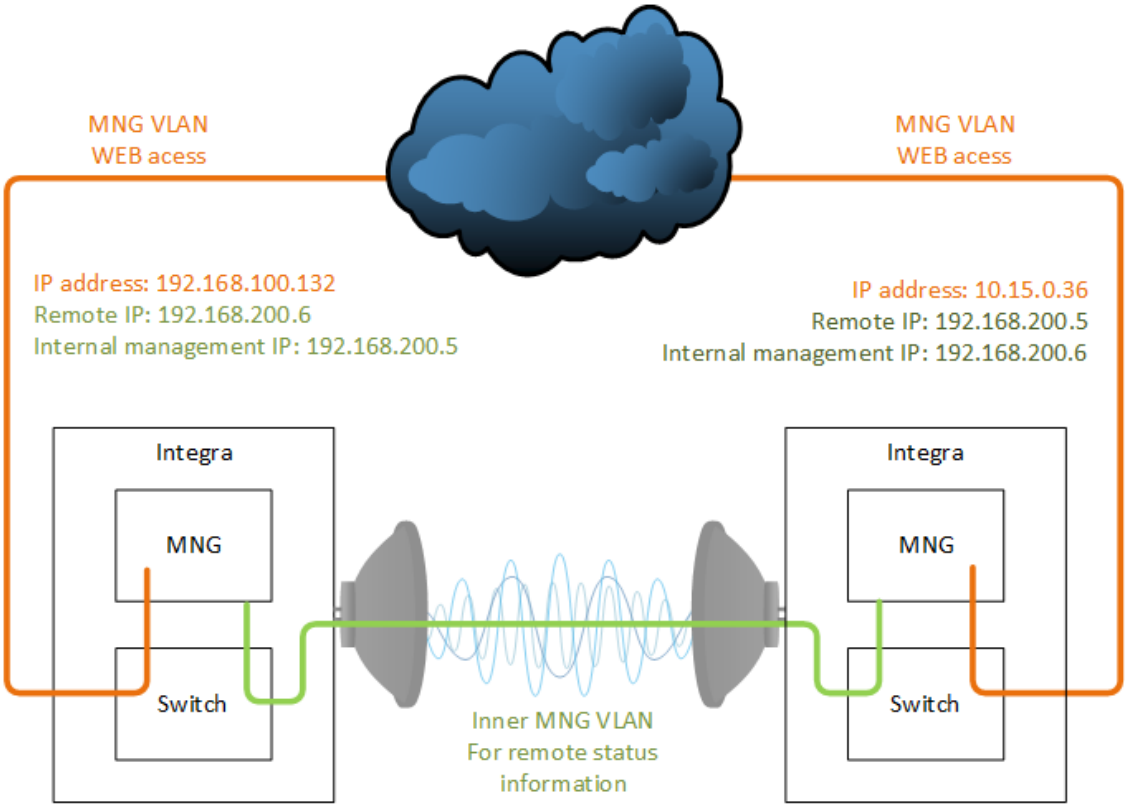


Figure 3-180 Integra internal addressing

If the IP addresses of the radios are in the same subnet, the radios can be accessed from any host within that subnet, and telemetry data can be exchanged with the remote side through the WAN link.

If the IP addresses of the radios are in different subnets, the remote side data must be routed externally. Alternatively, an **Internal Management IP** can be configured exclusively for remote data exchange, eliminating the need for external routing.

When VLANs are enabled, internal management traffic should operate within a dedicated VLAN, separate from the MNG VLAN configured on the *Networking→VLAN* page. The internal management VLAN must be restricted on all ports except the WAN, while the MNG VLAN should be blocked from passing through the WAN. Internal addresses could be used for GUI access.

The IP configuration page provides configuration of the management IP address, mask, and gateway, as well as allows specifying the remote IP address.

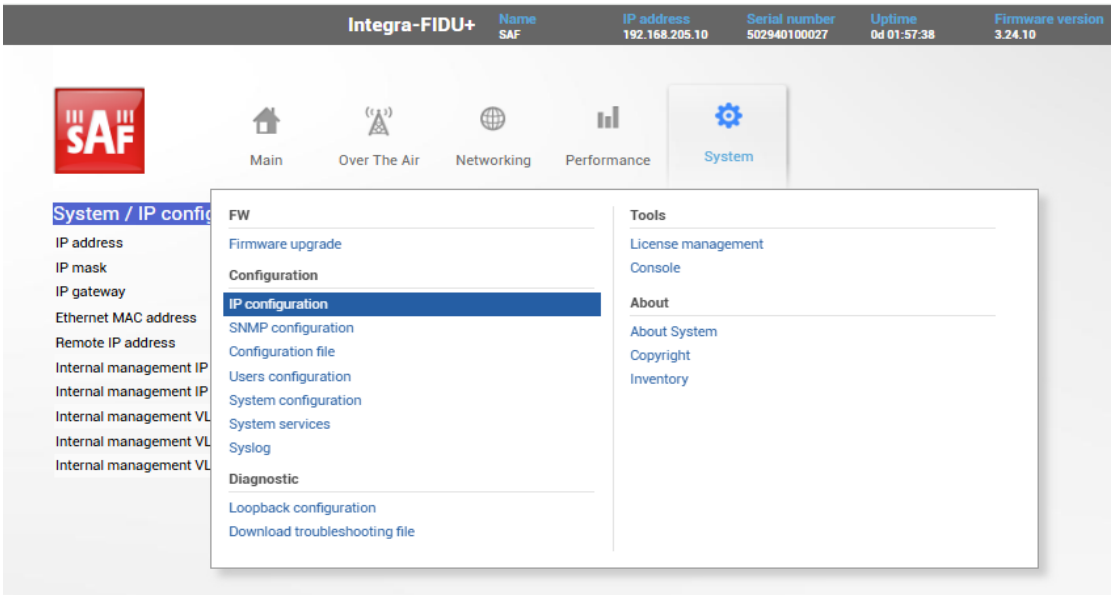


Figure 3-181 Accessing IP configuration page

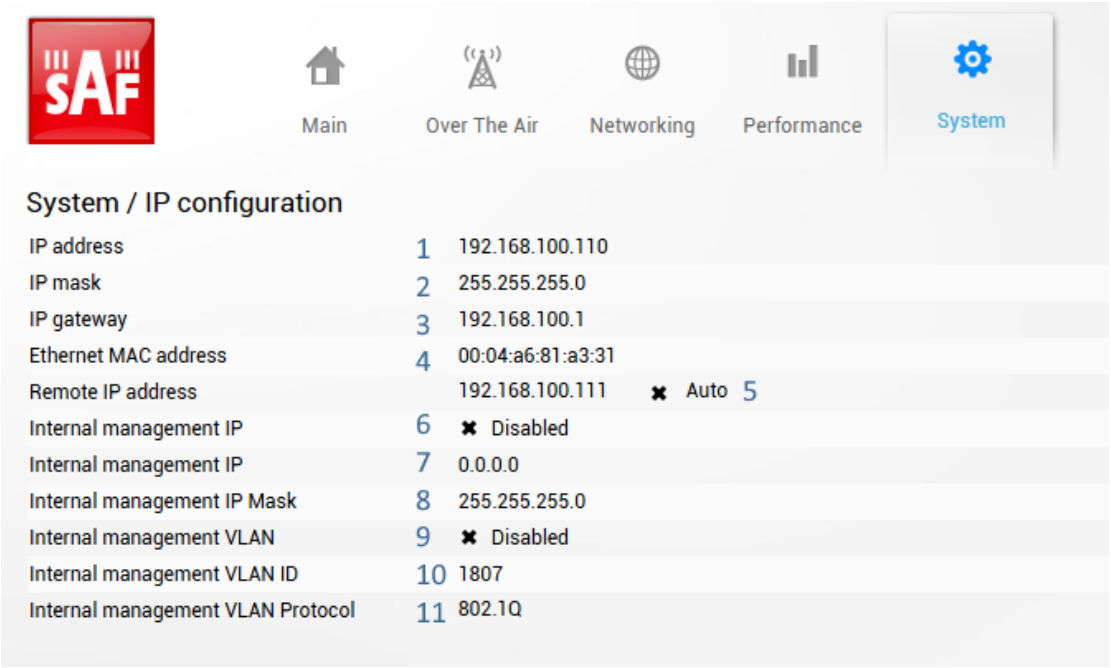


Figure 3-182 IP configuration page – status mode

Press MODIFY button.

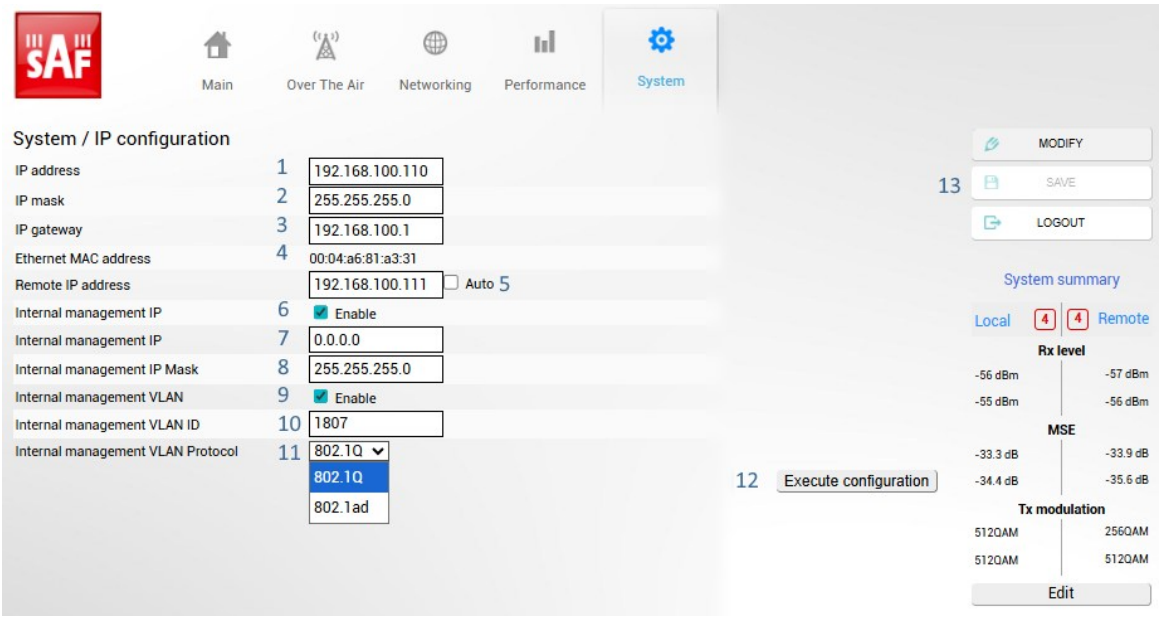


Figure 3-183 IP configuration page – modify mode

1) ***IP address*** – Indicates the IP address of the Integra series radio you are currently logged in to (status mode); allows specifying the IP address of the Integra series radio you are currently logged in to (modify mode). The default IP address is 192.168.205.10 (low side) or 192.168.205.11 (high side).
2) ***IP Mask*** – Indicates the IP mask of the Integra series radio you are currently logged in to (status mode); allows specifying the IP mask of the Integra series radio you are currently logged in to (modify mode). The default IP mask is 255.255.255.0.
3) ***IP gateway*** – Indicates the gateway address of the Integra series radio you are currently logged in to (status mode); allows specifying the gateway address of the Integra series radio you are currently logged in to (modify mode). By default, the gateway is not specified (blank).
4) ***Ethernet MAC address*** – shows the MAC address of the Integra series radio you are currently connected to.
5) ***Remote IP address*** – shows the IP address of the remote (far-end) Integra series radio. By default, the remote IP address is retrieved automatically, and therefore, the "Auto" checkbox is selected. In modify mode, you can unselect the "Auto" option and enter the remote IP address manually. The remote IP address manual setting is used only to establish an IP connection from the Local device to the Remote device, but will not modify the real IP address on the Remote device.
   In case when internal IP addresses are used, the remote side Internal management IP should be entered here (please see *Figure 3-180 Integra* internal *address*).
6) ***Internal management IP checkbox*** – check if internal management IP is necessary.
7) ***Internal management IP*** – configure internal management IP.
8) ***Internal management IP Mask*** - Indicates the internal address IP mask of the Integra series radio you are currently logged in to (status mode); allows specifying the internal address IP mask of the Integra series radio you are currently logged in to (modify mode). The default internal address IP mask is 255.255.255.0.
9) ***Internal management VLAN checkbox*** – check if a VLAN for internal management is necessary.
10) ***Internal management VLAN ID*** – set internal management VLAN ID. If VLANs are enabled in the network configuration, the internal management should run in its own VLAN.

Internal management VLAN ID **must differ** from the management access VLAN ID configured in "Configuration→VLAN configuration".

11) ***Internal management VLAN Protocol*** - if VLAN mode is "Enable" in "Networking→VLAN", choose "802.1Q". If VLAN mode is "QinQ" in "Networking→VLAN", choose "802.1ad"
12) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra series radio.
13) Please always remember to ***Save*** the configuration.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

system ip addr [<IP>]	Use to show/set the IP address of the management CPU.
system ip gw [{<IP>|clear}]	Use to show/manage the IP address of the gateway.
system ip mask [<mask>]	Use to show/set the subnet mask.
system ip mac	Use to show the MAC address of the management CPU.
system ip cfg {<ip address> <mask> | <ip address> <mask> <gateway> | <ip address/CIDR> | <ip address/CIDR> <gateway>}	Use to set the IP address and subnet, or optionally IP address, subnet mask, and gateway simultaneously.
system remoteip show	Use to show the remote IP address.
system remoteip auto	Use to set the automatic retrieval of the remote IP address.
system remoteip set <IP>	Use to define a remote IP address (deactivates automatic retrieval of a remote IP address).
system diag ping <IP_address>	Use to ping an IP address.

Please check if all radio configurations are saved.

configuration store	Save the configuration

Configuration example

1) Internal and external VLAN IDs must be added to the *VLAN configuration* table in "Networking→VLAN" page in Web GUI:

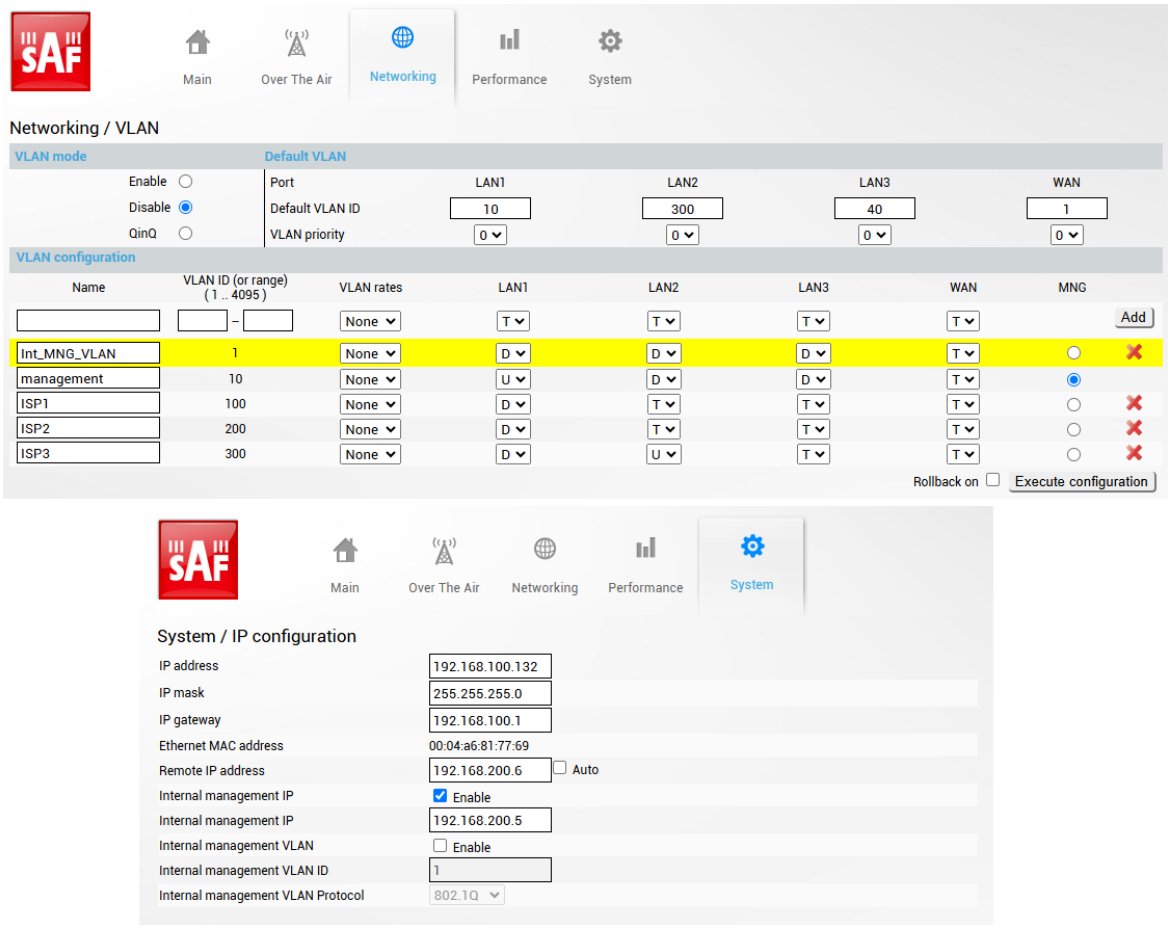


Figure 3-184 VLAN disabled

Internal management VLAN is added as "Int_MNG_VLAN" with VLAN ID 1, while external management VLAN is added as "management" with VLAN ID 10.

Enable 801.Q VLAN or 802.1ad QinQ in "Networking→VLAN ID" page, set accordingly "Internal management VLAN Protocol" and set internal management VLAN ID as per ID set in step #1 in "System→IP configuration" page in Web GUI.

2a) 802.1Q VLAN enabled

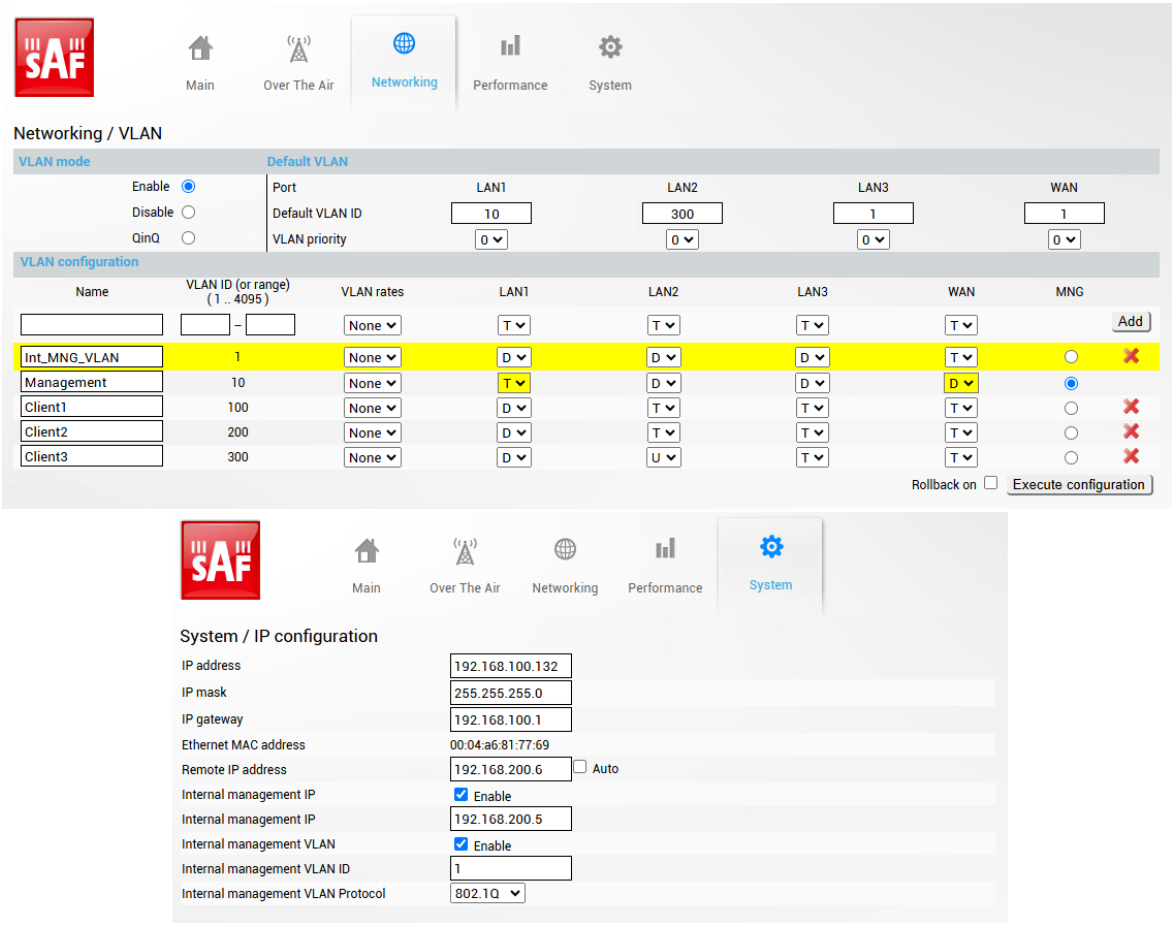


Figure 3-185 VLAN enabled

2b) 802.1ad QinQ enabled

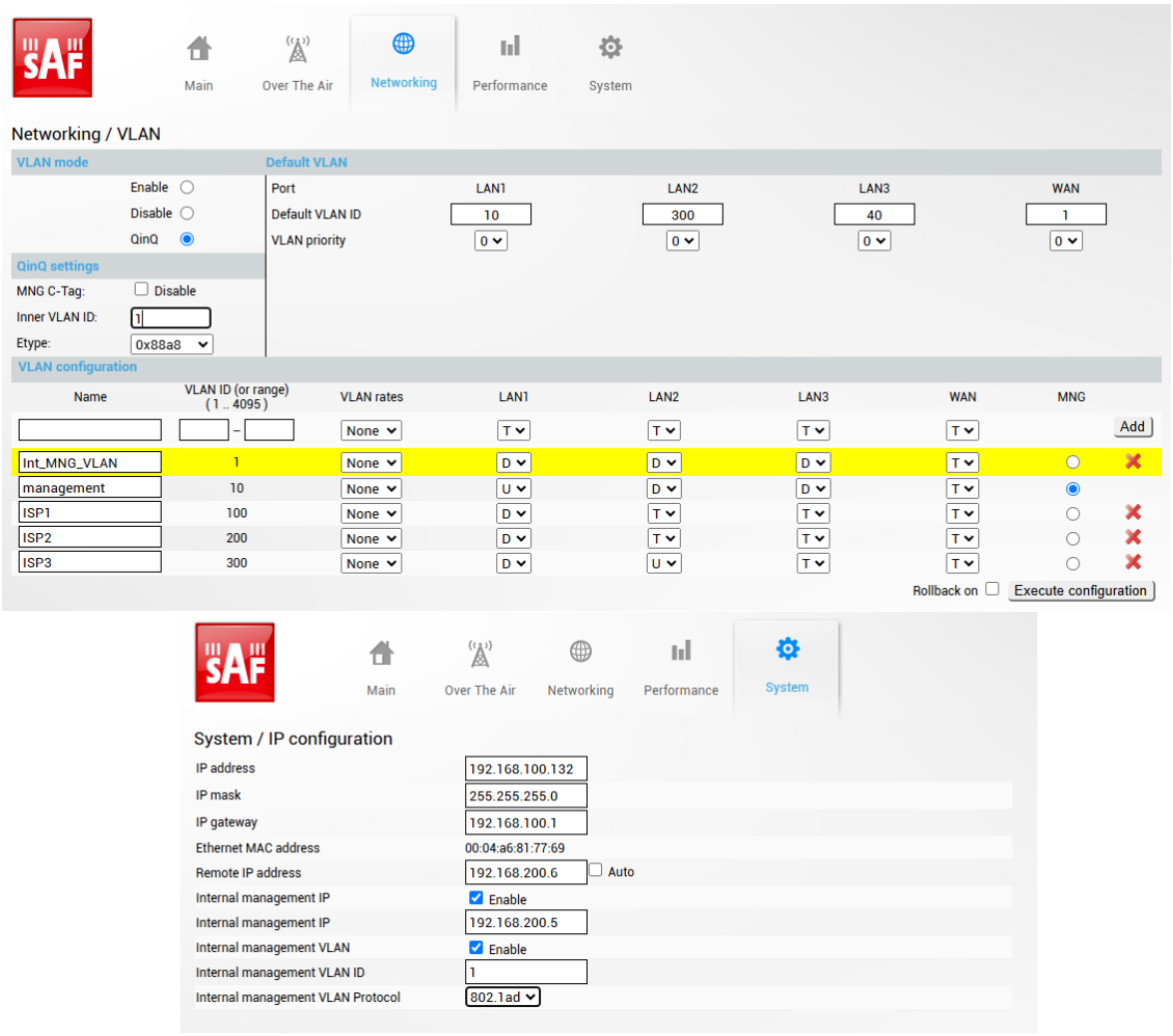


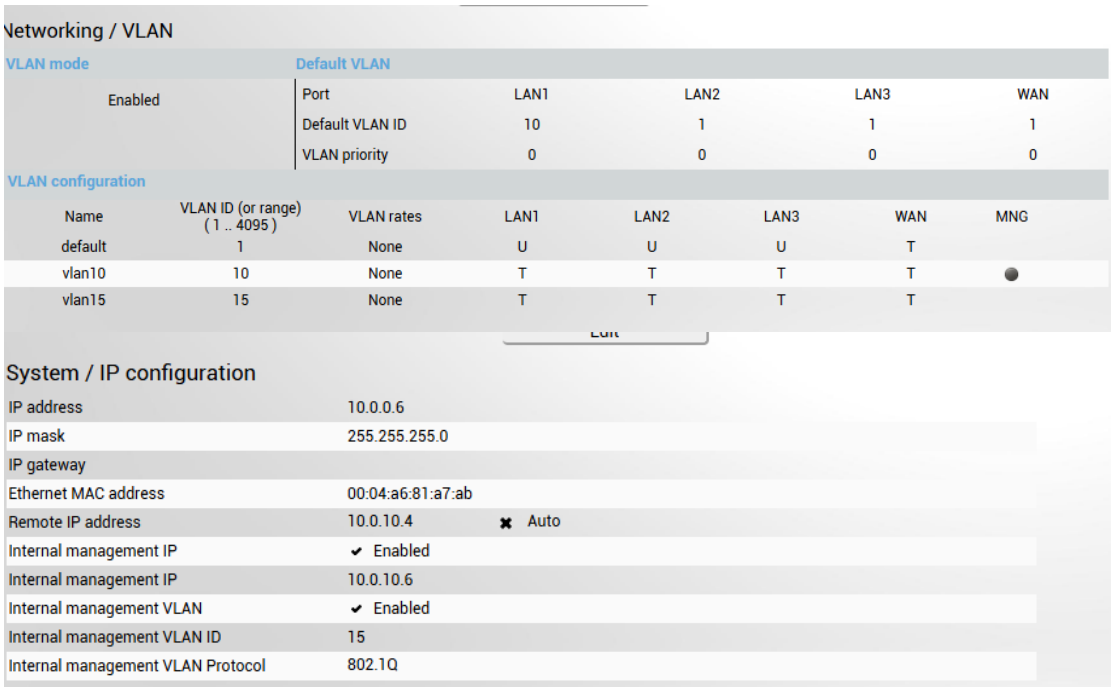
Figure 3-186 QinQ enabled

Internal IP configuration for aggregation / full redundancy protection configurations

When configuring internal IP addresses for aggregation or full redundancy (FD) protection (1+1 HSB FD) configurations, the internal management VLAN ID should be added to WAN, LAN2, and the configured traffic port (LAN1 or LAN3).

The internal management VLAN ID must also be configured on the external switches.

Configuration example on the local side unit:



Networking / VLAN

VLAN mode	Default VLAN				
Enabled	Port	LAN1	LAN2	LAN3	WAN
	Default VLAN ID	10	1	1	1
	VLAN priority	0	0	0	0

VLAN configuration

Name	VLAN ID (or range) (1 .. 4095)	VLAN rates	LAN1	LAN2	LAN3	WAN	MNG
default	1	None	U	U	U	T	
vlan10	10	None	T	T	T	T	●
vlan15	15	None	T	T	T	T	

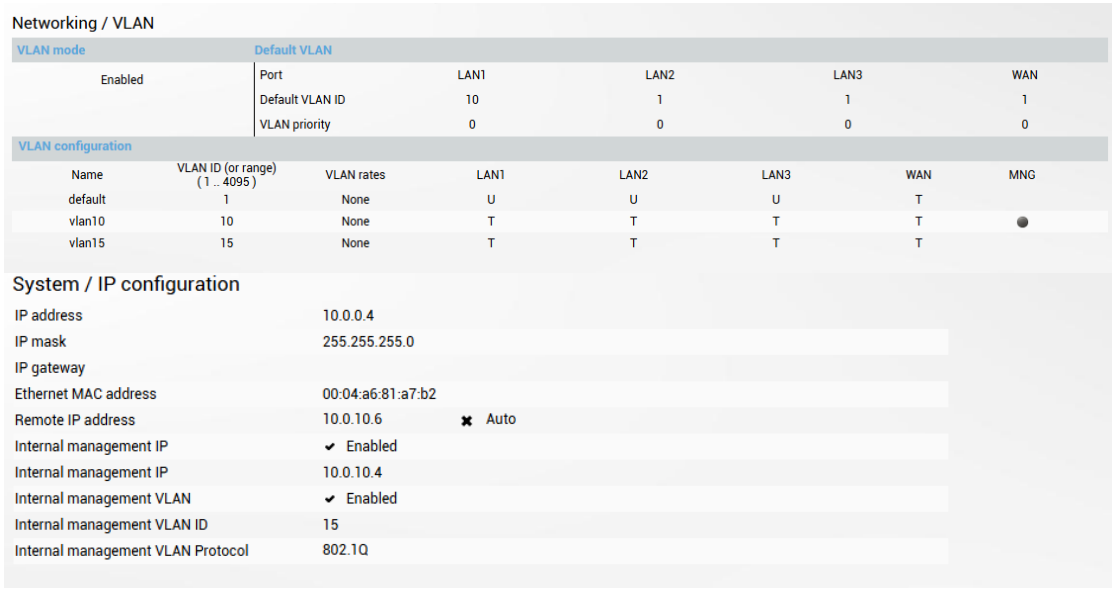
Edit

System / IP configuration

IP address	10.0.0.6	
IP mask	255.255.255.0	
IP gateway		
Ethernet MAC address	00:04:a6:81:a7:ab	
Remote IP address	10.0.10.4	✖ Auto
Internal management IP	✔ Enabled	
Internal management IP	10.0.10.6	
Internal management VLAN	✔ Enabled	
Internal management VLAN ID	15	
Internal management VLAN Protocol	802.1Q	

Figure 3-187 Local side iP configuration for 2+0 / 1+1 HSB

Configuration example on the remote side unit:



Networking / VLAN

VLAN mode	Default VLAN				
Enabled	Port	LAN1	LAN2	LAN3	WAN
	Default VLAN ID	10	1	1	1
	VLAN priority	0	0	0	0

VLAN configuration

Name	VLAN ID (or range) (1 .. 4095)	VLAN rates	LAN1	LAN2	LAN3	WAN	MNG
default	1	None	U	U	U	T	
vlan10	10	None	T	T	T	T	●
vlan15	15	None	T	T	T	T	

System / IP configuration

IP address	10.0.0.4	
IP mask	255.255.255.0	
IP gateway		
Ethernet MAC address	00:04:a6:81:a7:b2	
Remote IP address	10.0.10.6	✖ Auto
Internal management IP	✔ Enabled	
Internal management IP	10.0.10.4	
Internal management VLAN	✔ Enabled	
Internal management VLAN ID	15	
Internal management VLAN Protocol	802.1Q	

Figure 3-188 Remote side iP configuration for 2+0 / 1+1 HSB

System → Configuration → SNMP configuration

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

Relevant MIB files can be downloaded directly from Integra-X/-X2/-FIDU/-FIDU+ Web GUI. See (7) in *Figure 3-190* below.

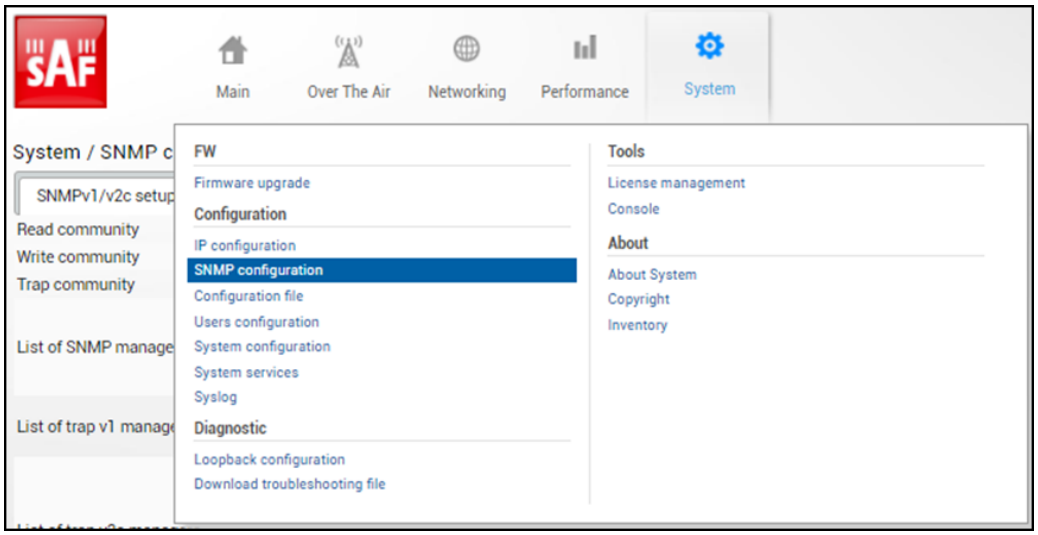


Figure 3-189 Accessing SNMP page

SNMPv1/v2c setup

Status mode

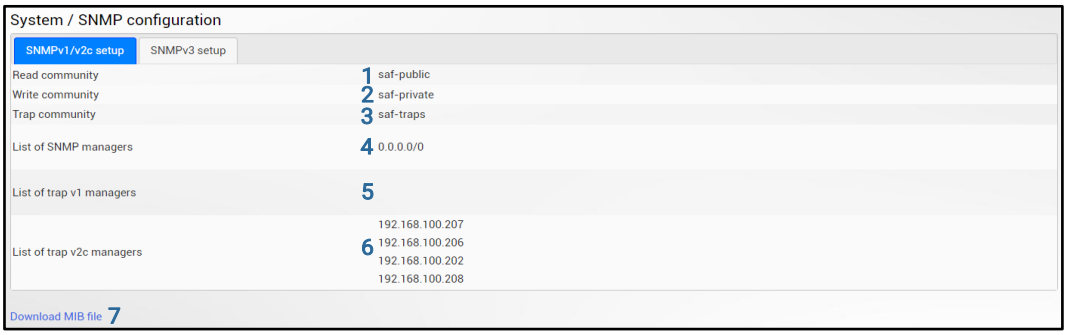


Figure 3-190 SNMP status page, SNMPv1/v2c shown

Press MODIFY button.

Modify mode

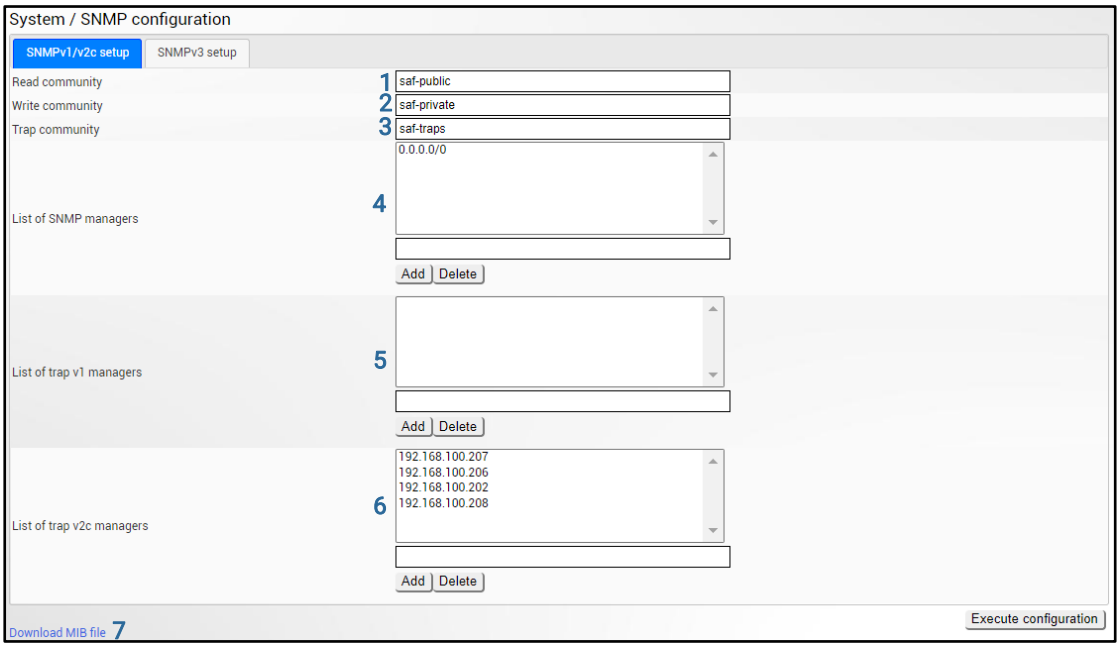


Figure 3-191 SNMPv1/v2c page modification page

1) ***Read community*** – Indicates currently specified read community for SNMPv1/v2c (status mode); allows specifying read community for SNMPv1/v2c of the agent to enable parameters to be read (modify mode). The default "read" community name is "saf-public".
2) ***Write community*** – Indicates currently specified write community for SNMPv1/v2c (status mode); allows specifying write community for SNMPv1/v2c of the agent to enable parameters to be written (modify mode). The default "write" community name is "saf-private".
3) ***Trap community*** – Indicates currently specified trap community for SNMPv1/v2c (status mode); allows specifying trap community for SNMPv1/v2c for trap authentication in monitoring applications (modify mode). The default trap community name is "saf-traps".
4) ***List of SNMP managers*** – Shows a list of configured SNMPv1/v2c host IP addresses (status mode); allows adding/deleting SNMPv1/v2c host IP addresses (modify mode). Specified IP addresses have access to read and modify configuration parameters using the appropriate read and write community names.
5) ***List of trap v1 managers*** – Shows a list of configured SNMPv1 trap IP addresses (status mode); allows adding/deleting SNMPv1 trap IP addresses (modify mode). Integra-X/-X2/-FIDU/-FIDU+ management controller sends SNMPv1 traps to the Trap Manager with the IP address specified here.
6) ***List of trap v2c managers*** – Shows a list of configured SNMPv2c trap IP addresses (status mode); allows adding/deleting SNMPv2c trap IP addresses (modify mode). Integra-X/-X2/-FIDU/-FIDU+ management controller sends SNMPv2c traps to the Trap Manager with the IP address specified here.
7) ***Download MIB file*** – Click to download Integra-X/-X2/-FIDU/-FIDU+ MIB files.
8) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+.

SNMPv3 setup

SNMPv3 is primarily improved with security settings. It does not rely on SNMP community names as it is in versions 1 and v2c.

Status mode

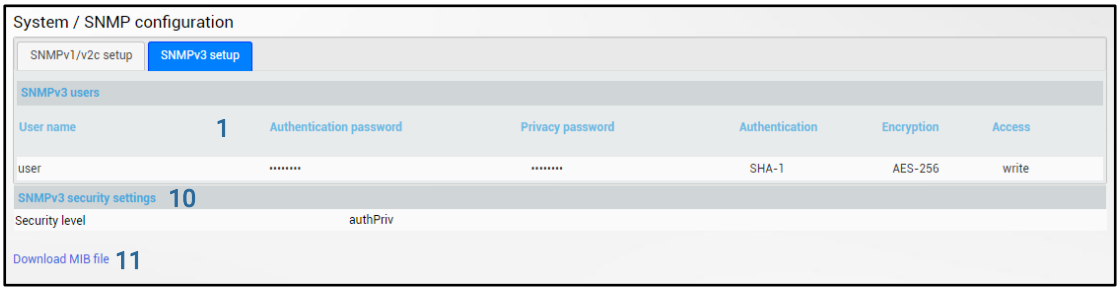


Figure 3-192 SNMPv3 status page

Press MODIFY button.

Modify mode

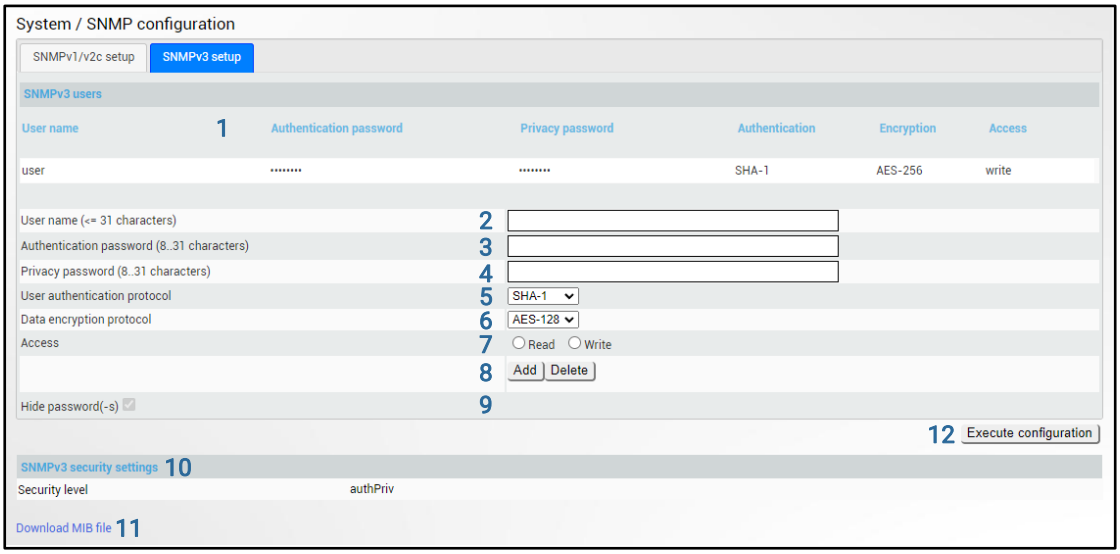


Figure 3-193 SNMPv3 setup page

1) ***SNMP users*** – Shows the list of configured SNMPv3 users.
2) ***User name (<=31 characters)*** – Enter SNMPv3 authentication user name. Length can be up to 31 symbols.
3) ***Authentication password (8..31 characters)*** – Enter the SNMPv3 authentication password. Length can be between 8 and 31 symbols.
4) ***Privacy password (8..31 characters)*** – Enter SNMPv3 data encryption password. Length can be between 8 and 31 symbols.
5) ***User authentication protocol*** – Use to specify user authentication protocol for selected user: *SHA-1, SHA-224, SHA-256, SHA-384,* or *SHA-512*.
6) ***Data encryption protocol*** – Use to specify data encryption protocol for selected user: *DES, AES-128, AES-192,* or *AES-256*.
7) ***Access*** – Select “Read” for read-only access or “Write” for read-write access.
8) ***Add/Delete*** – Use to add or delete the selected user name. To delete user names from the list, click on the required user name in the list above.
9) **Hide passwords(-s)** – Uncheck to display passwords for the selected SNMPv3 user.
10) ***SNMPv3 security settings*** – Shows SNMPv3 security settings used.
11) ***Download MIB file*** – Click to download Integra-X/-X2/-FIDU/-FIDU+ MIB files.

12) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

snmp manager {add | del} <manager>	Use to show/add/delete the manager IP address.
snmp manager read-community {set | del} <read-community>	Use to show/set/delete the read community name.
snmp manager write-community {set | del} <write-community>	Use to show/set/delete the write community name.
snmp showconfig {active | stored}	Use to show running or saved configuration.
snmp syscontact <syscontact>	Use to show/set system contact.
snmp traps trap-community {set | del} <trap-community>	Use to show/set/delete the trap community name.
snmp traps trapv1manager {add | del} <trapv1manager>	Use to show/add/delete v1 trap manager IP address.
snmp traps trapv2manager {add | del} <trapv2manager>	Use to show/add/delete v2c trap manager IP address.
snmp v3 user {add | del} <v3user> <authpass> <privpass> {r | w} {SHA-1 | SHA-224 | SHA-256 | SHA-384 | SHA-512} {DES | AES-128 | AES-192 | AES-256}	Use to show/add/delete v3 username with the corresponding authentication password, encryption password, read or write access level, authentication protocol, and data encryption protocol.

System → Configuration → Configuration file

Shows saved and running configurations, highlighting differences between both (unsaved changes).

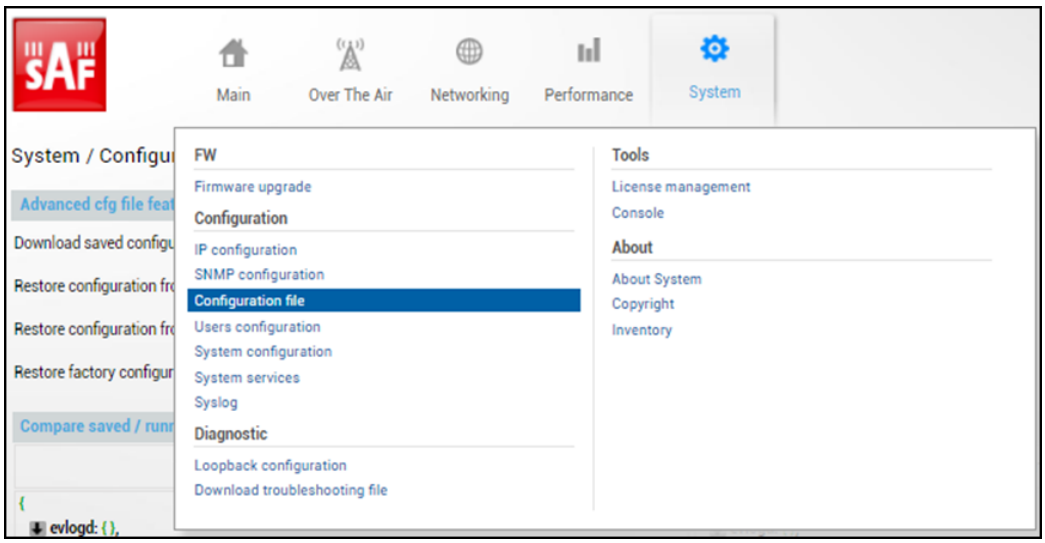


Figure 3-194 Accessing the configuration file page

Status mode

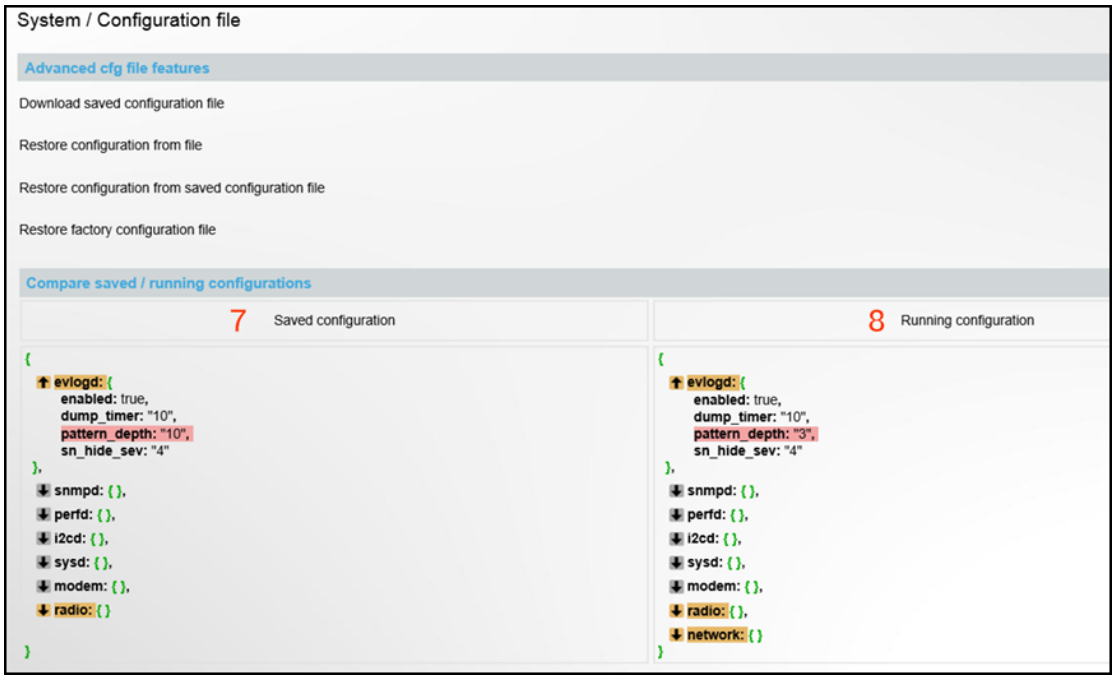


Figure 3-195 Configuration status page

Press MODIFY button.

Modify mode

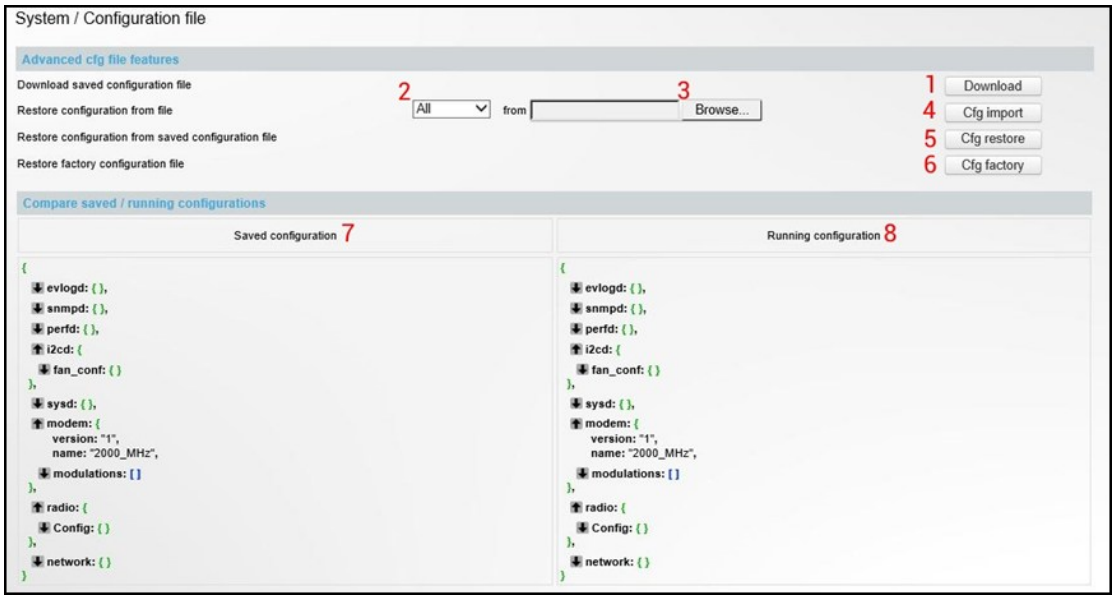


Figure 3-196 Configuration modify page

1) ***Download*** – Press to download the system configuration .txt file and save it on your hard drive.
2) ***All*** – Select *All* to restore the complete configuration.
3) ***Browse*** or ***Choose File*** (depending on the used web browser) – Press to browse for a saved configuration file on your hard disk drive.
4) ***Cfg import*** – Press to upload a configuration file to Integra-X/-X2/-FIDU/-FIDU+.

The uploaded configuration overwrites the saved configuration.

5) *Cfg restore* – Press to restore saved system configuration, i.e., unsaved changes will be discarded!

Restoring configuration overwrites the running configuration with the saved configuration.

6) *Cfg factory* – Resets system configuration to factory defaults.
7) *Saved configuration* – Shows saved system configuration.
8) *Running configuration* – Shows the currently running system configuration.

Distinct sections in saved and running configurations are highlighted in color. To examine particular differences, expand highlighted sections of the configuration by clicking on the down arrow of the appropriate configuration section.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

It is highly recommended to use the CLI command 'configuration browse' only after the SSH connection is established.

configuration browse {<name> | running | saved}	Use to show one of the last 10 configurations, running or saved configuration.
configuration download	Use to create a copy of the saved configuration file as a .txt file in the SFTP directory.
configuration factory	Use to reset the system configuration to factory defaults.
configuration factory i2cd	Use to reset the configuration of i2cd settings to factory defaults.
configuration factory modem	Use to reset modem configuration to factory defaults.
configuration factory netsys {mac-table | port-state}	Use to reset whole Ethernet configuration to factory defaults or particular sections using subcommands – "mac-table" for MAC table; "port-state" for port state configuration; "qos" for QoS configuration; "rate" for rate limit configuration; "vlan" for VLAN configuration.
configuration factory sysd	Use to reset the whole system configuration to factory defaults.
configuration import {All} <preset name>	Use to restore the configuration from a .txt file stored in the SFTP directory.
configuration load	Use to restore saved system configuration, i.e., unsaved changes will be discarded!
configuration status	Use it to check whether the running configuration is saved.
configuration store	Use it to save the running configuration.
configuration watch	Use to show the entities' watch status.

System → Configuration → Users configuration

Integra-X/-X2/-FIDU/-FIDU+ features 2 default user accounts – *admin* (full control) and *guest* (read-only).

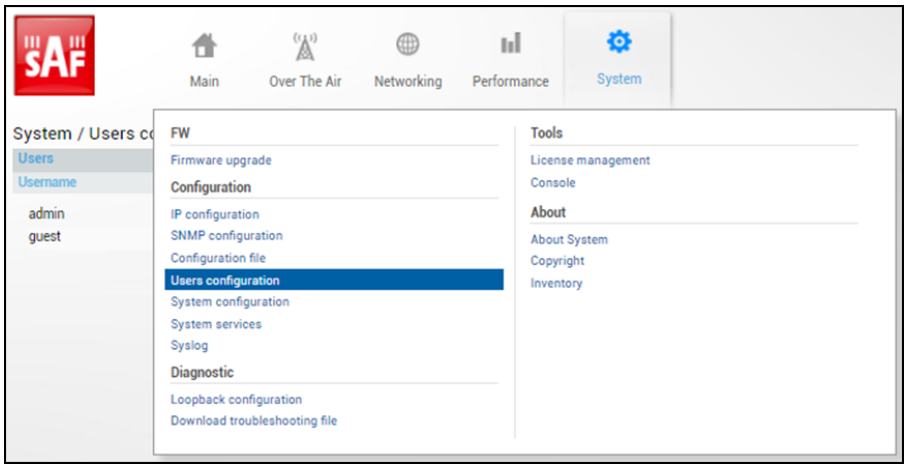


Figure 3-197 Accessing Users configuration page

Status mode

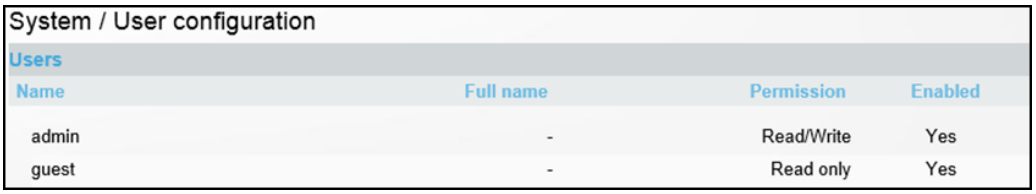


Figure 3-198 User configuration page

Press MODIFY button.

Modify mode

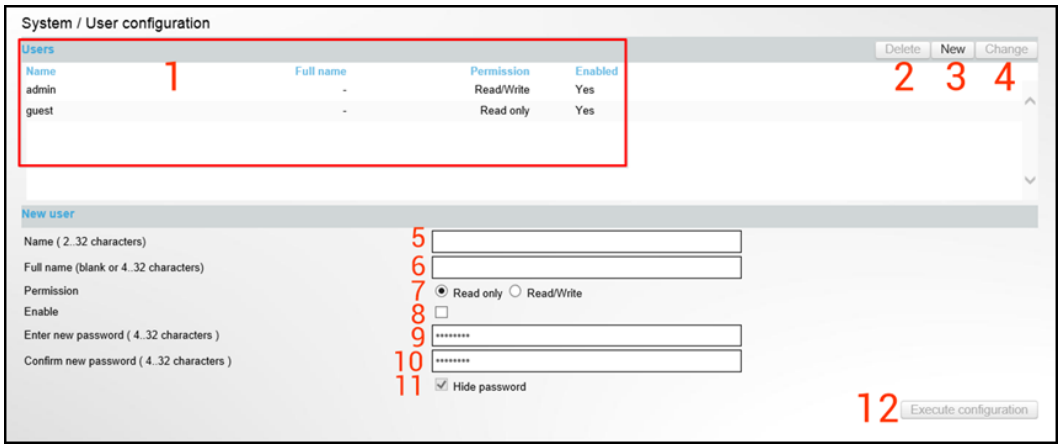


Figure 3-199 User management page

1) ***Users*** – By default, "admin" and "guest" users are created and listed. You can choose between these user accounts. "guest" user has monitoring privileges and cannot apply configuration changes.

> By default, the password for the "admin" account is '*changeme*', while no password is defined for the "guest" account.

2) ***Delete*** – delete the selected user. For "admin" this button is disabled.

3) ***New*** – by pressing the button dialog for new user creation opens.
4) ***Change*** – you can change the password and enable/disable a selected existing user, the structure of the "change" menu is the same as for new user creation.
5) ***Name*** – Enter a short name for the new user.
6) ***Full name*** – Enter a full name for the user.
7) ***Permission*** – choose permissions for the user. "Read only" or "Read/Write" available.
8) ***Enable*** – Check/uncheck to enable/disable a user account. "admin" account cannot be disabled.
9) ***Enter new password (4..32 characters)*** – Enter a new password. The length is between 4 and 32 characters.
10) ***Confirm new password (4..32 characters)*** – Confirm new password. The length is between 4 and 32 characters.
11) ***Hide password*** – Uncheck to display the entered password in plaintext.
12) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

system user info	Use to show information on the current user.
system user mgmt <username> **access** {r|w}	Use to set read ("r") or write ("w") access right for a particular <username>. The "admin" user cannot be modified.
system user mgmt <username> **delete**	Use to delete a particular <username>. The "admin" user cannot be deleted.
system user mgmt <username> {enable|disable}	Use to enable or disable a particular <username>. The "admin" user cannot be disabled.
system user mgmt <username> **info**	Use to show information on a particular <username>.
system user mgmt <username> **password** <password>	Use to set a password for a particular <username>.
system user new <username> <password> {r|w} <fullname>	Use to create a new user with specified <username>, <password>, <fullname>, and read ("r") or write ("w") permissions.
system user factory	Use to reset all users to factory defaults.
system password change <password>	Use to change the password for the current user.
system password reset	Use to reset all passwords to the default.

System → Configuration → System configuration

Specify time settings and system/location names.

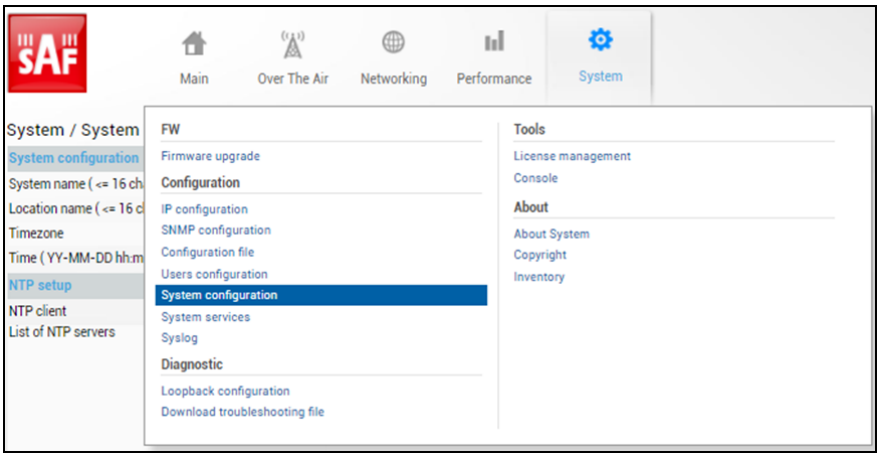


Figure 3-200 Accessing System configuration page

Status mode

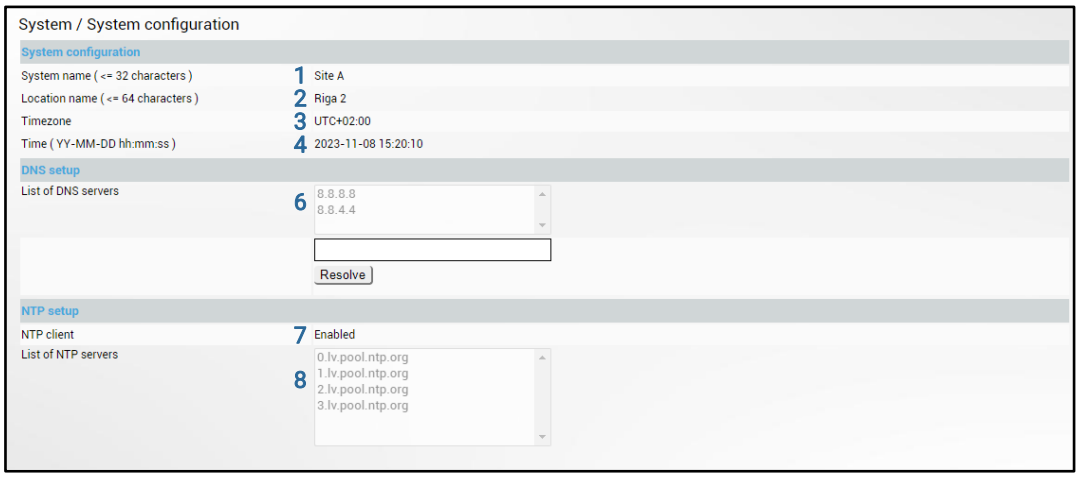


Figure 3-201 System configuration – status mode

Press MODIFY button.

Modify mode

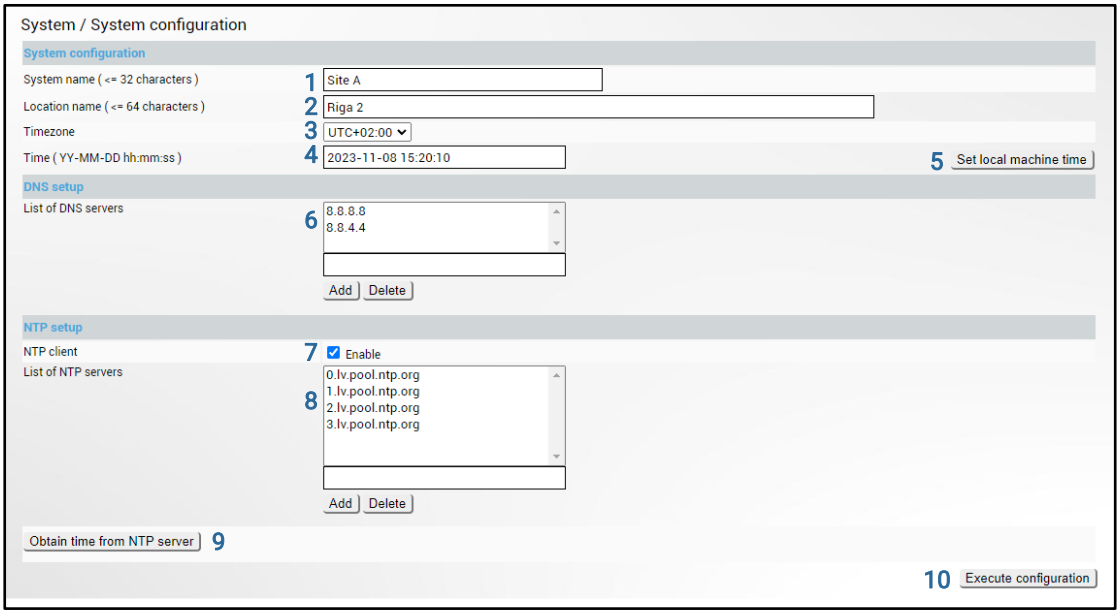


Figure 3-202 System configuration – modify mode

1) ***System name*** – Allows entering a preferred system name. The maximum length of the system name cannot exceed 32 symbols. The default name is 'SAF'.
2) ***Location name*** – Allows entering a preferred system location name. The maximum length of the location name cannot exceed 64 symbols. By default, the system location is not specified.
3) ***Timezone*** – Allows specifying the time zone.
4) ***Time (YY-MM-DD hh:mm:ss)*** – Allows changing the system date and time manually by entering the date and time in a specific syntax.
5) ***Set local machine time*** – Press to force the system to use the time set on your PC, from which you are connected to the Web GUI.
6) ***List of DNS servers*** – Allows defining a DNS server for translating domain names (e.g., for an NTP server).
7) ***NTP client*** – Allows enabling or disabling the NTP (Network Time Protocol) client.
8) ***List of NTP servers*** – Allows adding or deleting IP addresses or DNS addresses of NTP servers.
9) ***Obtain time from NTP server*** – Press to force the system to obtain the time from an NTP server.
10) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+.

The default system language selection is only available per the license. Please send a request for translation and obtaining a license to *info@saftehnika.com.*

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

system datetime <datetime>	Use to show/set the system time and date. Use "YYYY-MM-DD/hh:mm:ss" syntax for date/time.
system discovery clear	Use it to clear the device's surroundings.

system discovery list	Use to show the list of found devices using the discovery protocol.
system discovery refresh	Use to refresh the device's surroundings.
system discovery remote <dst> <bcast>	Use to perform remote discovery using the specified IP address and the broadcast IP address.
system dns dig <domain name>	Use to resolve a domain using the configured DNS servers.
system dns server {add <DNSip> | clear | remove <DNSip>}	Use to add/remove a DNS server with a specified IP address or to remove all DNS servers from a list.
system dns status	Use to show the configured DNS servers` list.
system location <location>	Use to show/define system location.
system name <sysname>	Use to show/define the system name.
system ntp {enable | disable}	Use to enable or disable the NTP client.
system ntp server {add <NTPip> | clear | remove <NTPip>}	Use to add/remove an NTP server with a specified IP address/hostname or to remove all NTP servers from a list.
system ntp status	Use to show the NTP status and the configured NTP servers` list.
system ntp sync	Use to force the system to obtain the time from an NTP server.
system ntp timezone <-12:00 ... 14:00>	Use to show/define UTC zone (for example '2' for UTC+2 and '-3:30' for UTC-3:30).
system uptime	Use to show system uptime since the last system start.

System → Configuration → System services

Define Web GUI connection parameters and centralized user management (RADIUS).
Refer to chapter *RADIUS authentication* for an example of RADIUS configuration.

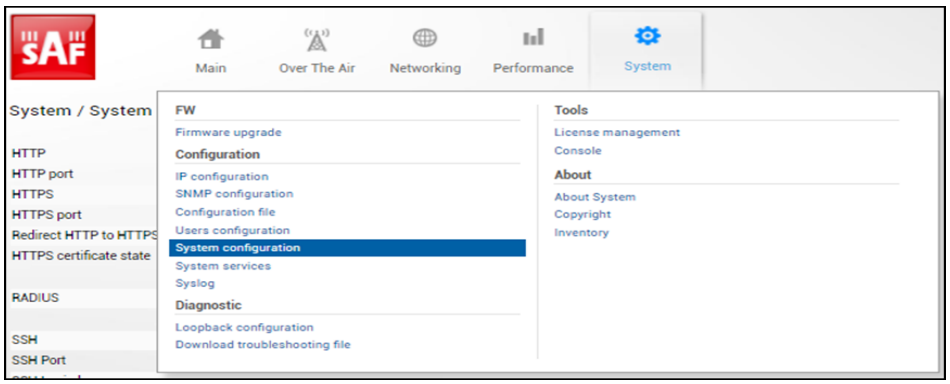


Figure 3-203 Accessing System services page.

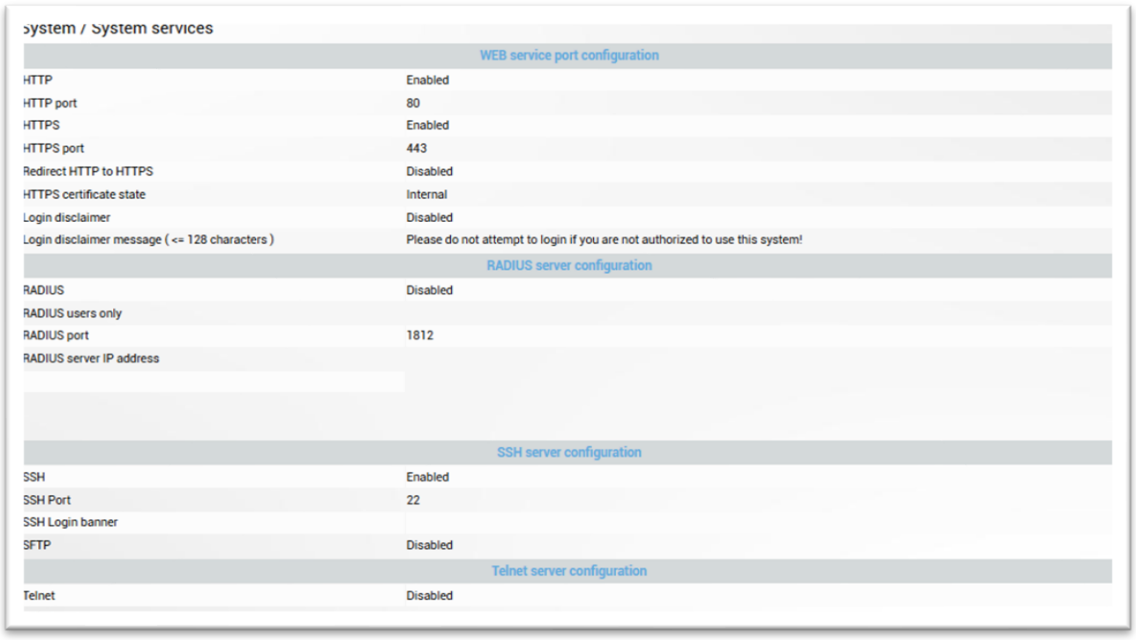


Figure 3-204 System services – Status mode

Press MODIFY button

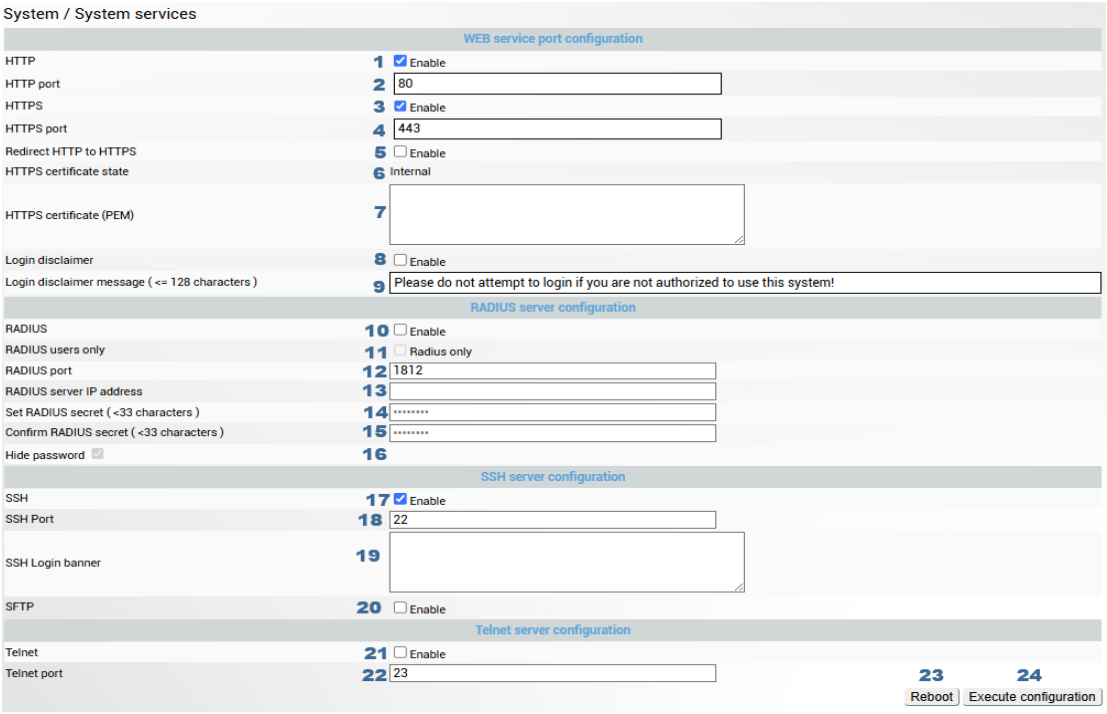


Figure 3-205 System services page – modify mode

1) *HTTP* – allows disabling or enabling HTTP access to the Web GUI. By default, HTTP access is enabled.
2) *HTTP port* – allows specifying TCP port for Web GUI access via HTTP. By default, TCP port 80 is defined.
3) *HTTPS* – allows disabling or enabling HTTPS access to the Web GUI. By default, HTTPS access is enabled.

By disabling both HTTP and HTTPS, you will lose the possibility to connect to the Web GUI.

4) ***HTTPS port*** – allows specifying TCP port for Web GUI access via HTTPS. By default, TCP port 443 is defined.
5) ***Redirect HTTP to HTTPS*** – allows enabling automatic redirecting from HTTP to HTTPS.
6) ***HTTPS certificate state*** – shows what type of SSL certificate is used on the device for HTTPS connections. There are 2 types of SSL certificates:
   a. *User* – user's own uploaded and configured SSL certificate for HTTPS connections.
   b. *Internal* – factory default firmware compiled SSL certificate for HTTPS connections. If a user's SSL certificate is uploaded and configured for HTTPS connections, then the device will first try to use this certificate. In case Integra-X/-X2/-FIDU/-FIDU+, for some reason, can't use the User certificate, and there are any errors in the User certificate usage process, then Integra-X/-X2/-FIDU/-FIDU+ will use the Internal certificate for HTTPS connections.
7) ***HTTPS certificate (PEM)*** – the user can paste the PEM format textual encoding of the SSL certificate in this field, and then the device will use this SSL certificate for HTTPS connections.
8) ***Login disclaimer*** – enables login disclaimer.
9) ***Login disclaimer message*** – allows the user to customize the login disclaimer message.
10) ***RADIUS*** - allows enabling or disabling RADIUS (Remote Authentication Dial-In User Service) server authentication for device access. By default, RADIUS server usage is disabled.
11) RADIUS users only – if enabled, only users whose authentication is successfully verified by the configured RADIUS server will be able to log in and manage the device (only RADIUS users can enable this function)
12) ***RADIUS port*** – allows specifying a port for RADIUS server access. By default, port 1812 is defined.
13) ***RADIUS server IP address*** – allows specifying the RADIUS server IP address.
14) ***Set RADIUS secret*** – allows specifying RADIUS server password.
15) ***Confirm RADIUS secret*** – used for confirmation of RADIUS server password.
16) ***Hide password*** - uncheck to see the entered RADIUS server password in plain text.
17) ***SSH*** - allows enabling or disabling the SSH service on the device.
18) ***SSH Port –*** allows selecting a port number for the SSH service.
19) ***SSH Login banner –*** allows specification of a textual banner message that will be shown when a user tries to log in to the device via SSH connection.
20) ***SFTP*** – Enables SFTP.

Use WinSCP utility to access SFTP on Windows OS.

21) ***Telnet –*** allows enabling or disabling the Telnet service on the device.
22) ***Telnet port -*** allows selecting a port number for the Telnet service.
23) ***Reboot*** – allows rebooting of the Integra-X/-X2/-FIDU/-FIDU+ device (cold restart).
24) By pressing ***„Execute configuration"*** changes made in this section will be applied to the local side Integra-X/-X2/-FIDU/-FIDU+ device. It is not possible to apply these settings to devices on both sides at the same time, and changes need to be made on each side separately.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

system service HTTP {enable | disable}	Use to show status or enable/disable the HTTP service.
system service HTTP port <port>	Use to show/change the port number for the HTTP service.
system service HTTPS {enable | disable}	Use to show status or enable/disable the HTTPS service.

system service HTTPS port <port>	Use to show/change the port number for the HTTPS service.
system service HTTPS ssl_cert import <cert>	Allows to import and configure SSL certificate in PEM format, previously uploaded to device memory via FTP, for usage on further HTTPS connections.
system service HTTPS ssl_cert reset	Allows to stop the usage of previously uploaded and imported user's own SSL certificates and configures the device to use its own Internal SSL certificate.
system service ftp {enable | disable}	Use to show status or enable/disable FTP service.
system service redirect {enable | disable}	Use to show status or enable/disable HTTP redirection to HTTPS.
system service ssh banner {clear | set <banner text> | show}	Use to clear/set/show SSH login (1-255 characters long) banner.
system service ssh {enable | disable}	Use to enable/disable the SSH service.
system service ssh port {set <port> | reset | show}	Use to set/reset/show the port number of the SSH service. By default, port 22 is defined.
system service ssh status	Use to show the status of the SSH service.
system service status	Use to show the service ports' configuration.
system service telnet {enable | disable}	Use to enable/disable TELNET service.
system service telnet port {reset | set <port> | show}	Use to reset/set/show a port number of the TELNET service. By default, port 23 is defined.
system service telnet status	Use to show the status of the TELNET service.
system service telnet-client <IP_address>	Use to connect to a remote Integra-X/-X2/-FIDU/-FIDU+ with the specified IP address. (This command is not supported in Web Console).
system radius addr <IP_address>	Use to define the RADIUS server IP address.
system radius {enable | disable}	Use to enable/disable RADIUS configuration.
system radius port <port>	Use to define a port number (0...65535) of a RADIUS server. By default, port 1812 is defined.
system radius secret <secret>	Use to define a RADIUS server password (less than 33 characters long).
system radius status	Use to show RADIUS configuration status.

System → Configuration → Syslog

Integra-X/-X2/-FIDU/-FIDU+ supports the Syslog standard for system management message logging and sending to a monitoring Syslog server.

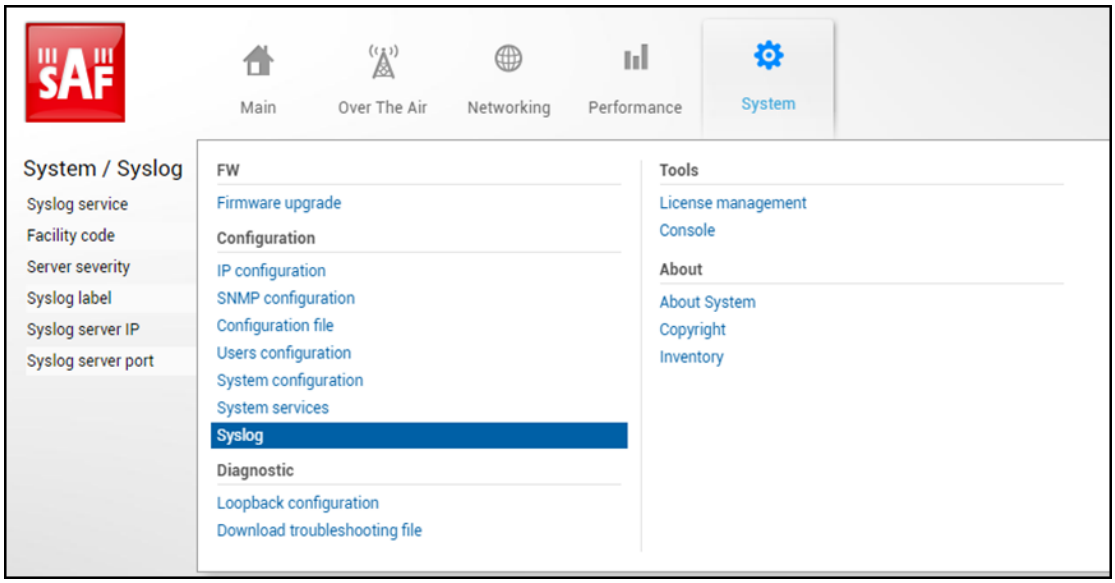


Figure 3-206 Accessing Syslog page

The following syslog parameters can be configured:

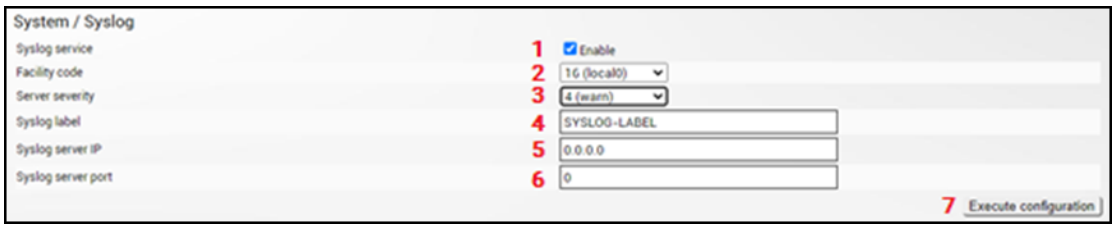


Figure 3-207 Syslog modify page

1) ***Syslog service*** – allows enabling ☑ or disabling ☐ Syslog service on the device.
2) ***Facility code*** – allows selecting the facility code for the Syslog messages from the device. Messages with different facility codes may be handled differently on the Syslog server. The following facility codes are possible:
    a. 16 (local0);
    b. 17 (local1);
    c. 18 (local2);
    d. 19 (local3);
    e. 20 (local4);
    f. 21 (local5);
    g. 22 (local6);
    h. 23 (local7).
3) ***Server severity*** – allows selecting the maximal severity (priority) level for sensor log event messages that will be sent from the device to the Syslog server. Each sensor has 4 log event types that trigger Syslog message sending:
    a. ***set*** – indicates the time when the current sensor value comes out of the normal value range or the current sensor value is not valid at all;
    b. ***reset*** – indicates the time when the current sensor value comes back to the normal value range from the previous set event state;
    c. ***down*** – indicates the time when the sensor stops receiving data about the parameter it monitors, for example, due to some hardware fault;
    d. ***up*** – indicates the time when the sensor recovers data reception about the parameter it monitors from the previous down event state.

    Additionally, each event type can have one of 8 severity levels:
        a. 0 (emerg);
        b. 1 (alert);

c. 2 (crit);
d. 3 (error);
e. 4 (warn);
f. 5 (notice);
g. 6 (info);
h. 7 (debug).

By default, all sensors in Integra-X/-X2/-FIDU/-FIDU+ have the following severity levels for each of their 4 event types:

a. set alert;
b. reset notice;
c. down alert;
d. up notice.

Log event severity can be changed with the CLI command **log sensor mgmt** <sensor> **message** <event> <severity>.

4) ***Syslog label*** – allows selecting additional textual labeling/tagging for Syslog messages.
5) ***Syslog server IP*** – allows configuring an IP address for the Syslog server where the device should send Syslog messages.
6) ***Syslog server port*** – allows configuring the port that the device should use for Syslog message sending.
7) By pressing ***„Execute configuration"*** changes made to the Syslog configuration page will apply to the local side Integra-X/-X2/-FIDU/-FIDU+ device.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

log syslog cfg	Use to show the current Syslog configuration.
log syslog disable	Use to disable Syslog message sending.
log syslog enable	Use to enable Syslog message sending.
log syslog facility <facility code>	Use to set the facility code for Syslog messages.
log syslog ip <IP address>	Use to set an IP address for the Syslog server.
log syslog label <syslog_label>	Use to set a label/tag for syslog messages.
log syslog port <syslog_port>	Use to set a port for the syslog server.
log syslog severity <severity>	Use to set the maximal severity level for Syslog messages that will be sent from the device.
log group mgmt <name> **add destination** {event|perf|snmp|syslog}	Use to add a destination for a group.
log group mgmt <name> **remove destination** {event|perf|snmp|syslog}	Use to remove a destination from a group.
log sensor mgmt <sensor> **message** <event> <severity>	Use to set the severity level for sensor event log messages.

System → Diagnostic → Loopback configuration

Loopback configuration allows verifying system operation.

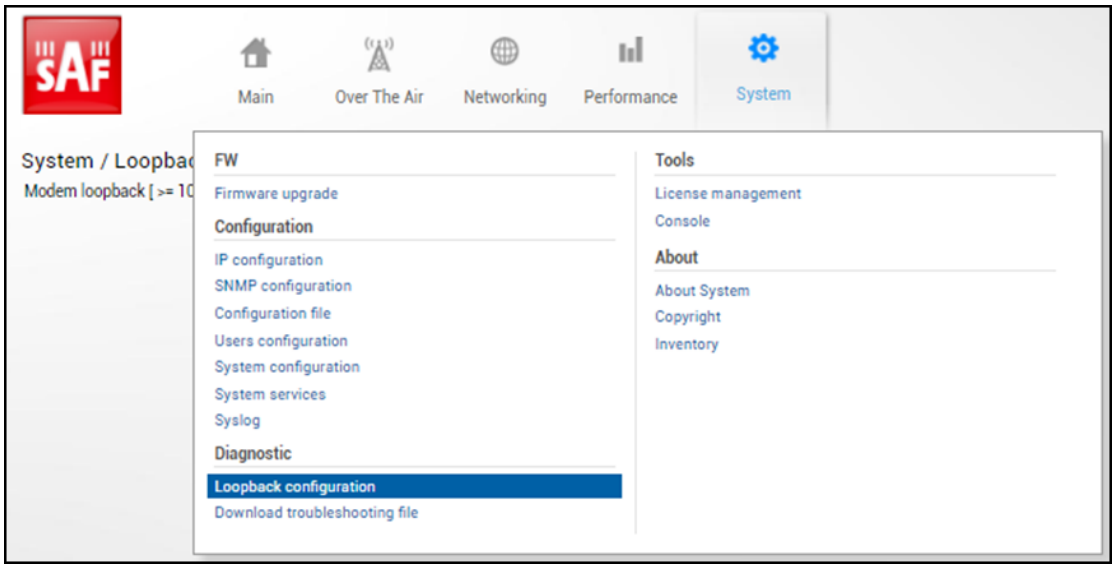


Figure 3-208 Accessing Loopback configuration page

Status mode

Figure 3-209 Loopback configuration status page

Press MODIFY button.

Modify mode

Figure 3-210 Modifying Loopback settings

1) ***Modem loopback*** – Indicates whether modem loopback is active (status mode); Allows enabling modem loopback by changing the status to "On" and specifying loopback duration time (modify mode). During modem loopback, the signal is looped back to a local end after the modem, and Integra-X/-X2/-FIDU/-FIDU+ should be able to synchronize to itself. Both MSE and FEC load should not generate an alarm (values should not be colored in red). When loopback is activated, a "Loopback duration time" countdown timer will appear.
2) By pressing ***„Execute configuration"***, changes made to the corresponding section apply only to the local side Integra-X/-X2/-FIDU/-FIDU+.

While modem loopback is active, "Modem loopback: Enabled, digital" indication will be shown on the "Main" status page.

Figure 3-211 below shows an example of the Main status page during modem loopback:

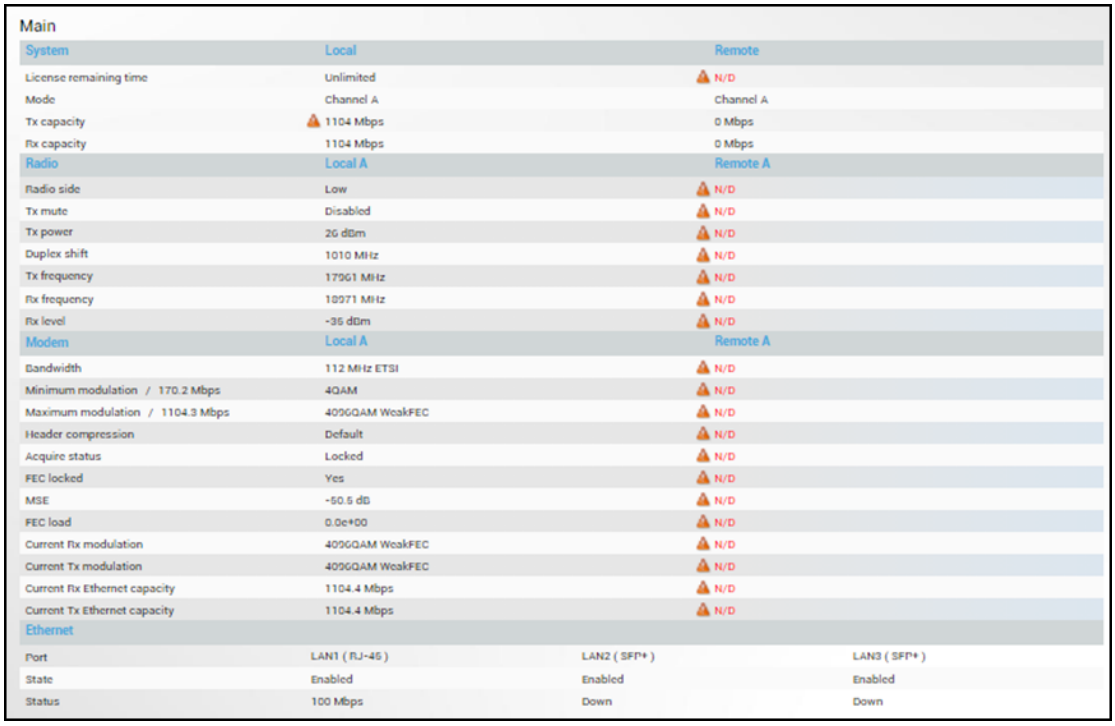


Figure 3-211 main page indicating Loopback

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

modem loopback	Use to show modem loopback status.
modem loopback digital <10..1000000>	Use to enable modem loopback for a specified time in seconds.
modem loopback digital none	Use to disable modem loopback.

System → Diagnostic → Download troubleshooting file

By navigating to the “Download troubleshooting file” the “.tar.gz” archive containing various troubleshooting data files will be automatically generated and downloaded to your PC.

When contacting SAF technical support team (techsupport@saftehnika.com) regarding troubleshooting issues, please always provide the troubleshooting file.

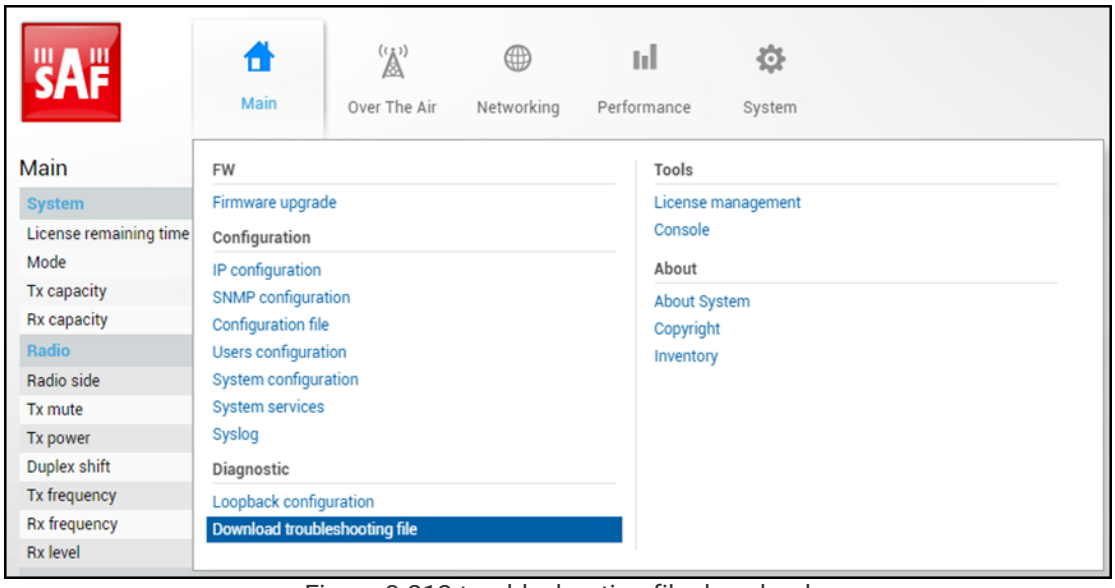


Figure 3-212 troubleshooting file download

Clicking on the ”Download troubleshooting file” will open a prompt window (*Figure 3-213*) asking to confirm the troubleshooting file download process.

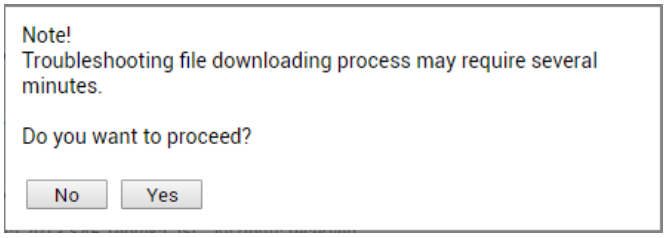


Figure 3-213 Confirmation window for troubleshooting file download

Clicking on the ***Yes*** button will start a process that will download the troubleshooting file archive package to your hard disk drive (“Downloads” folder of your browser).

File contents:

conf	Subfolder with the last configuration files.
chA_constell.bmp	Snapshot of the modem constellation graph for channel A.
chA_spectrum.bmp	Snapshot of modem Rx spectrum graph for channel A.
chB_constell.bmp	Snapshot of the modem constellation graph for channel B.
chB_spectrum.bmp	Snapshot of modem Rx spectrum graph for channel B.
config.txt	Saved system configuration file.
devel.tar.gz	For debugging only.
equ_tapA.bmp	Snapshot of the adaptive equalizer taps` coefficients for channel A.

equ_tapB.bmp	Snapshot of the adaptive equalizer taps` coefficients for the channel B
eventlog.txt	Alarm-event log file
Perflog_503840100675_D18X2R03L_2024-01-30_10-56-16.zip	An archive containing performance log files with a maximum of 1440 entries for 1, 15, and 60-minute intervals
troubleshoot.html	Information on currently running firmware and stored firmware files; system configuration including Web services, RADIUS, IP address, user, NTP configuration, and inventory info; SNMP v1/v2c/v3 configuration; alarm status, alarm threshold, and sensor configurations; radio status, configuration, and counters; currently active license and added license files; modem including modem status and configuration, counters, list of allowed modem profiles, header compression; Ethernet configuration and counters of LAN, WAN and MNG ports

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

system troubleshoot clear	Use to clear ftp://misc/ directory.
system troubleshoot diag	Use to show troubleshooting file diagnostics information.
system troubleshoot export ftp	Use to export troubleshooting file to ftp://misc/ directory.
system troubleshoot make	Use it to generate a troubleshooting file.
system troubleshoot status	Use to show troubleshooting file status.

System → Tools → License management

Provides a list of available licenses, time left for each license, and license upload controls.

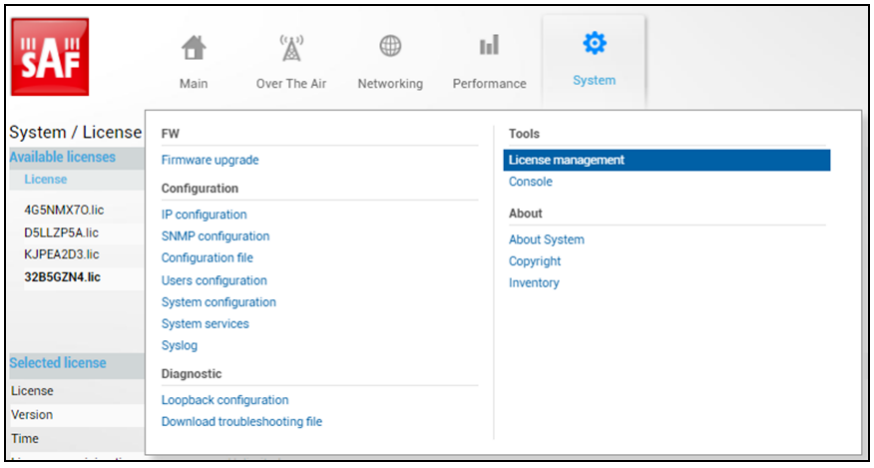


Figure 3-214 Accessing License management page

Status mode

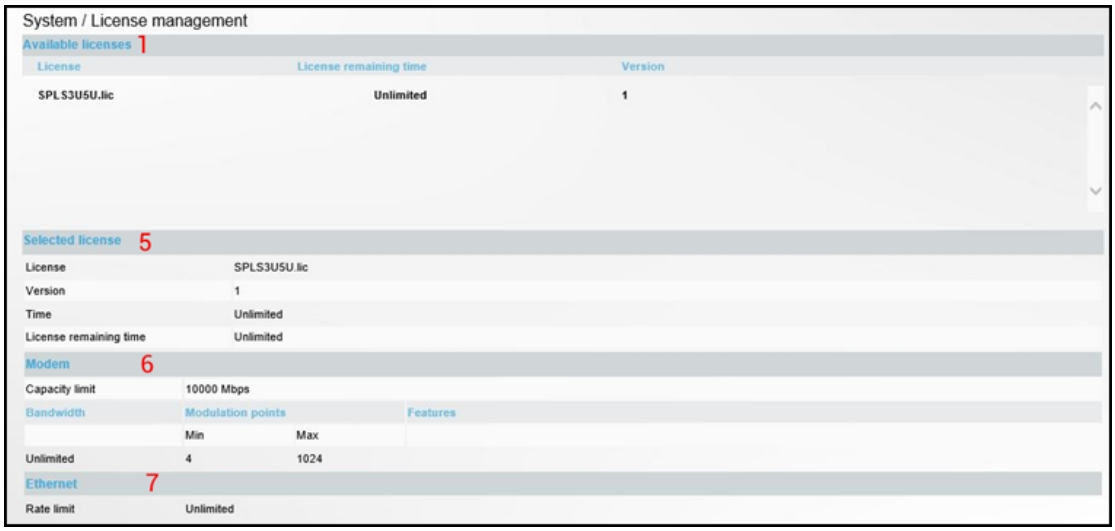


Figure 3-215 Licence status window

Press MODIFY button.

Modify mode

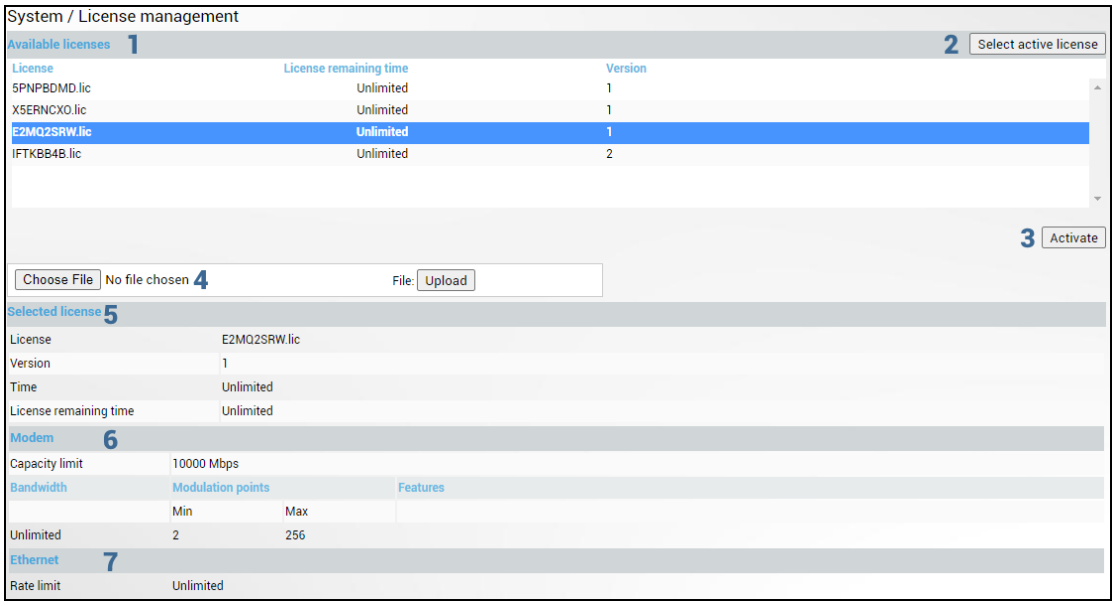


Figure 3-216 Licence status modify page

1) ***Available licenses*** – shows a list of available licenses, remaining time, and version.
2) ***Select active license*** – highlights the currently active license in the list of available licenses.
3) ***Activate*** – Select a license from the list and press “Activate” to switch to the preferred license.
4) ***Browse*** or ***Choose File*** (depending on the used web browser) and ***upload*** – Press to browse for a license file (*.lic) on your hard disk drive. Press “Upload” to upload a license file (*.lic) to Integra-X/-X2/-FIDU/-FIDU+.
5) ***Selected*** – shows the version and time of the currently selected license.
6) ***Modem*** – shows modem settings of the currently selected license.
7) ***Ethernet*** – shows the Ethernet rate limitation of the currently selected license.

When the license expires, the link capacity will drop to 2 Mbps, and you will see a warning on the Main page.

When the license expires, the next license on the list needs to be activated manual

New license activation

1) Open the license management page via Web GUI: *System → Tools → License management*.
2) Press the "MODIFY" button.
3) Press the "***Browse***" or "***Choose File***" button (depending on the used web browser), browse for the new license file (*.lic), select it, and press ***"Upload"***.

The license file should be in the format XXXXXXXX.lic
Do not change the original license filename; otherwise, the license file will not be accepted!

4) Choose the uploaded license from the list and press the ***"Activate"*** button.

If a new license supports the current modem configuration, no changes will be applied.

If the modem was configured to a modem configuration that is not supported by the new license key, the modem will be reconfigured to the maximum allowed configuration in the chosen channel bandwidth.

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

license list	Use to list available licenses.
license list active	Use to view the settings of a currently active license.
license file list	Use to list available license files.
license file add <filename>	Use to add the uploaded license file to the license file list from the FTP directory.
license file activate <filename>	Use to activate the previously added license file.
license file restriction <filename>	Use to view the settings of a license file.

System → Tools → Console

The Console page provides CLI functionality in Web GUI.

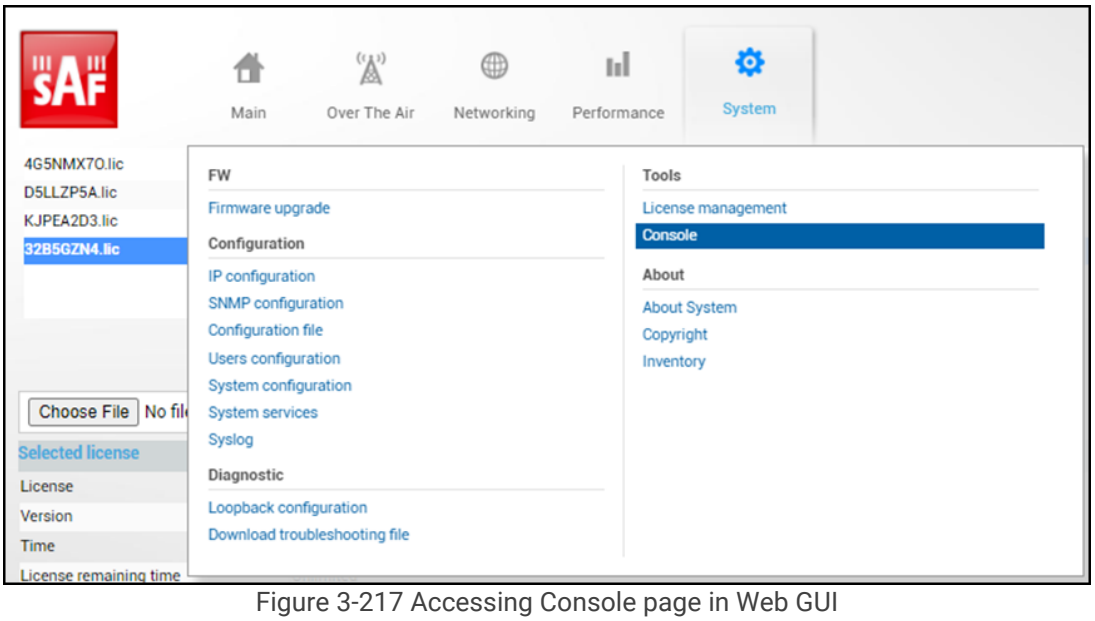


Figure 3-217 Accessing Console page in Web GUI

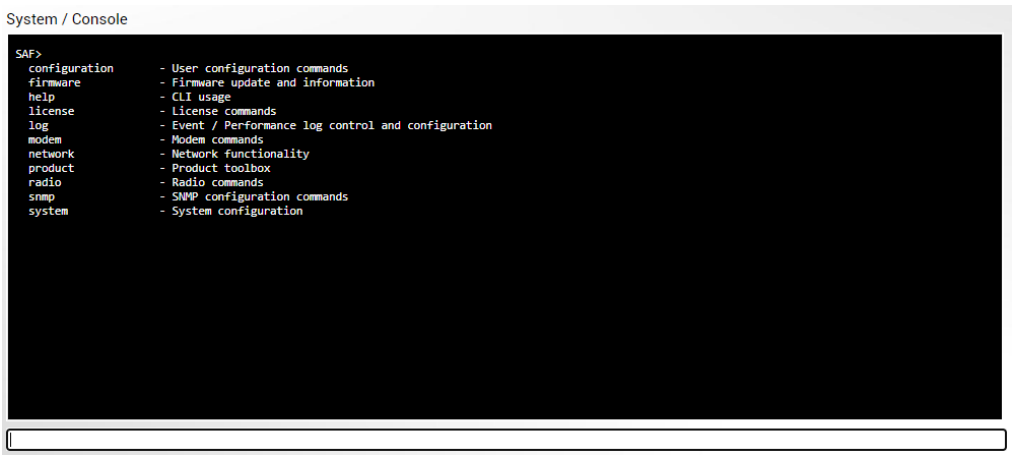


Figure 3-218 Console in WEB GUI

Use syntax “<command> ?” to see information on subcommands.

Use ↵ ENTER key to execute the entered command.

A list of valid CLI commands can be found at the end of each Web GUI page description.

Refer to the chapter *COMMAND LINE INTERFACE* for details on how to connect to other CLI interfaces (serial, SSH, Telnet).

System → About → About System

Provides a short description of Integra series products.

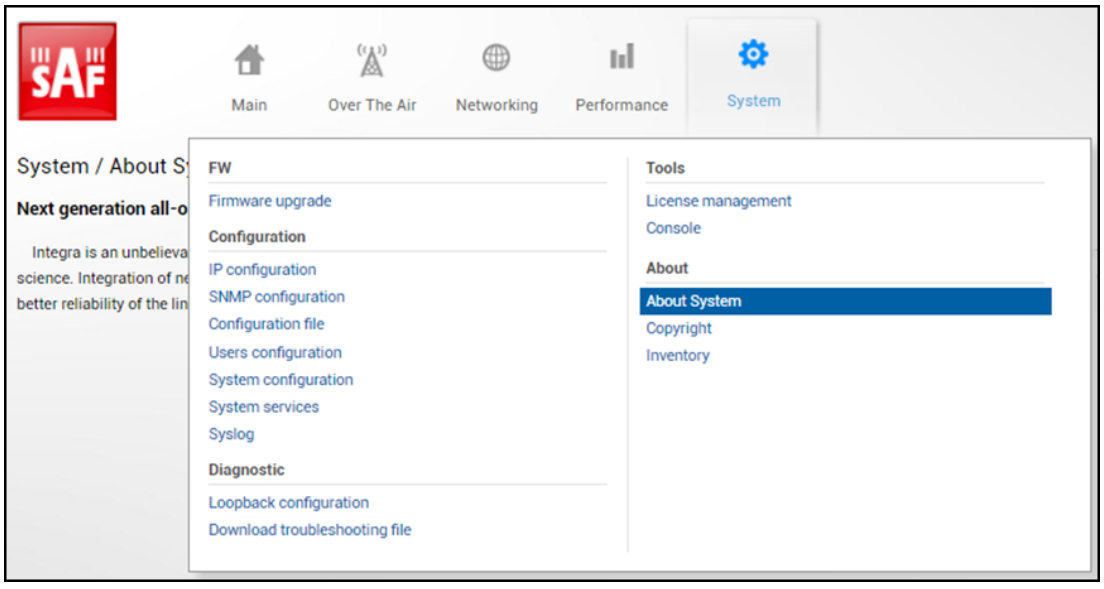


Figure 3-219 Access to About System page

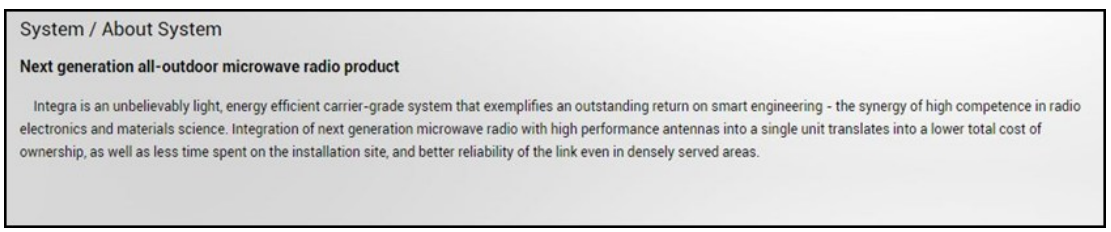


Figure 3-220 Integra series About page

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

product info	Use to show detailed information on the Integra-X/-X2/-FIDU/-FIDU+ radio.
system number	Use to show the Integra-X/-X2/-FIDU/-FIDU+ serial number.

System → About → Copyright

Displays copyright information.

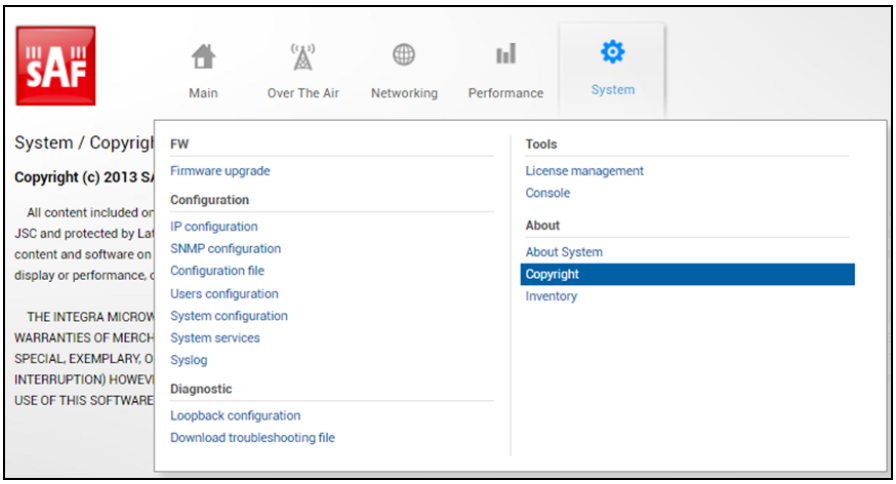


Figure 3-221 Accessing Copyright page

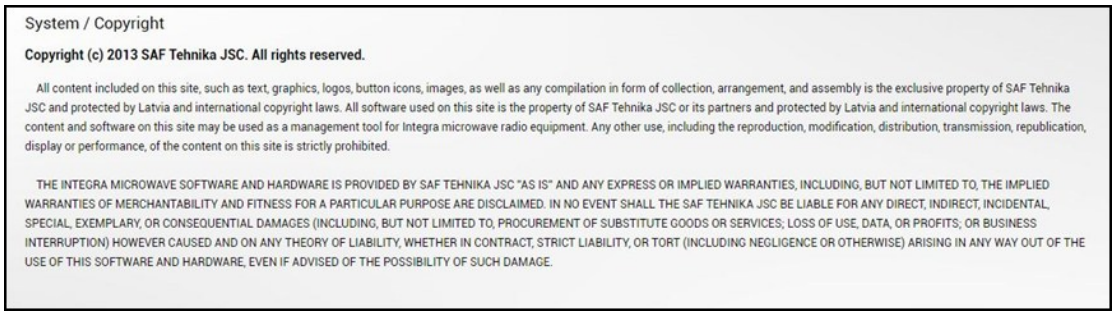


Figure 3-222 Integra series Copyright page

System → About → Inventory

Displays hardware-related information, including such parameters as MB (Mother Board) revision, and Product Serial Number.

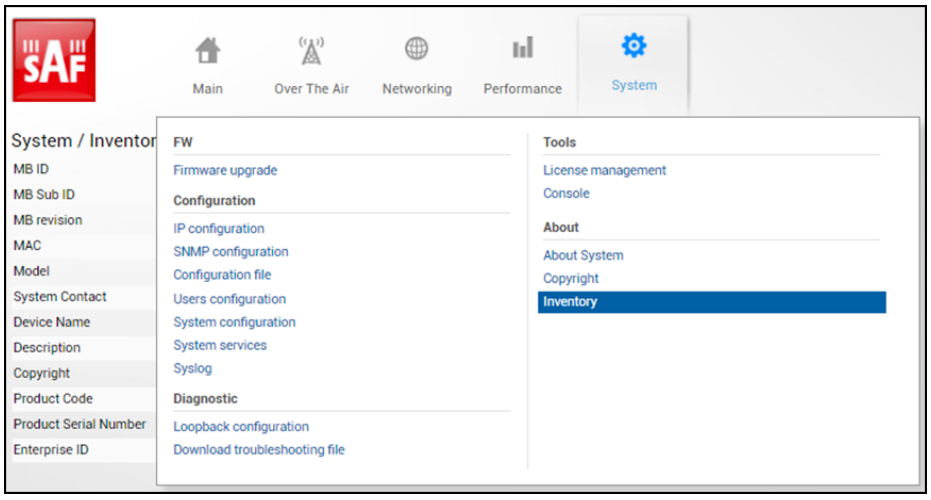


Figure 3-223 Accessing Inventory page

Figure 3-224 Integra series Inventory page

CLI commands (Chapter 4 *COMMAND LINE INTERFACE*)

product info	Use to show detailed information on the Integra-X/-X2/-FIDU/-FIDU+ FODU.
system number	Use to show the Integra-X/-X2/-FIDU/-FIDU+ serial number.

Chapter 4 COMMAND LINE INTERFACE

The Command line interface (CLI) is available via 4 individual interfaces:

- Secure Shell (SSH).
- Telnet (disabled by default).
- Serial terminal.
- Web GUI (*System → Tools → Console*, partial functionality).

The available CLI commands are found in "CLI commands" tables in the corresponding Web GUI page sections in the chapter *WEB GUI*.

For SSH, Telnet, or serial connection, you can use any client supporting the corresponding interfaces (e.g., PuTTY, Tera Term, etc.).

CLI commands are not case-sensitive.

A User can abbreviate commands and parameters as long as they contain enough letters to be distinguished from any other currently available commands or parameters.

Useful CLI keyboard shortcuts can be printed by CLI command **help.**

```
SAF>help
  Enter             - Execute current line
  Tab               - Complete current line
  Home              - Move cursor to beginning
  End               - Move cursor to the end
  Up/Down           - History navigation
  Ctrl-k            - Delete the rest of the line
  Ctrl-w            - Delete a word
  Ctrl-c            - End session
  marked text       - Indication of erroneous user input
```

Figure 4-1 CLI keyboard shortcuts

Note that in the Web GUI console (described in subsection *System → Tools → Console*) those shortcuts will not work.

Connecting to serial RS232 interface

To connect to an Integra-X/-X2/-FIDU/-FIDU+ serial terminal, you will require a USB cable with a USB Type B connector. See the chapter *USB port* for pinouts.

To connect the PC to the RS-232 serial management port, using serial terminal-emulation software (e.g., PuTTY), use the following parameters:

Baud rate: 115200

Data bits: 8

Parity: None

Stop bits: 1

Data flow control: None

Below are connection steps with PuTTY - Windows freeware software.

1) Open PuTTY and go to the "Serial" category. Specify the COM port number you will be using, change "Speed (baud)" to "115200" and "Flow control" to "None", see *Figure* 4-2 *PuTTY interface:*

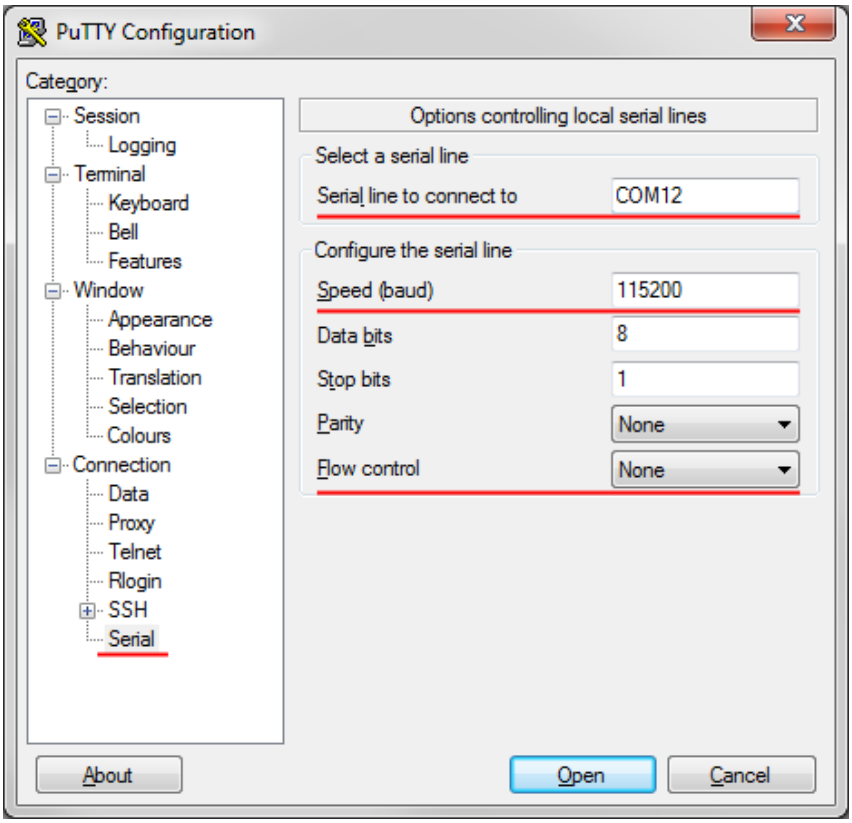


Figure 4-2 PuTTY interface

2) Press “Open” and after pressing the “Enter” key following login dialog should appear:

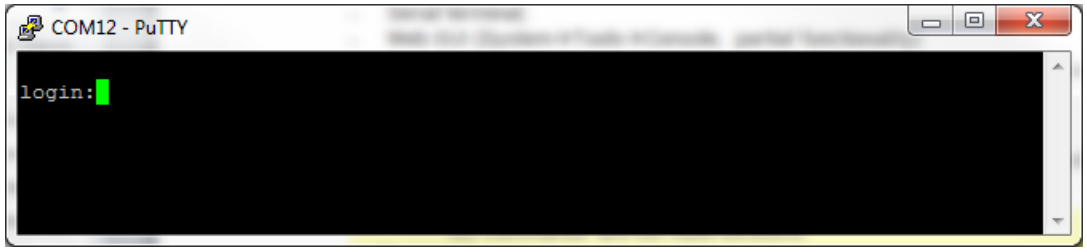


Figure 4-3 Login prompt

3) Enter the username and password. The default credentials are as follows:

login: **admin**

password: **changeme**

4) After successful login, “SAF>” prompt should appear (the prompt will differ if the system name is not the default one):

Figure 4-4 system prompt

5) Press “Ctrl+C” to log off from the current session.

Closing the PuTTY window does not log off from the current serial terminal session.

Connecting to SSH

The SSH connection to the Integra-X/-X2/-FIDU/-FIDU+ FODU is carried out using an Ethernet management connection. Ethernet management port connection details are described in the chapter *Ethernet management connection configuration*.

You can use any SSH client. Below are connection steps with PuTTY - Windows freeware software.

1) Open *PuTTY*, choose "Connection Type": "SSH", enter the IP address, and make sure that the correct port number is used ("22" by default), see *Figure 4-5 PuTTY interface for SSH connection:*

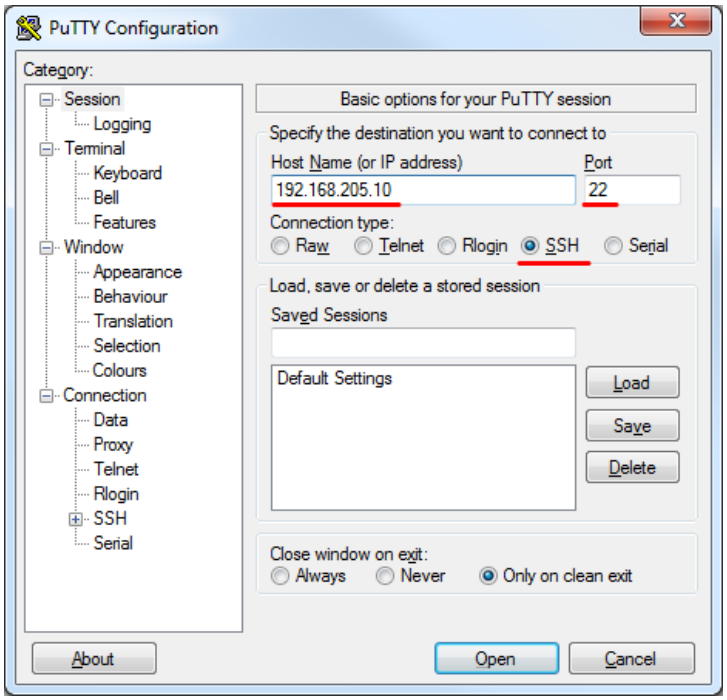


Figure 4-5 PuTTY interface for SSH connection

2) Press "Open. After a successful login, the following prompt, see *Figure* 4-6 Login *prompt*, should appear:

Figure 4-6 Login prompt

3) Enter the username and password. The default credentials are as follows:
   login: **admin**
   password: **changeme**
4) After successful login, "SAF>" prompt should appear (the prompt will differ if the system name is not the default one), see *Figure 4-7 System prompt*.

Figure 4-7 System prompt

Connecting to Telnet

A Telnet connection to the Integra-X/-X2/-FIDU/-FIDU+ FODU is carried out using the Ethernet management connection. Ethernet management port connection details are described in the chapter *Ethernet management connection configuration*.

By default, Telnet service is disabled. See *CLI commands (*Chapter 4 COMMAND LINE *INTERFACE)* for CLI commands on how to manage the system telnet service.

You can use any Telnet client. Below are connection steps with PuTTY - Windows freeware software.

1) Open *PuTTY*, choose "Connection Type": "Telnet", enter the IP address, and make sure that the correct port number is used ("23" by default).

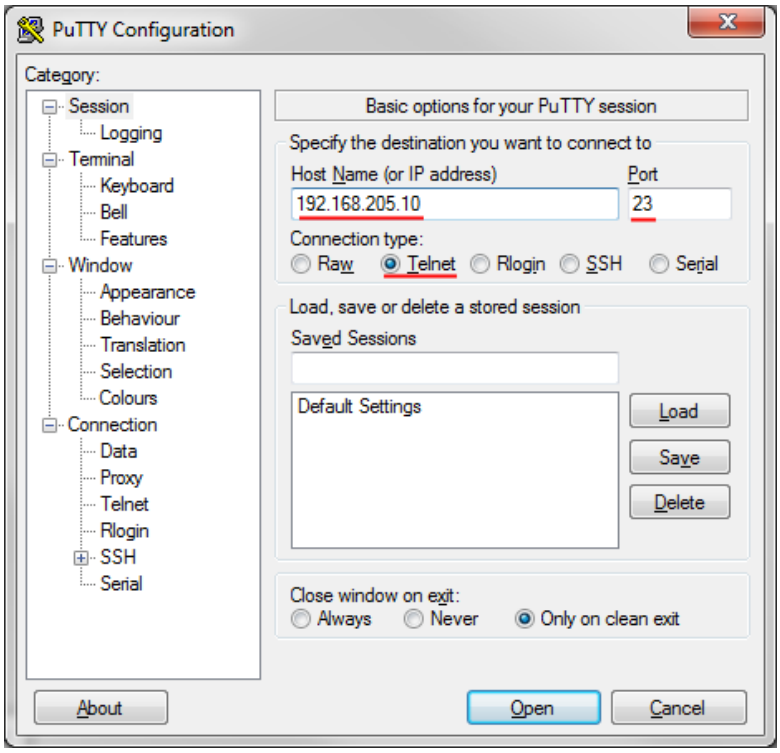


Figure 4-8 Telnet connection by Putty

2) Press "Open" to connect. After a successful connection, the following prompt should appear, see *Figure 4-9*.

Figure 4-9 Telnet login prompt

3) Enter the username and password. The default credentials are as follows:
login: **admin**
password: **changeme**

4) After successful login, “SAF>” prompt should appear (the prompt will differ if the system name is not the default one):

Figure 4-10 System prompt

Connecting to SFTP

1) Open WinSCP, select File protocol “SFTP”, specify Integra-X/X2/FIDU/FIDU+ IP address, username (admin), and password (by default - changeme).

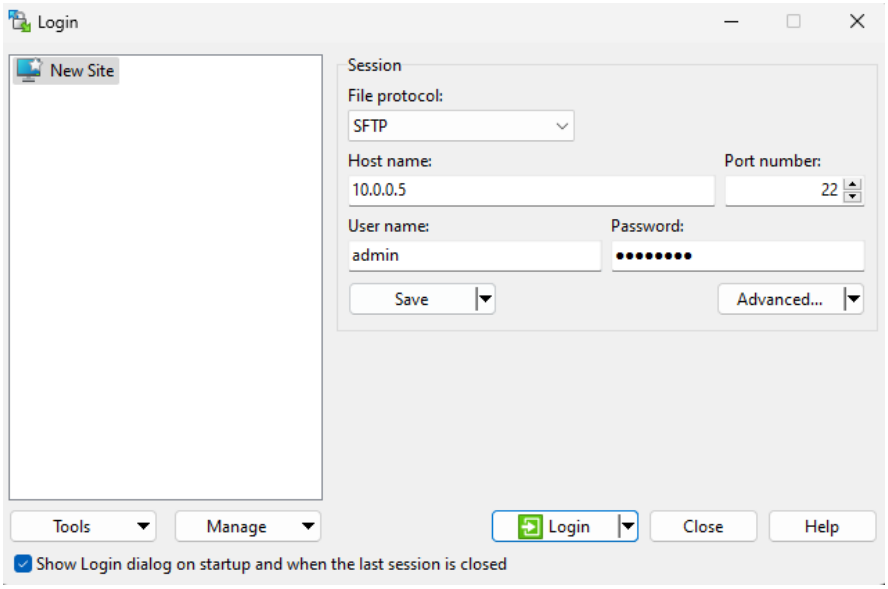


Figure 4-11 Connecting to SFTP #1

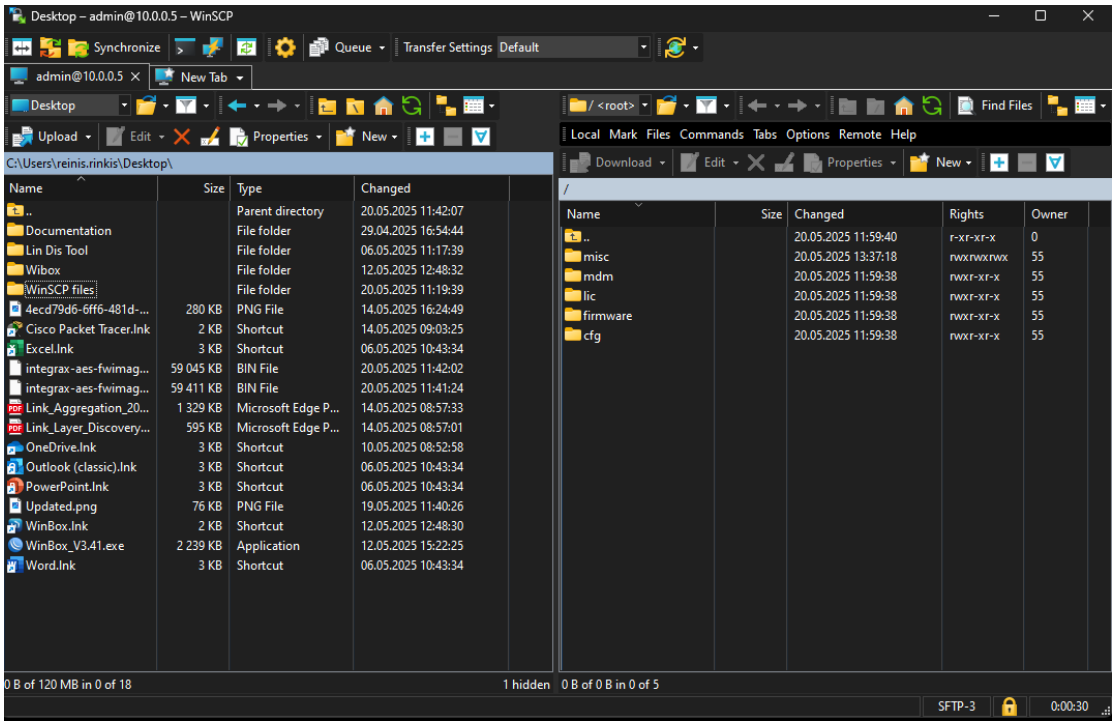


Figure 4-12 Connecting to SFTP #2

SFTP – uploading the firmware

1) Locate where the firmware file is stored

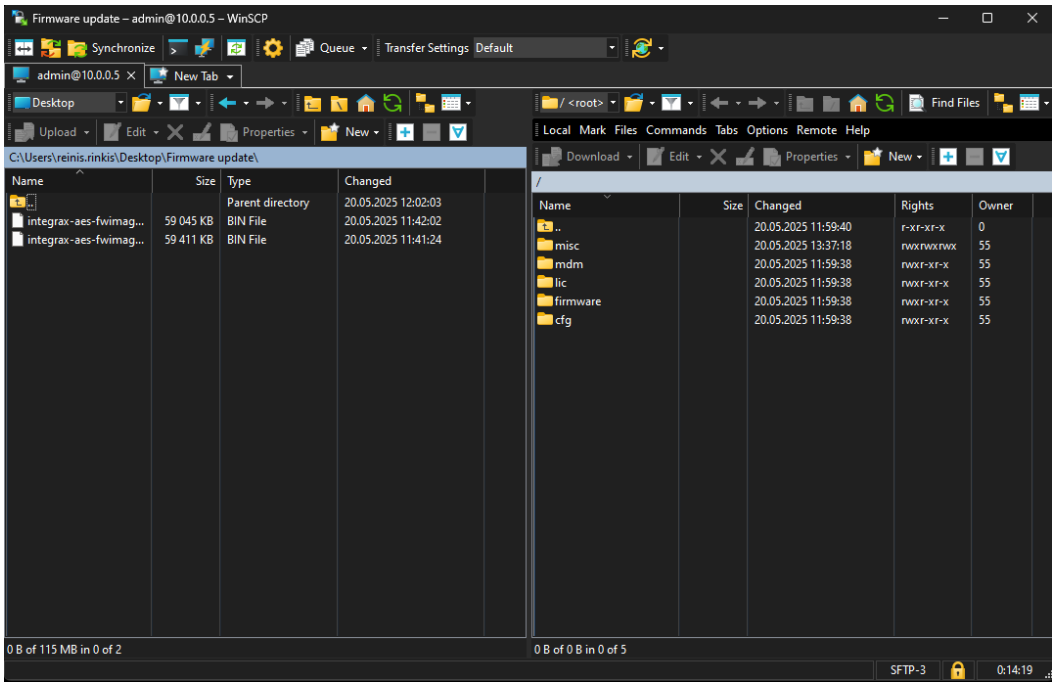


Figure 4-13 SFTP – uploading the firmware #1

2) Click and drag your Firmware file into “firmware” folder.

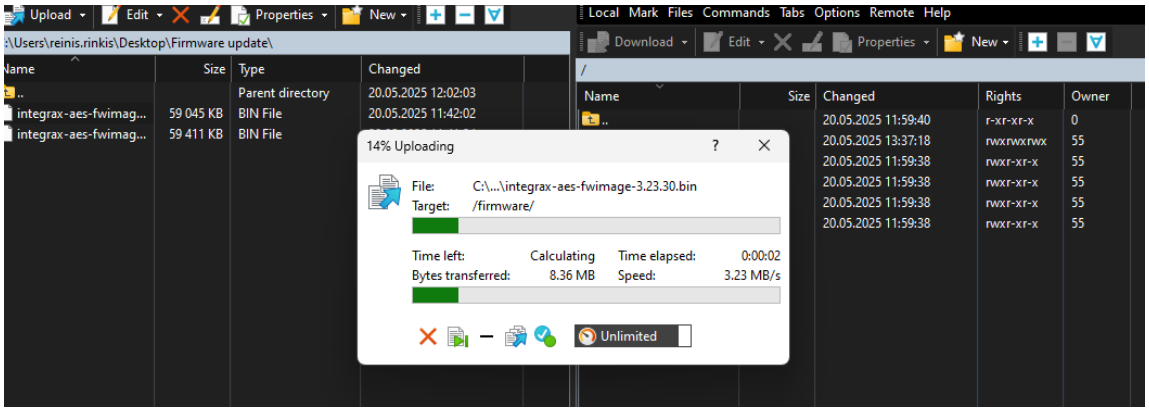


Figure 4-14 SFTP – uploading the firmware #2

3) When the upload is complete, you can verify it using CLI command - "firmware upload"

Figure 4-15 SFTP – uploading the firmware #3

4) Use CLI command “firmware install <version> fw1” to install the firmware

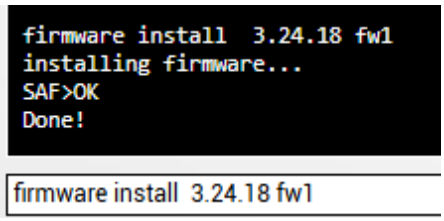


Figure 4-16 SFTP – uploading the firmware #4

5) After a reboot, verify that the firmware version has been applied.

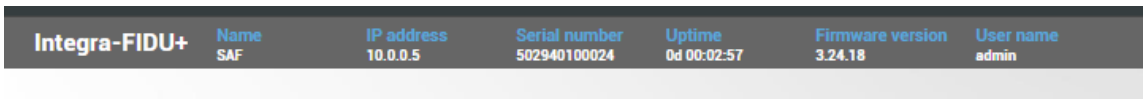


Figure 4-17 SFTP – Uploading firmware #5

SFTP – downloading the configuration file

1) Generate the configuration file using the CLI command "configuration download"

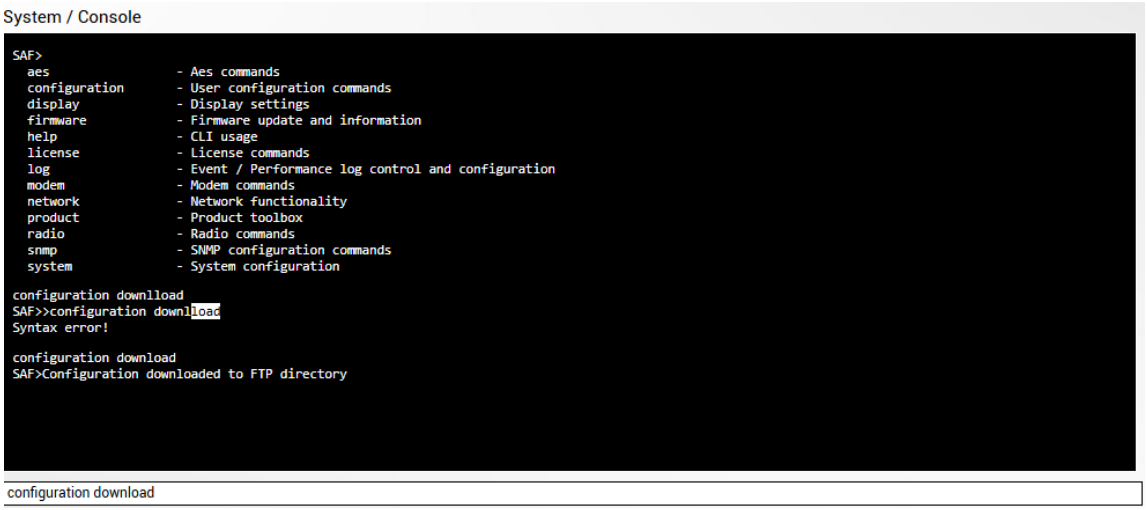


Figure 4-18 SFTP – downloading the configuration file #1

2) In WinSCP open folder "cfg".

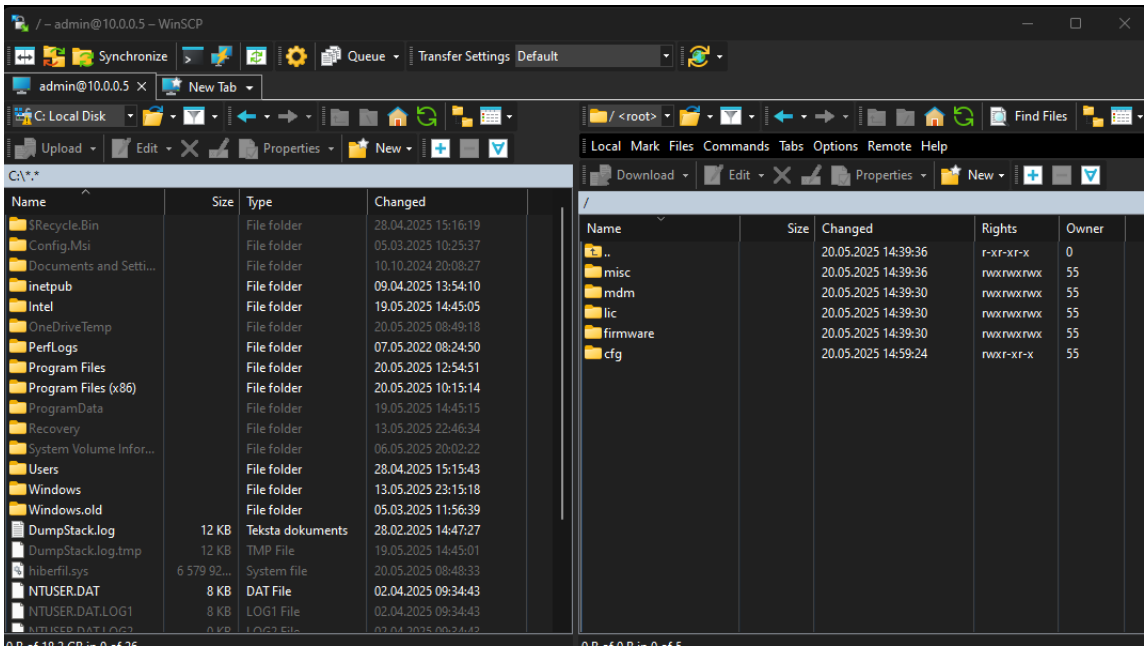


Figure 4-19 SFTP – downloading the configuration file #2

3) Here you can see, manage, and open all configuration files.

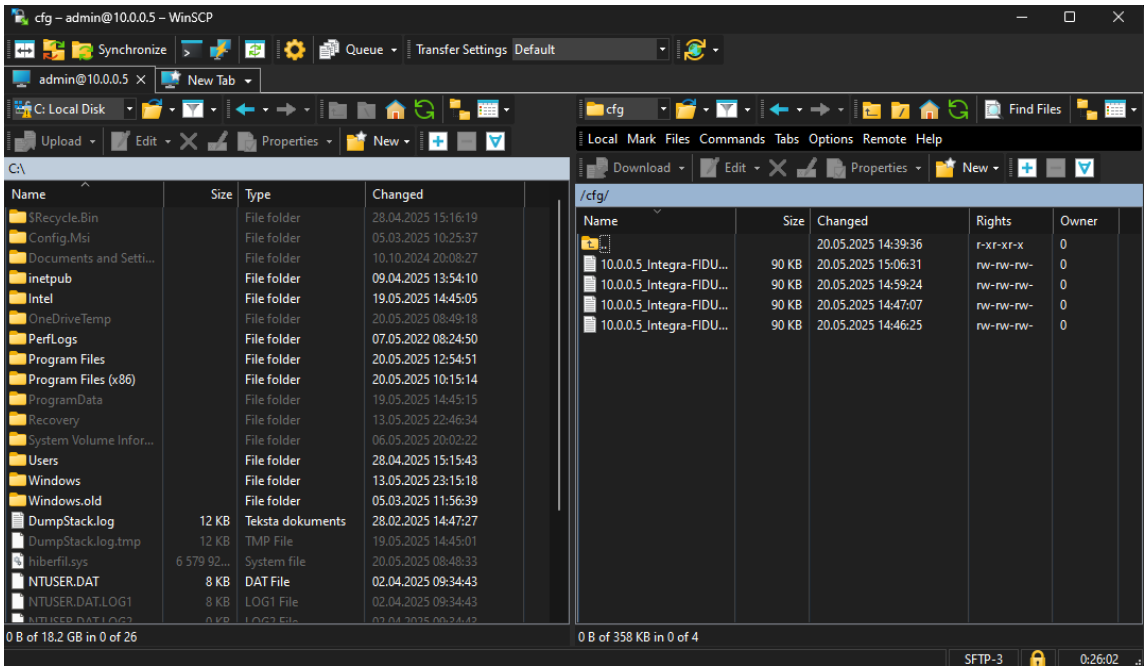


Figure 4-20 SFTP – downloading the configuration file #3

SFTP – downloading the troubleshooting file

1) Generate a troubleshooting file using the CLI command "system troubleshoot make"

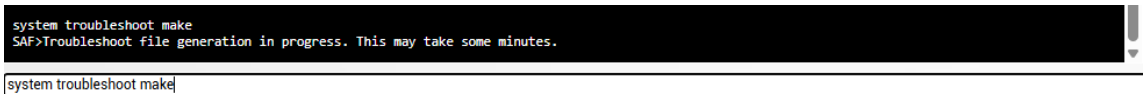


Figure 4-21 SFTP – downloading the troubleshooting file #1

It takes 5-10 minutes to generate a troubleshooting file.
You may not receive a confirmation of the finished process.

2) Export the troubleshooting file using the CLI command "system troubleshoot export ftp"

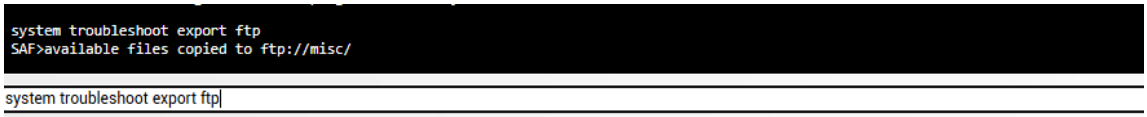


Figure 4-22 SFTP – downloading the troubleshooting file #2

Although the CLI command contains the “FTP” part, the troubleshooting file will be available via SFTP.

3) Using WinSCP download the troubleshooting file and unzip it to open it.

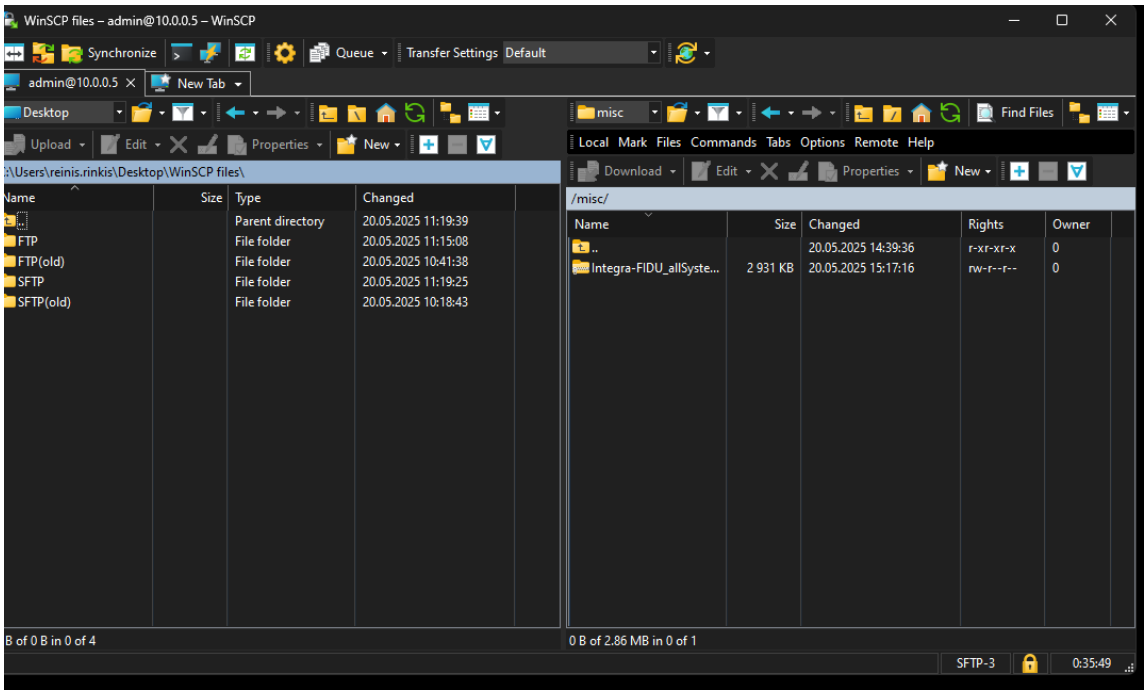


Figure 4-23 SFTP – downloading the troubleshooting file #3

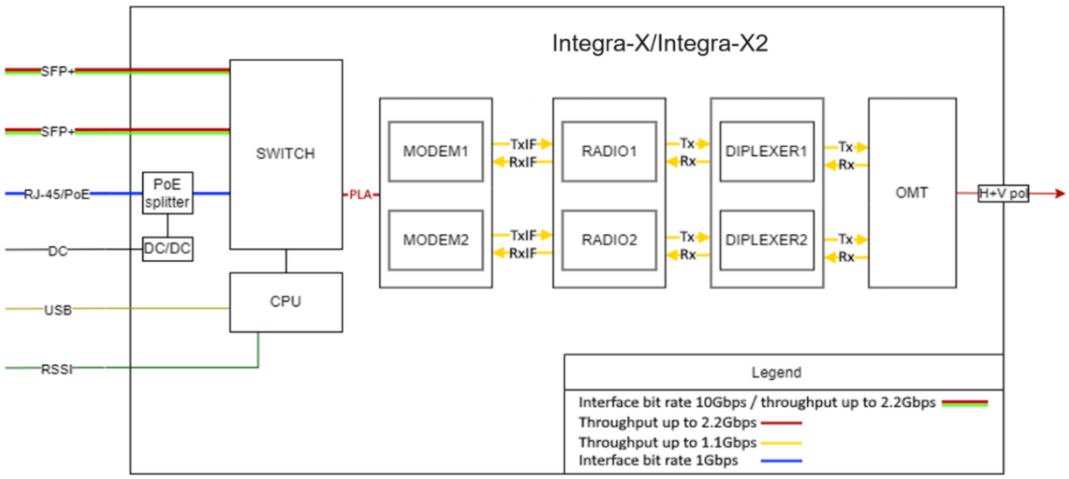
Chapter 5 FUNCTIONAL DESCRIPTION

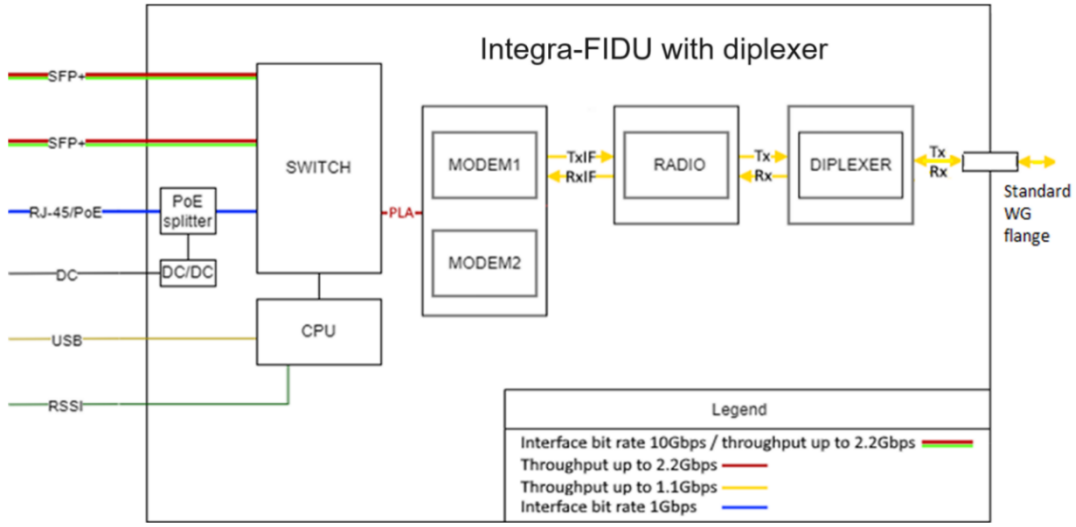
Integra block diagram

General internal block diagrams of Integra-X, Integra-X2, and Integra-FIDU/FIDU+ are shown in *Figure 5-1*. It has a built-in 10 Gbps Ethernet switch with a 50 Gbps switching capacity that has three LAN ports: LAN1 - 1Gbps PoE-in port that can be used for powering Integra radio, refer to *Powering Integra-X/-X2 devices* LAN2, and LAN3 SFP+ ports where interface speed can reach up to 10Gbps, refer to *SFP ports* to see the SFP compatibility. To get more information about other interfaces, refer to the INTERFACES section.

Physical link aggregation (PLA) happens after the traffic has passed the switch, where the maximum Integra-X/-X2/-FIDU/-FIDU+ throughput capacity of 2.2Gbps in a full-duplex mode can be reached. At this level user traffic is split into two halves 1.1Gbps on each half, the first half goes through MODEM1 -> RADIO1 -> DIPLEXER1, and the same happens with the other half of the user traffic that goes through MODEM2 -> RADIO2 -> DIPLEXER2 after that the user traffic goes thru OMT that transmits the traffic simultaneously on horizontal and vertical polarization.

Maximum link throughput of 2.2 Gbps is achievable only by utilizing the SFP+ interface. If you are using an RJ45 interface, then the maximum throughput of 1 Gbps can be reached.





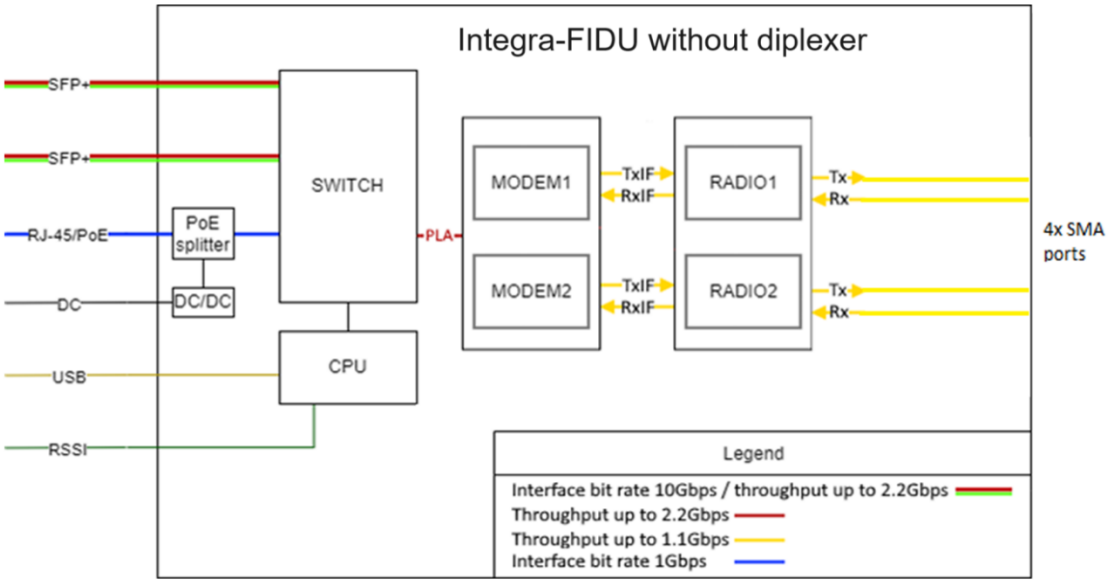


Figure 5-1 Integra-X/Integra-X2/Integra-FIDU/FIDU+ block diagrams

Description of SAF produced PoE injectors

Universal programmable PoE injector (P/N I0ATPI43)

The I0ATPI43 is an indoor Power over Ethernet injector that complies with IEEE 802.3af, LT PoE++, and Ultra PWR standards. It provides Gigabit Ethernet and DC power via a single Ethernet cable (Cat5e or better). Built-in protection conforms to the IEC 61000-4-5 standard (Class 3 up to 2kV surge).

The accepted input voltage is 10…57V DC. The output voltage is either stabilized to 57V DC or remains equal to the input voltage, depending on the selected operating mode.

For PoE power connection, Ethernet cable from the PoE injector port DATA+PWR must be connected to Integra-X/X2 RJ-45 port (LAN1). Interconnection scheme with Integra is shown in *Figure 5-2*.

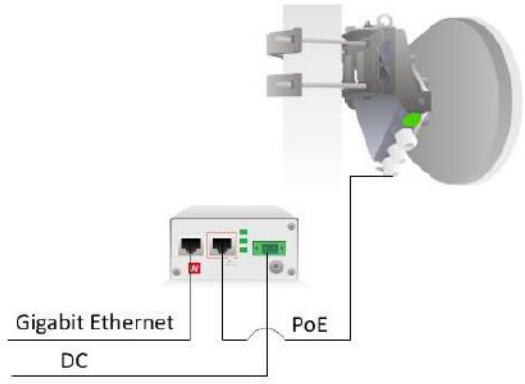


Figure 5-2 SAF produced PoE injector power connection schema with Integra-X/X2

The combined length of Ethernet cables from CPE to PoE injector (“DATA” port) and from PoE injector to Integra-X/X2 (“DATA+PWR” port on PoE injector) should not exceed 100m to provide Ethernet data connection from CPE to Integra-X/X2. It is recommended to use outdoor type STP/FTP Ethernet cables, Cat5e or better, for the connection.

Please check *Table* 8-2 Cable lengths for PoE connection from SAF-produced injector to Integra-X/-X2 *radio* for cable considerations, using powering Integra-X/X2 only by PoE means.

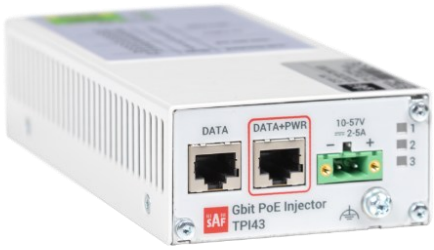


Figure 5-3 I0ATPI43 PoE injector

The front panel has 3 indication LEDs. LED3 indicates the position of DIP switch S2.

Table 5-1 PoE injector I0ATPI43 LED indication

1		PoE enabled and supplied to DATA+POWER port
2		The output voltage is equal to the input voltage
3		Input voltage is within the range of 22-57V
		Input voltage is within the range of 10-22V

The injector has a built-in DC/DC converter, which can be switched on / off depending on customer setup. With the DC/DC converter switched on, the output voltage will be stabilized to 57V, regardless of whether the input voltage varies from 10 to 57V. It is designed to compensate for the voltage loss in long cables or an insufficient input voltage from the power supply.

In turn, the mode with the DC/DC converter switched off is suggested in setups with maximum output power needed in harsh, hot environments. The power consumed by the injector, as well as the heat dissipated, will be the minimum in this mode. The power supply providing input voltage should be stabilized in this case, and ensure voltage as close to 57V as possible.

The back panel has 2 switches to operate the PoE injector in different modes, please refer to the *Table 5-2*.

Table 5-2 PoE injector I0ATPI43 power mode DIP switch selection

S1	S2	Mode	P(out) max	V(out)	Description
↑	↑	A[4]	120W	57V	DC/DC converter switched on; UltraPWR
↓	↑	B	90W	57V	DC/DC converter switched on; LTPoE++
↑	↓	C	120W	=V(in)	DC/DC bypass; UltraPWR
↓	↓	D	90W	=V(in)	DC/DC bypass; LTPoE++

↓ — DIP switch position DOWN, ↑ — DIP switch position UP

The position of DIP switches must be changed only when the input voltage is disconnected and the PoE injector is turned off.

The PoE injector has built-in lightning and surge protection, preventing transient over-voltages from damaging the radio and the user's indoor equipment. The device also has

[4] Default recommended mode

overcurrent and short circuit protection, and it is protected against reversed polarity of the input voltage.

Please be aware that proper grounding should always be used for all elements of your site setup, including the PoE injector and the powered equipment.

Table 5-3 Electrical specifications for P/N I0ATPI43

Electrical specification		
Data rate	Up to 1000 Mb/s	
DC/DC Mode	Two modes switchable: active / disabled	
Input Voltage	10 – 57 V	
Output Voltage	Two modes switchable: 57 V / equal to the input voltage	
Max Output Current @ UIN 22…57 V DC	802.3af mode LTPoE++ mode UltraPWR mode	0.375 A 2.25 A 2.8 A
Max Output Current @ UIN 10…22 V DC	802.3af mode	0.375 A
Power Connector[6]	2ESDV-02P, centerline 5.08 mm / 0.2”, with screw locks	
Ethernet Connectors	Shielded RJ45 jacks	
Data Lines	Pins (1, 2), (3, 6), (4, 5), and (7, 8)	
Power Lines	+ (1, 2) and (4, 5); - (3, 6) and (7, 8)	
Power Clamping Voltage	+/- 70 V	
Surge protection according to CEI EN 61000-4-5	Class 3 up to 2kV surge	
Max data cable length	100 m	

Table 5-4 Mechanical specifications for P/N I0ATPI43

Mechanical specification	
Ports	RJ45 - Data RJ45 - Data + Power DC - 2ESDV-02P socket with screw locks Grounding screw
Dimensions (W/H/D):	82 mm/41 mm/154 mm
Weight	0.4 kg
Enclosure	Steel
Operating Temperature	-10°C to +50°C
Mounting	With bracket (included) 19” rack mounting shelf (P/N I0KTPI11.003) DIN-rail clip (P/N I0STPI11.001)

[6] 2ESDV-02P plug with screw locks is included

Integra-X/X2 radio power connection redundancy

For power connection redundancy Integra-X/X2 device can be powered simultaneously on both power ports: a 2-wire DC port and LAN1 RJ-45 port. Yet Integra-X/X2 will have an active power connection (main) only from one of the two power sources – the other one is in standby mode and ready to take over the power supply connection in case the main power source fails.

Note that Integra-X/X2 will use the main power source, the one that is connected to it first. The only exception here is when, at first, the device is powered from a PoE injector and then the DC power supply, which also has a higher voltage level, is connected – in this case, Integra-X/X2 will switch over to the DC power supply.

Note also that Integra-X/X2 will power on almost immediately and without any delay when connected to the DC power source. The only requirement here is that the DC power source should provide at least 38V as a minimum voltage level. However, it will take a couple of seconds for the device to start from SAF Tehnika PoE injectors. So, in the case when the device is connected simultaneously with the PoE injector and DC power source, it will connect faster with the DC power source and select it as the main connection. When the PoE injector detection process is finished, it will become the standby power supply in such a connection. For uninterrupted and hitless power supply failover operation on Integra-X/X2, there is only 1 possible power connection configuration with I0ATPI43 PoE injector : Integra-X/X2 has SAF Tehnika **I0ATPI43 PoE injector as the main power source (note that it should be used only in Mode A, with 120W and DC/DC converter switched on)** and **DC power supply as a standby power source**. If the PoE connection fails, then the device will switch over without any service interruption to the DC power supply. For such a configuration to correctly work, the DC power supply voltage should also be less than that from the PoE injector. So, if SAF Tehnika PoE injectors provide 57V for PoE connection, then the DC power source in such a configuration should have a lower voltage level, for example, 48V. In such a connection, the PoE injector should be connected first. Only when Integra-X/X2 device is fully powered from it, then the DC power source should be connected.

In case Integra-X/X2's main power source is a DC power supply, and SAF produced PoE injector is used in PoE 120W mode as a standby power source (for DIP switch settings on the injector, see *Table 5-2*), if the main DC power supply fails, then Integra-X/-X2 will switch off, after a couple of seconds, start the detection process of PoE connection, establish PoE connection, and start up again. The longest period here is the Integra-X/X2 device start-up process, which can take 30 – 60 seconds, so this will also determine service interruption duration in this type of power redundancy configuration in case of a main power supply breakdown. Another vulnerability of this power connection is when the main DC power supply does not fail completely and under some circumstances its voltage level just decreases under 38V, for example, even providing just 10V, then Integra-X/X2 will not switch over to a stand-by PoE power connection and will still try using main DC power supply as the main power source with insufficient voltage level. Such incidents can cause Integra-X/X2 to stop working normally till the DC power supply is turned off or breaks down completely.

Using DC power supply as the main power source in power redundancy is not recommended; an additional power monitoring and control equipment must be used with this type of redundant power connection.

Please note that the LAN1 port has a lower overvoltage protection rating compared to the input. To enhance protection, an external overvoltage protection device may be installed.

Information about built-in cooling fans

Integra-X and Integra-X2 FODU have two class IP68 built-in cooling fans. The operation and monitoring of the cooling fans are automatically managed by the device software, and users cannot control or intervene with their operation, for example, turn on or turn off any of them.

Integra-FIDU/FIDU+ has two built-in cooling fans, and operation and monitoring are automatically managed by the device software, and users cannot control or intervene with their operation. Integra-FIDU/FIDU+ cooling fans can be replaced by the user.

The cooling fans are turned on in the following situations:

1) When the device is powered up, the cooling fan operates for 2 minutes.
2) After the reboot of the device (cooling fan operation time 2 minutes).
3) Once every 24 hours of operation (self-check mode, operation time 2 minutes).

The cooling fans in all 3 above-mentioned situations will be turned on only if the temperature on the casing of the device is 20°C or higher.

4) When the temperature on the casing of the device reaches over 60°C. The fan operates until the temperature decreases to 55°C.

The status of the cooling fans can be viewed and checked by the user with the following CLI commands (*System → Tools → Console*):

system fan events <enable | disable>	Use to enable or disable fan status indication in the event log.
system fan	Use to view the fan status condition.

The following fan status conditions are possible:

ON – indicates that the cooling fans are turned on.

OFF – indicates that the cooling fans are turned off.

FROZEN START – indicates that the temperature measured on the casing of the device is below 20°C and cooling fans will not be turned on upon device reboot, power-on, or 24-hour self-check. Fans will turn on only when the temperature goes above 20°C.

The system fan command output will show the following information:

```
system fan
SAF>                FAN STATUS:
                  State #1        OFF          1
                  State #2        OFF          2
       System temperature         58           3
   Rotation per minute #1         OFF          4
   Rotation per minute #2         OFF          5
       State event output         DISABLED     6

   RUNNING CONFIGURATION:
             fan_available        Yes          7
                   time_on        120          8
                  time_off        86400        9
                  timehyst        20           10
                  temp_max        60           11
                 temp_delta       5            12
                temp_freeze       20           13
                  speed_min       1000         14
                  speed_max       10000        15
                speed_delta       150          16
                  state_msg       0            17
```

Figure 5-4 System fan command output

1) ***State #1*** – shows the operational status of the 1st fan in the device.
2) ***State #2*** – shows the operational status of the 2nd fan in the device.

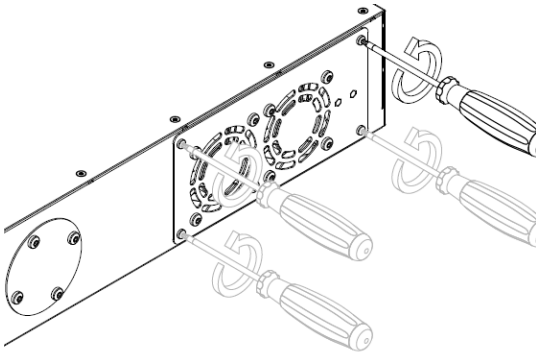
3) *System temperature* – shows the last recorded temperature measurement in Celsius degrees from the casing of the device.
4) *Rotation per minute #1* – shows the rotation speed of the 1st fan in the device.
5) *Rotation per minute #2* – shows the rotation speed of the 2nd fan in the device.
6) *State event output* – shows whether the fan status indication is recorded in the event log of the device.
7) *fan_available* – shows whether the device can detect installed fans.
8) *time_on* – shows the time in seconds for how long fans will turn on in case of the device reboot, power-on, or 24-hour self-check.
9) *time_off* – shows the time in seconds for periodic fan self-checks. 86400 seconds = 24 hours.
10) *timehyst* – shows the delay time in seconds for when the device will stop temperature measurements and wait idly after any fan status change.
11) *temp_max* – shows the temperature threshold in Celsius degrees, which will initiate the fan turning on.
12) *temp_delta* – shows the temperature difference from temp_max to which temperature on the casing of the device should decrease for fans to turn off.
13) *temp_freeze* – shows the temperature threshold in Celsius degrees below which fans will not be switched on in case of the device reboot, power-on, or 24-hour fan self-check.
14) *speed_min* – shows minimally acceptable fan rotation speed (rounds per minute) in ON status. If the fan rotation speed falls below this value in ON status, then the device will detect that the fan is rotating too slowly and will generate an alarm.
15) *speed_max* – shows the maximal acceptable fan rotation speed (rounds per minute) in ON status. If the fan rotation speed exceeds this value in ON status, then the device will detect that the fan is rotating too fast and will generate an alarm.
16) *speed_delta* – shows the rotation speed (rounds per minute) difference by which the fan speed should change to return to normal operation mode, and the fan alarm to clear after it has reached speed_max or speed_min threshold. speed_max alarm will clear when rotation speed has decreased by speed_delta, speed_min – when the speed has increased by speed_delta.
17) *state_msg* - shows whether the fan status indication is recorded in the event log of the device.

During self-check and cooling conditions or in case of system or cooling fan failure, the following events/alarms will be registered in the active alarm status and the event log (Performance → Alarm → Alarm status and *Performance → Alarm → Alarm event log*):

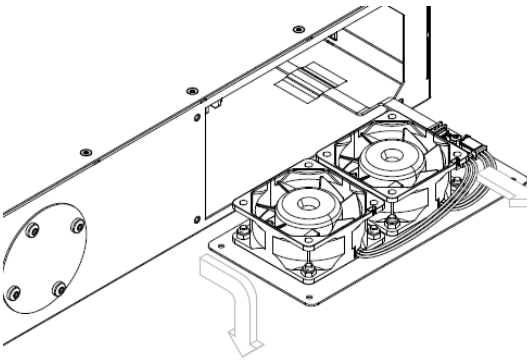
The fan #<No.> speed FAILURE ON - tested speed <current_speed> rpm (MIN <conf_min>, MAX <conf_max>) – SET	This alarm will be set if the measured speed (Revolutions per Minute) of the cooling fan is outside the predefined range.
The fan #<No.> speed <current_speed> rpm – RESET	In case the measured speed returns within the predefined speed range, the alarm will be reset.
Fan: communication error (<Error CD>)	Indication in case the system cannot read the data from the cooling fans.
Fan: error msg received: <Error Msg>	Indication in case the system cannot read the data from the cooling fans, or the data received from the cooling fans is erroneous.

If SNMP trap sending is configured on the device, it will also be sent for fan alarms.

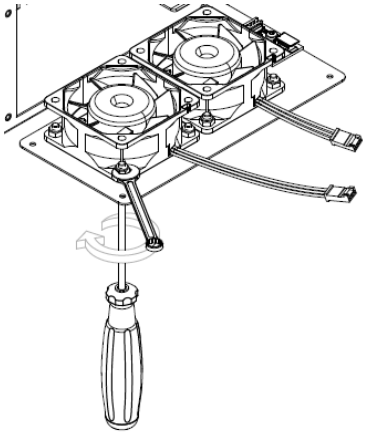
Integra-FIDU/FIDU+ cooling fans are replaceable on-site. Instructions for Integra-FIDU/FIDU+ cooling fan replacement are as follows:

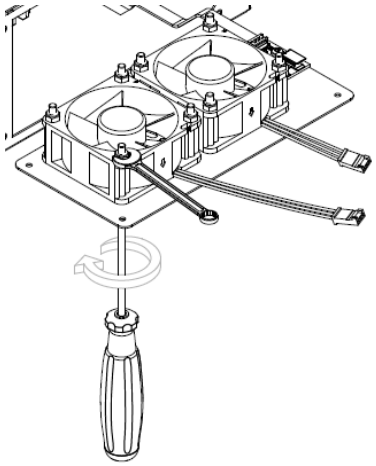


1 Using a T10 screwdriver unscrew 4 screws to remove the fan block from the FIDU.

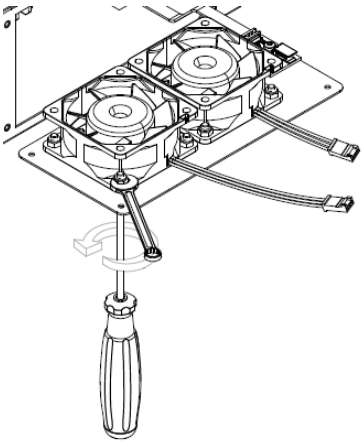


2 Disconnect the cooling fan cables from the controller board.

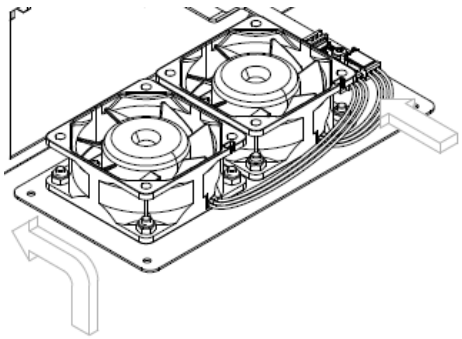




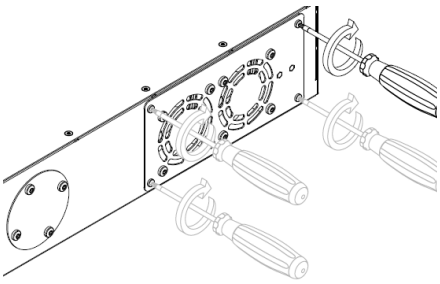
3 Using a T20 screwdriver and a 7mm wrench, unscrew and remove the fans from the fan block. The pictures above indicate two types of cooling fans. Integra-FIDU/FIDU+ can be equipped with any of the two cooling fan versions.



4 With the same T20 screwdriver and 7mm wrench, attach new fans to the fan block.



5 Connect the fan cables to the controller board.



6 Using a T10 screwdriver, attach the fan block to the FIDU.

ACM - Adaptive Coding and Modulation

ACM technology allows operators to achieve high-capacity data transmission over microwave links and improve 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, video conferencing, and file moving (download/upload) can operate at more relaxed availability levels. Knowing traffic parameters and weather conditions in the link location, it is possible to build a very reliable system. There could be temporary link congestion situations, which could be even unnoticeable for a customer if the link has not completely lost its synchronization. Switching between modulation schemas is hitless - this means that during a modulation change, there is no data loss. This is one more advantage of moving from TDM to IP traffic. For this, ACM maintains the best possible capacity in given conditions. The link will reduce capacity, but still stay up, synchronization is not lost. In case of very harsh weather conditions, if the link loses sync, it will become synchronized faster if ACM is enabled.

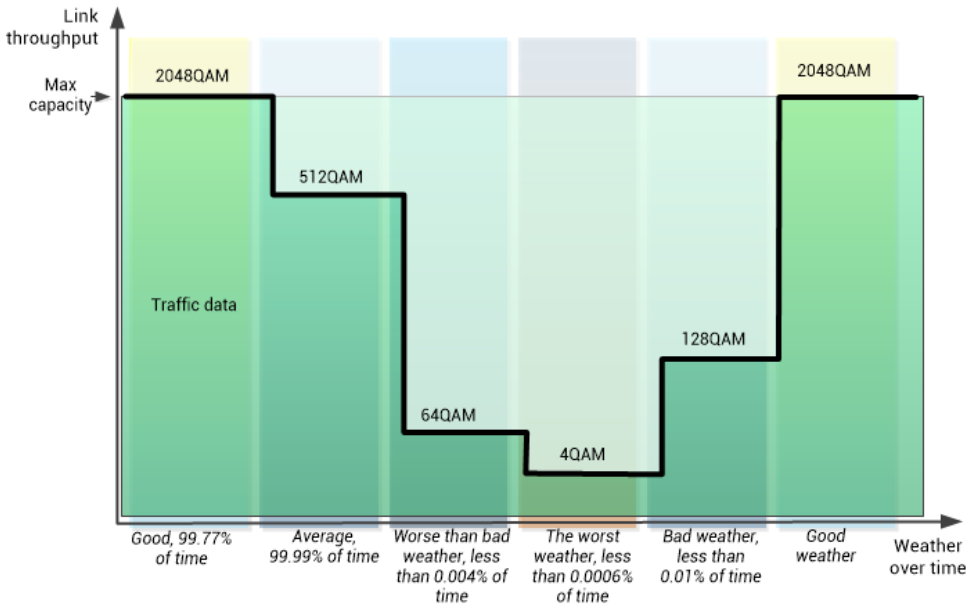


Figure 5-5 Modulation switching scheme

Let's look at the hard weather scenario for the 15km long link in the N climatic zone, 11GHz frequency, see *Figure 5-5*.

When weather conditions are clear, the wireless link operates at maximum capacity and maximum modulation 2048QAM, providing services with the full data rate. If link conditions become poor, during heavy rain, severe atmospheric refraction changes for very long links, for example, services are adapted dynamically to the changing link conditions. This is done by switching between modulation schemes according to the radio conditions. If we look at availability values in *Figure 5-5* we see that the link is available practically all the time, if properly installed.

An ACM profile defines the modulation for a given range of the MSE (Mean Square Error) alone, which is the inverse of SNR (Signal to Noise Ratio). The MSE range of each profile defines the threshold for switching from one ACM profile to another (see *Table 5-5* below):

Table 5-5 MSE thresholds for ACM modem profile switching

Channel bandwidth, MHz	112	100	80	60 ETSI	60 FCC	56	50	40 ETSI	40 FCC	30	28	25	20 ETSI	20 FCC	14	10	7	5
	MSE, dB																	
4QAM–>16QAM	-18.8	-18.8	-18.6	-18.7	-18.6	-18.6	-18.7	-18.9	-18.7	-18.5	-18.5	-18.6	-18.6	-18.5	-16.8	-18.4	-18.6	-17.9
16QAM–>32QAM	-22.6	-22.5	-22.1	-22.2	-22.3	-22.4	-22.2	-22.3	-22.1	-22.3	-22.1	-22.4	-22.3	-22.3	-22.5	-22.3	-22.1	-21.8
32QAM–>64QAM	-25.2	-25.1	-25.3	-25.0	-25	-24.9	-24.9	-25.0	-25.3	-25.2	-25.1	-25.1	-25.4	-25.1	-25.1	-24.9	-25.0	-25.0
64QAM–>128QAM	-27.8	-28.1	-27.7	-28.0	-28	-27.9	-27.9	-28.0	-28.2	-27.9	-27.9	-27.8	-28	-28.1	-28.1	-28.1	-27.9	-28.0
128QAM–>256QAM	-31.1	-31.2	-30.8	-31.0	-31.2	-30.8	-31.2	-30.9	-31.1	-31	-31	-30.9	-30.9	-31.1	-31.0	-31.0	-31.1	-31.0
256QAM–>512QAM	-33.8	-33.9	-33.8	-34.0	-34	-33.7	-33.8	-33.8	-34.0	-34	-33.8	-33.8	-33.9	-33.9	-34.1	-34.1	-34.1	-33.8
512QAM–>1024QAM	-37.3	-37.0	-36.9	-37.1	-37	-36.9	-37.0	-37.1	-37.1	-37.1	-36.9	-37.3	-37.4	-37.3	-37.2	-37.1	-37.2	-37.2
1024QAM–>2048QAM	-39.3	-39.6	-39.7	-39.8	-39.6	-39.8	-39.6	-39.8	-39.6	-39.9	-40	-39.8	-39.8	-39.7	-39.9	-40.0	-39.9	-40.1
2048QAM–>4096QAM	-42.3	-42.6	-42.6	-43.0	-42.9	-42.8	-42.8	-43.2	-43.0	-42.9	-42.9	-42.8	-43.2	-43	-42.6	-43.2	-43.1	-43.7
4096QAM–>4096QAM WF	-43.2	-43.3	-43.5	-43.8	-43.6	-43.4	-43.4	-43.8	-43.6	-43.6	-43.5	-43.7	-43.9	-43.7	-44.2	-44.3	-44.3	-44.4

Channel bandwidth, MHz	112	100	80	60 ETSI	60 FCC	56	50	40 ETSI	40 FCC	30	28	25	20 ETSI	20 FCC	14	10	7	5
	MSE, dB																	
4096QAM WF–>4096QAM	-41.6	-41.6	-42.2	-42.2	-42.3	-41.7	-42.1	-42.1	-41.8	-42.1	-42.3	-42.1	-42.4	-42.1	-42.4	-42.6	-42.6	-43
4096QAM–>2048QAM	-40.7	-40.7	-41.0	-40.9	-41.1	-40.7	-41.1	-40.8	-40.8	-41.0	-40.9	-40.9	-41.1	-40.8	-41.4	-41.5	-41.7	-42
2048QAM–>1024QAM	-37.8	-37.9	-37.9	-38.0	-38.2	-38.0	-38.2	-38.2	-38.2	-38.0	-38.0	-37.9	-38.1	-38.0	-38.4	-38.4	-38.3	-38
1024QAM–>512QAM	-35.2	-35.1	-35.3	-35.0	-35.4	-35.1	-35.5	-35.1	-35.2	-35.3	-35.4	-35.4	-35.2	-35.2	-35.4	-35.3	-35.2	-35
512QAM–>256QAM	-31.8	-32.0	-32.0	-32.0	-32.0	-32.0	-32.3	-31.6	-32.0	-32.2	-31.9	-31.9	-31.8	-31.8	-32.0	-31.8	-32.1	-32
256QAM–>128QAM	-28.9	-29.1	-29.1	-28.9	-29.2	-29.2	-29.4	-28.9	-29.1	-29.1	-29.2	-28.8	-29.0	-29.0	-29.2	-28.8	-28.9	-29
128QAM–>64QAM	-25.9	-26.4	-25.9	-25.7	-26.0	-26.2	-26.1	-25.8	-26.1	-26.0	-26.3	-25.8	-26.0	-26.2	-25.8	-26.2	-25.7	-26
64QAM–>32QAM	-23.0	-23.2	-23.3	-23.0	-23.1	-23.2	-23.1	-23.0	-23.3	-23.1	-23.0	-22.9	-23.1	-23.0	-23.0	-22.9	-22.9	-23
32QAM–>16QAM	-20.6	-20.3	-20.3	-20.0	-20.3	-20.4	-20.4	-20.2	-20.3	-20.3	-20.2	-20.5	-20.2	-20.3	-20.5	-20.6	-19.9	-19.8
16QAM–>4QAM	-16.8	-16.7	-16.4	-16.7	-16.6	-16.7	-16.7	-16.6	-16.8	-16.8	-16.7	-16.6	-16.5	-16.4	-16.8	-16.6	-16.7	-16

Each ACM profile has a different spectral efficiency, derived from its modulation. MSE is visible all the time in the default System summary, and also on the *Main page*.

When the lowest 4QAM modulation is reached, link synchronization loss will occur when the BER 10^{-6} MSE threshold is exceeded. Below is the table of BER 10^{-6} thresholds for every modulation.

Table 5-6 MSE thresholds for BER 10^{-6}

4QAM	-7.8
16QAM	-12.7
32QAM	-16.0
64QAM	-18.9
128QAM	-21.9
256QAM	-25.1
512QAM	-28.1
1024QAM	-31.4
2048QAM	-34.3
4096QAM	-37.7
4096QAM WF	-38.7

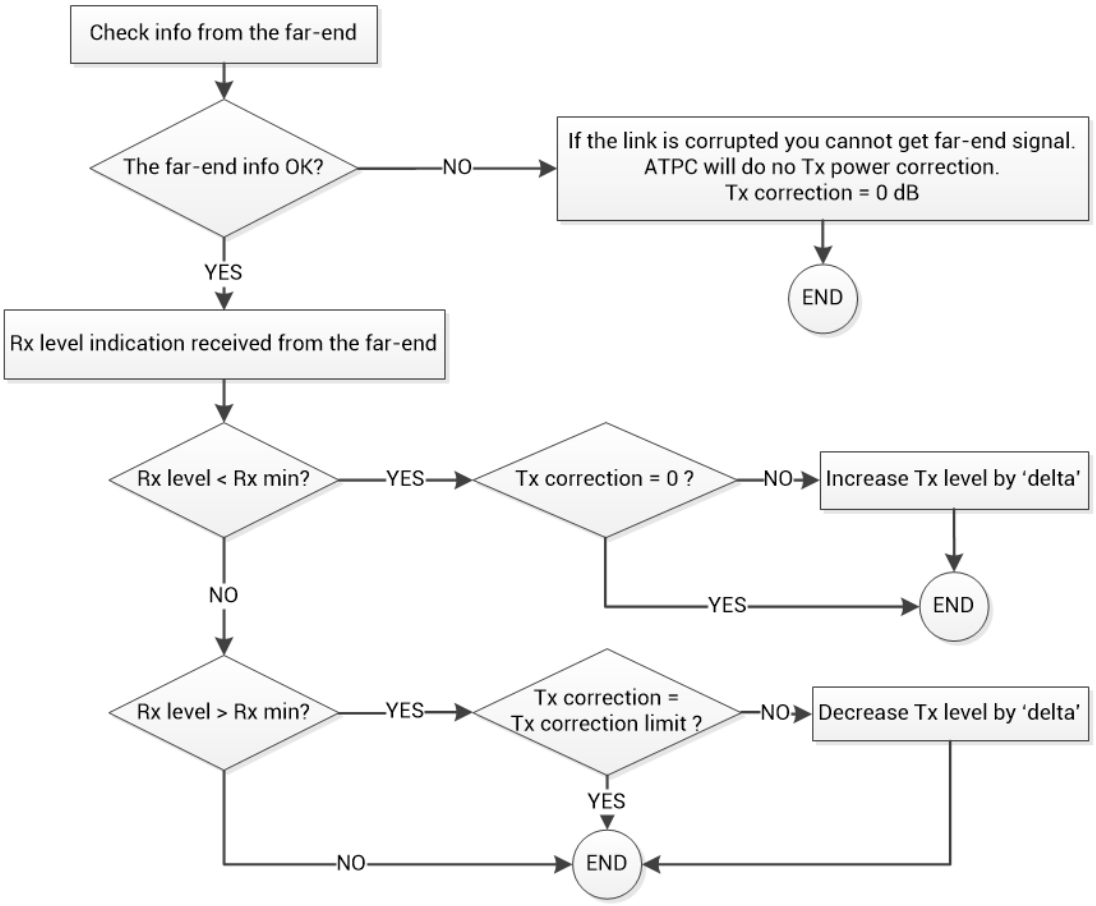
Max Tx power value will differ for each modulation because input and output radio frequency chains introduce a certain nonlinearity, and this causes an error that decreases MSE. To maintain acceptable linearity with high power Integra-X/-X2/-FIDU/-FIDU+ features, a pre-distortion algorithm for IF signal (ADPD – Adaptive Digital Pre-Distortion), which ensures increased output power.

ATPC (Automatic Transmit Power Control)

ACM can be implemented together with **automatic transmit power control (ATPC)**. ATPC reduces the average transmitted power as well as co-channel interference (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's momentary conditions. The lower average Tx power also extends the equipment's meantime between failures.

ATPC can be used together with ACM to control the transmitted power in any given ACM profile. Different configurations 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 configuration, ATPC reduces the average transmitted power, benefiting each ACM profile and any link condition.

Integra-X/-X2/-FIDU/-FIDU+ receives information about the Rx level from the far-end Integra-X/-X2/-FIDU/-FIDU+ through the service channel. Depending on the received Rx level parameter, the local Integra-X/-X2/-FIDU/-FIDU+ adjusts the transmitter power per the algorithm shown below.



Rx level – the Rx level value received from the far-end site
Rx max – maximum permissible Rx level at the far-end site
Rx min – minimum permissible Rx level at the far-end site
Tx correction – value by what ATPC has decreased Tx power
Tx correction limit – defined maximum of Tx correction
Delta – the value by which Tx power is changed according to the far-end Rx level indication (1dB by default)

Figure 5-6 ATPC algorithm flow diagram

Link State Propagation and Backup

Link state propagation

Link state propagation (LSP) functionality allows shutting down specified LAN ports if synchronization loss events occur so that customer-premises equipment (CPE) can apply necessary changes promptly. LSP could be used for faster backup link activation or when link aggregation is used with external switches. There could be a situation when the radio link has errors or a critical bitrate drop, but this is not effectively detected by the connected CPE switch, and data loss could occur.

For example, let's look at a time delay at LACP when detecting the fault of a LAG (Link Aggregation Group) member. Please see Figure 5-7 Link aggregation with LSP *Figure 5-7* below.

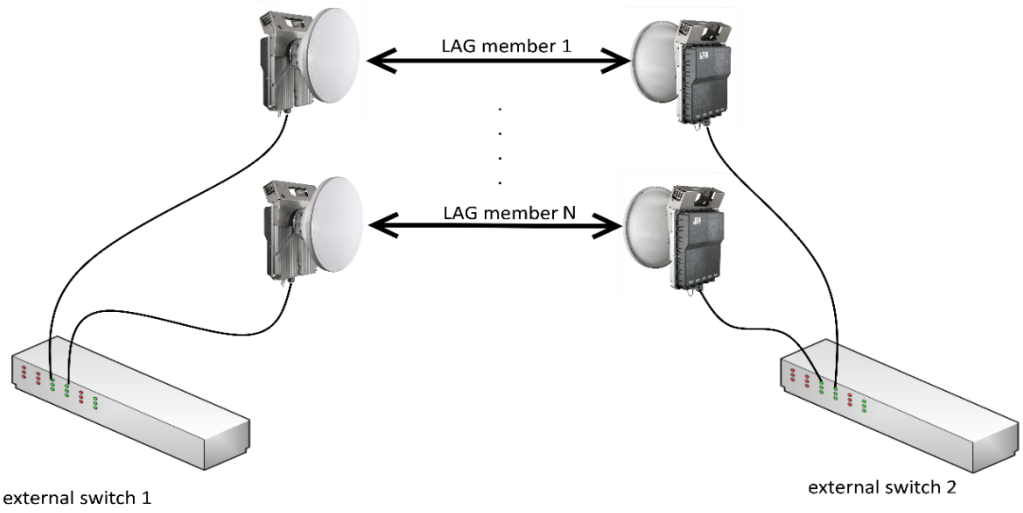


Figure 5-7 Link aggregation with LSP

During normal operation, all LAG members have equal capacity, and external switches pass data from all ports. If one of the LAG member links has failed or degraded below a certain level, then LACP doesn't react instantly; there is usually about a minute delay when data is still sent to the faulty member and is lost. To avoid this, you can configure certain thresholds on the Integra-X/-X2/-FIDU/-FIDU+ (please see *Networking → Ethernet → Link State Propagation and Backup* for the configuration) for Tx, Rx, or both Tx and Rx bitrates on the WAN port when the link is considered as lost and the port is blocked instantly, thus forcing LACP to exclude this path from the LAG or switch to the backup link to avoid data loss during the fault detection time.

The main threshold you can configure here is a "Min required capacity" – the link capacity value under which LSP is triggered. When this happens, the designated LSP port is disabled, and all traffic at the port is discarded. Please pay attention to the considerations below:

1) Check the management channel configuration – if the management is accessible only through the port with an enabled LSP, access to the radio will be lost. To avoid this, we recommend using a different port for the management when using LSP or Backup-Link functionality. Management cables are not shown in *Figure 5-7.*
2) When traffic is asymmetric in both directions, you can choose the traffic direction that triggers LSP using "Mode" selection. It is possible to choose ingress or egress traffic and specify the appropriate threshold for it.

By default, "Min required capacity" is set to "0", meaning that LSP is triggered only when link synchronization is down.

LSP state is switched off when the configured "Min required capacity" is exceeded. There is a special case when "LAN auto recovery" is not "0". In this case, the LSP state is switched "off" after the configured time, and the port becomes active.

Backup link

The Backup-link has the same activation logic as LSP; however, in this case, data is not dropped, but switched to a "Backup-link port". This allows to activation of a LAN port when link synchronization is down, or link capacity drops below a defined threshold while keeping the LAN port disabled during normal operation. This allows the primary link to carry traffic during normal conditions and reroute the traffic flow to a backup link when configured trigger conditions are met. See the example in *Figure 5-8.*

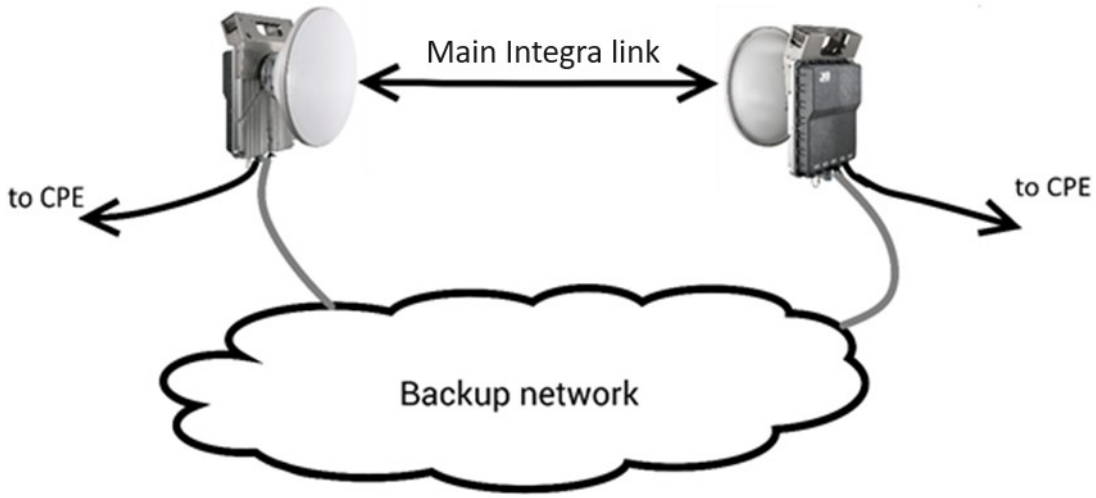


Figure 5-8 Primary Integra link with the backup network

In the event of a main link failure, traffic is seamlessly redirected to the configured backup ports. The backup link may utilize an IP network or another radio link, typically operating at a lower frequency and offering greater resilience to environmental factors such as precipitation.

A common deployment scenario involves dual-band operation: an 80 GHz (E-band) high-capacity link (up to 10 Gbps) is used as the main link, while a licensed microwave link, such as an 18 GHz SAF Integra-X microwave providing up to 2.2 Gbps, is configured as the backup. This dual-band setup ensures service continuity during adverse weather conditions. For instance, if the E-band link degrades below 1.5 Gbps due to heavy rain, traffic is rerouted to the more resilient microwave link. Refer to Figure 5-10 for an example.

Upon backup link activation, the MAC table is flushed, and the main link WAN port begins discarding traffic to avoid duplication. Management of the remote device is maintained via the backup link. Additionally, QoS policies can be applied to traffic traversing the backup path.

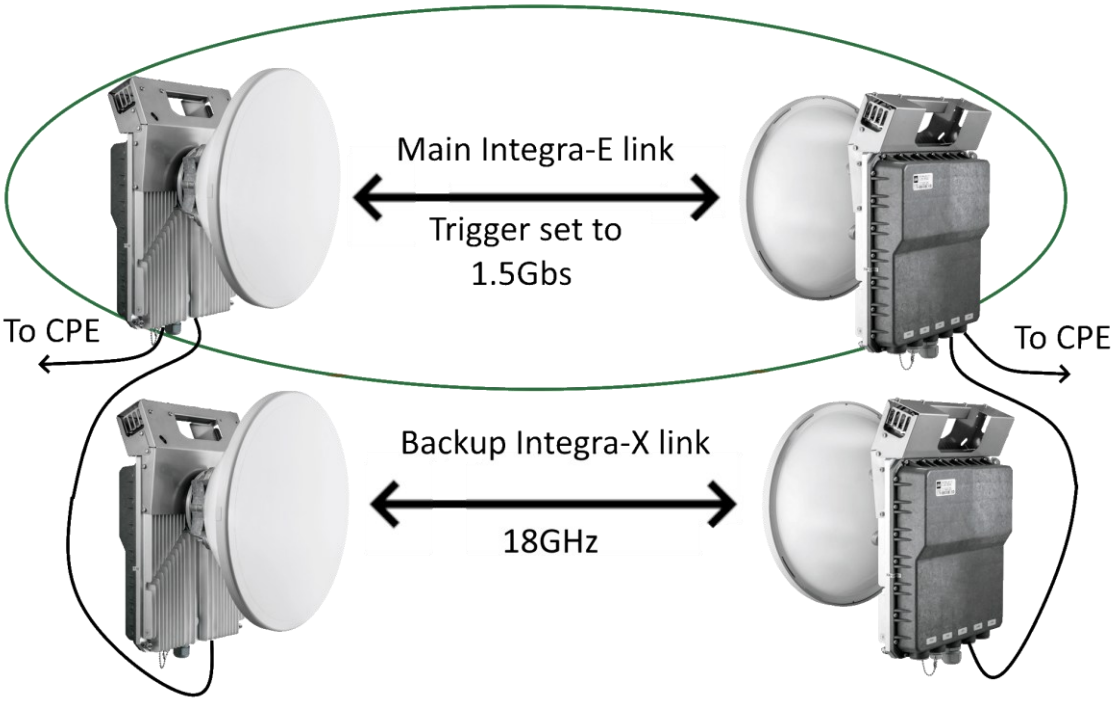


Figure 5-9 Backup through 18 GHz Integra-X/-X2 link

Inverse Backup

The Inverse Backup logic is very similar to Backup-link mode, but the main difference is that Main data link and Backup link are reversed. See the example below in *Figure 5-10*.

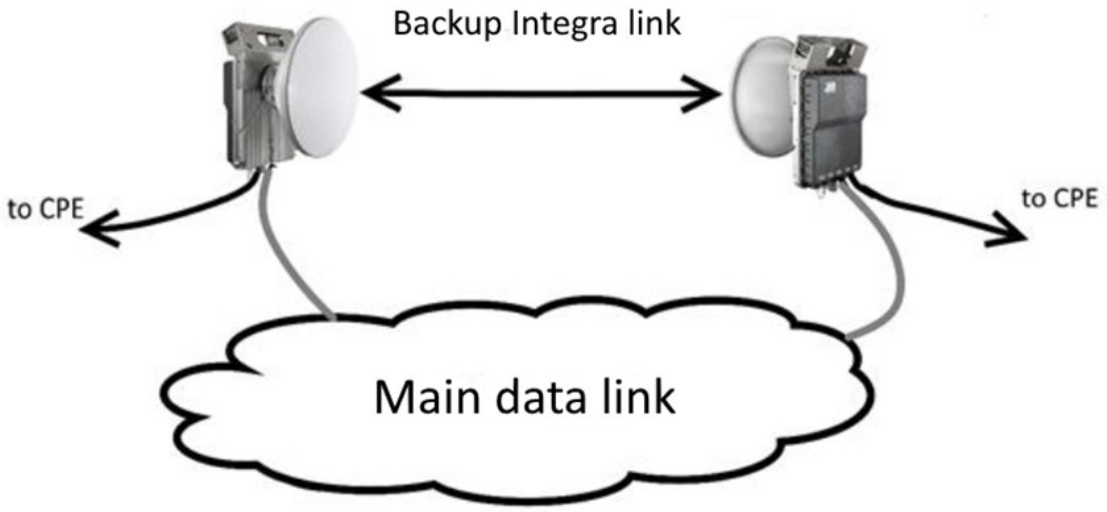


Figure 5-10 Backup Integra-X/-X2 link with Main data link

The terminology used for the Inverse Backup state on the WEB GUI page remains the same as for the Backup-link state. Refer to *Networking → Ethernet → Link State Propagation and Backup* section for the description of the corresponding WEB GUI page.

During normal operation, traffic on the backup Integra link is switched to the configured Backup-link port, which should be connected to the Main data link, but the WAN (on the Backup Integra link) discards traffic.

During the connection failure on the configured Backup-link LAN port, traffic is switched to the Backup Integra link WAN port, and the Main data link becomes completely isolated, meaning that management access to the Main data link equipment will be unavailable via Backup-link LAN port. It is important that the equipment on the Main data link is capable of disabling the LAN port connected to the backup Integra link if the Main data link fails; otherwise, the switchover to the Backup Integra link will not take effect.

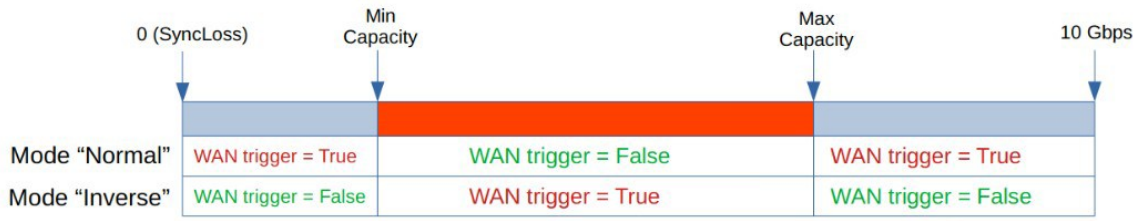
Link state propagation Advanced

LSP Advanced functionality provides the ability to separately configure WAN status trigger conditions and timers for each LSP port. This means that ACM switching to some modulation, ensuring a particular WAN speed, may trigger the disabling of one LSP port and the enabling of another. Each port separately monitors WAN condition and has its own min/max Ethernet capacity thresholds.

“WAN Trigger” condition activation (True state) – triggers the corresponding port to switch off.

“WAN Trigger” condition is responsible for monitoring the status of the WAN link and provides information about whether the LSP port must be switched to “DOWN” or “UP” state. “WAN Trigger” allows specifying the WAN capacity range (0 – 10000 Mbps, the value “0” means that LSP Advanced is triggered in case of synchronization loss) within which a trigger must be enabled or disabled. The “WAN Trigger” logic has direct and inverse modes of operation: “Normal” and “Inverse”, where “Normal” mode activates the trigger when the capacity is outside of the configured range, and “Inverse” mode activates the trigger when the capacity is within the configured range.

LSP port switching action after the “WAN Trigger” action can be delayed by using the “Timer on Activation” and “Timer on Deactivation”. The “Timer on Activation” provides a time delay after the “WAN Trigger” switches from “False” to “True” state before the LSP port switches to “DOWN” state. The “Timer on Deactivation” provides a time delay after the “WAN Trigger” switches from “True” to “False” state before the LSP port switches to “UP” state. See the “WAN Trigger” and timer logic in *Figure 5-11*.



SyncLoss	Wait Activation timer	Set port DOWN
WAN Trigger = True	Wait Activation timer	Set port DOWN
WAN Trigger = False	Wait Deactivation timer	Set port UP

Figure 5-11 LSP Advanced “WAN Trigger” logic

WAN High Priority port (packet fragmentation)

There are two Ethernet ports connecting the modem and the switch of the Integra-X/-X2/-FIDU/-FIDU+: WAN HP (High Priority) and WAN LP (Low Priority). The WAN packet fragmentation functionality provides a means to split traffic between the WAN HP port and WAN LP port.

The WAN HP port is meant for small-sized and latency-sensitive frames (e.g., voice, video, telephony) – these frames are transmitted with higher priority and never get fragmented before being transmitted over the radio channel.

The WAN LP is meant for bulk traffic – larger or jumbo frame size and non-sensitive to latency (e.g., WEB traffic, file transfer). These frames are inferior in priority than the frames going over the

WAN HP link. Transmission of a single low-priority jumbo frame over the radio in one piece may cause increased delay to high-priority packets waiting in a queue. Therefore, large frames may be fragmented in the WAN LP link, so that small delay-sensitive frames in the WAN HP link may be transmitted in between (as shown in *Figure 5-12*).

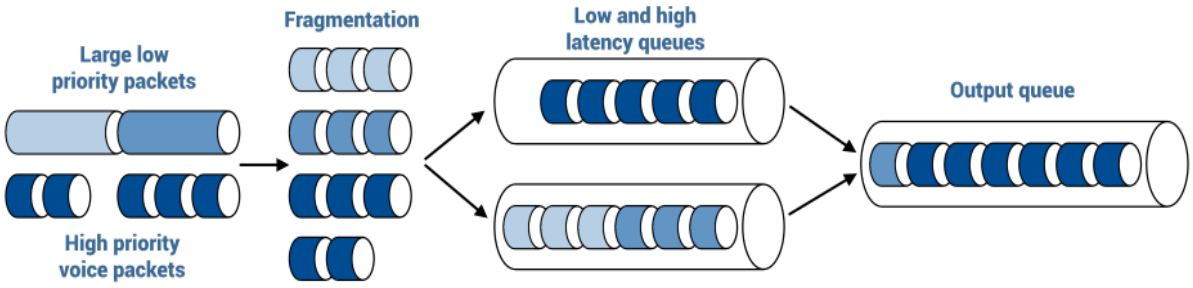


Figure 5-12 WAN packet fragmentation and interleaving algorithm

WAN packet fragmentation splits traffic between the WAN HP and WAN LP ports based on VLAN ID, as shown in *Figure 5-13*. Note that VLANs must be enabled on the device to use the WAN HP port functionality.

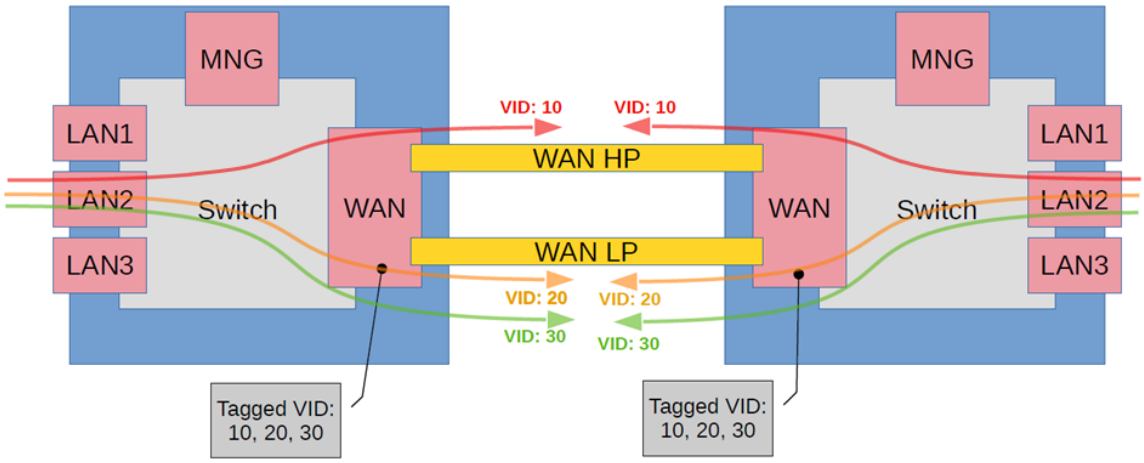


Figure 5-13 Example of splitting different VLANs to HP and LP ports over the WAN channel

Only those VLANs (single ID or range) may be redirected to the WAN HP port, which is configured as Tagged (Trunk) on the WAN port. Configuration must be identical on the local and the remote devices for proper operation.

In case VLAN mode is switched to “Disable”, packet fragmentation will be disabled automatically.

In case VLAN ID (or range) are removed from the WAN port, they are removed from the WAN HP redirection table automatically.

Header compression

In many applications, such as Voice over IP (VoIP), interactive gaming, or messaging, the size of the header is significant compared to the size of the payload data. Over the end-to-end connection comprised of multiple hops, these headers are significant, but they can be omitted over a single link. It is beneficial to compress those headers to provide high-capacity packet saving, achieve better bandwidth utilization, and efficiently use expensive resources. Reduction in packet loss and improved interactive response time are additional important benefits gained by the header compression.

Header compression is accomplished by identifying packets with a recurring pattern of their header fields. Such header fields with recurring values are omitted and replaced with a much shorter tag (2 to 4 bytes). The tag that replaces the mask is known as a compression tag.

Packet Header Compression Header compression engine enables the compression of the following protocols over the radio link:

- VLAN
- IPv4
- IPv6
- UDP
- TCP

Header compression creates a compression gain, which is the ratio between the original packet capacity and the compressed packet capacity. The compression gain achieved depends on the header and packet size, and the recurrence of the various packet types. For example, compressing Layer 2 and Layer 3 headers of 128-byte long Ethernet frames yields more than 37% compression gain (this includes IFG, Preamble, and FCS removal, and GFP-added encapsulation), e.g., instead of 460 Mbps without Header compression, tests show 633 Mbps with Header Compression.

In this example, packets had Layer2+VLAN(0x8100)+VLAN(0x8100)+IPv4+TCP headers. See the picture below (header fields in white are not subject to compression).

Besides, the removal of Layer1 Preamble (7 bytes), start frame delimiter (1 byte), FCS (4 bytes), and Interframe Gap (12 bytes) takes place.

A handshake mechanism between the transmitter and the receiver ensures that header compression is synchronized on both sides of the link. The receiving side is removing the compression headers and reconstructing the original header fields.

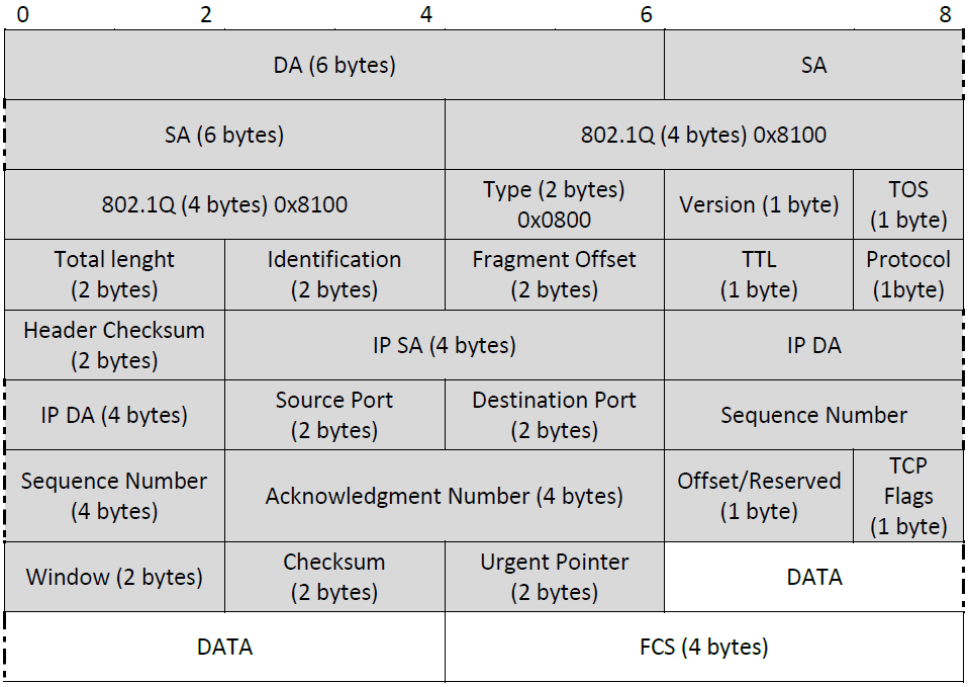


Figure 5-14 Datagram structure with Layer 2 – Layer 4 headers

Header Replacement

At the transmitter, the header is removed and replaced by the compression tag.

One of the bits in the GFP header indicates to the receiver if the packet is compressed.

The receiver uses the compression tags to search the database for the original header fields. It then replaces the compressed tags with the original header fields. In case the original packet CRC was removed, a new CRC is recalculated at the MAC.

Example with the same as above (2x802.1Q VLAN + IPv4 + TCP) 128-bytes frame:

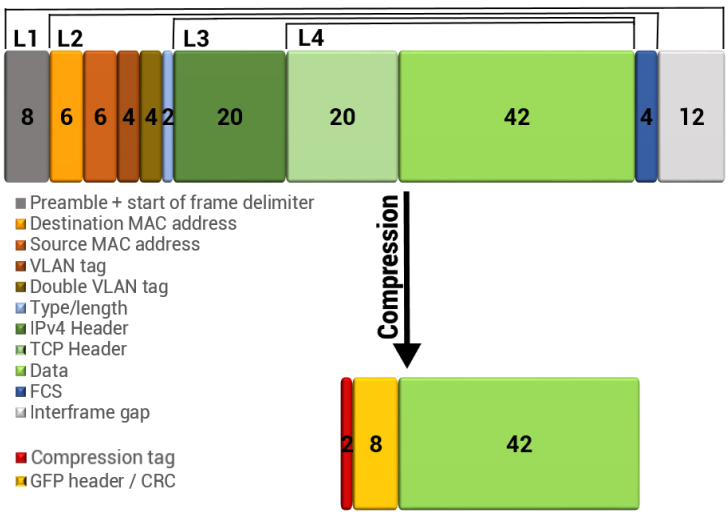


Figure 5-15 Example of the header replacement result

Header Compression Statistics

The average compression gain is calculated by reading byte counters in a 1s resolution period.

The compression measures the net compression gain and the gross compression gain:

- Net compression gain represents the compression ratio in the percentage of the outgoing bytes of the header compression block to the incoming bytes.
- Gross compression represents the compression ratio in percentage between incoming bytes the outgoing bytes, including the PLA and the GFP overheads.

Adaptive equalizer

Integra-X/-X2/-FIDU/-FIDU+ radios feature an 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 for the inequalities in frequency response, mitigating the effects of multipath propagation or interference. From the equalizer graph (*Performance → Over The Air → Equalizer graph*) you can find input signal spectrum distortions in Integra-X/-X2/-FIDU/-FIDU+, using QAM modulation. This filter equalizes not only a separate quadrature channel but also provides cancellation of cross-interference between polarizations.

The adaptive equalizer is realized as a complex-arithmetic 40-tap digital FIR (Finite Impulse Response) filter. In other words, the equalizer is a selective frequency amplifier and attenuator, a device, in application to an IF (Intermediate Frequency) band-limited signal, is schematically shown in the picture below:

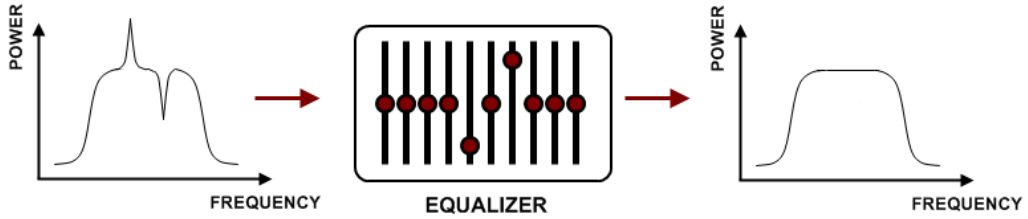


Figure 5-16 Adaptive equalizer

Firmware upgrade management with SNMP

The firmware upgrade procedure can be performed using a set of SNMP read/write variables. This allows optimizing the process for a large number of radio units in a network.

The following steps describe the whole process.

1) Enable the FTP server by setting (SNMP SET command) **integraXsysServicesFtpSwitch** variable to “2”.
2) Check if the FTP server is enabled by reading (SNMP GET command) the following variable: **integraXsysServicesFtpSwitch**.
3) Transfer the required firmware file (“bin” file inside the FW package archive) to the "firmware" folder in the FTP directory (for more information, refer to the chapter *FTP directory*). Use the following FTP address: **ftp://anonymous@DEVICE_IP:/firmware/** (where *DEVICE_IP* should be substituted with the IP address of Integra radio).
4) Initiate the upload of the transferred firmware file by setting **integraXsysServicesFwUpload** variable to “1”. Only a single firmware file is allowed to be present in the "firmware" folder during the upload. Please note that the command execution usually takes up to 30 seconds, and SNMP read/write requests will return a timeout error during this time. In about 30 seconds, the newly uploaded firmware should be seen in **integraXsysServicesFwAvailView** list (see the next step) and available for installation.
5) View information about the firmware versions already available for installation by reading **integraXsysServicesFwAvailView** variable: you will get a string containing index numbers and names of all firmware versions available for installation (n1: candfw1; n2: candfw2; etc.).
6) As the memory allocated for the firmware files is limited, the upload can fail if there are several firmware versions already uploaded (a maximum of 5 files are permitted). The unnecessary items can be removed with **integraXsysServicesFwRemove** variable (setting to “n", where “n” is the index number of the selected firmware file from **integraXsysServicesFwAvailView** list). All items can be removed by setting **integraXsysServicesFwRemoveAll** variable to “1".
7) Install the required candidate firmware by setting **integraXsysServicesFwInst** variable to “n", where “n” is the index number of the selected firmware file from **integraXsysServicesFwAvailView** list. Please note that the installation execution usually takes up to 30 seconds, and SNMP read/write requests will return a timeout error during this time.
8) In about 30 seconds, initiate system reboot by setting **integraXsysServicesReboot** to “1”.
9) After the system reboots, check the current FW version by reading **integraXsysServicesFwCurrInfo** variable.
10) As additional functionality, a user can switch between two firmware banks (fw1 and fw2) using **integraXsysServicesFwSwitchNext** variable (setting to “1/2” for fw1/fw2 bank accordingly). This will change the firmware bank that will be used during the next startup. The currently used firmware bank can be viewed by reading **integraXsysServicesFwSwitchRunning** variable. The firmware bank selected for the next startup can be checked by reading **integraXsysServicesFwSwitchNext** variable. Please note that when the firmware is installed, it is assigned to a vacant bank (not occupied by the previously running firmware); this bank will be selected for the next startup automatically.

The description of the relevant OIDs is given in the table below:

integraXsysServicesReboot (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.1)	WRITE	Set "1" to initiate a system reboot.

integraXsysServicesFtpSwitch (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.2)	READ-WRITE	Status and on/off switch for the FTP server (set "1/2" to disable/enable).
integraXsysServicesFwCurrInfo (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.3)	READ-ONLY	Currently running FW information.
integraXsysServicesFwAvailView (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.4)	READ-ONLY	List of the uploaded FW files available for installation.
integraXsysServicesFwRemove (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.5)	WRITE	Set "n" to remove the n-th FW file from the uploaded FW list.
integraXsysServicesFwRemoveAll (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.6)	WRITE	Set "1" to remove all FW files from the uploaded FW list.
integraXsysServicesFwUpload (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.7)	WRITE	Set "1" to start the upload and make the FW available for installation.
integraXsysServicesFwInst (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.8)	WRITE	Set "n" to install the n-th FW file from the uploaded FW list.
integraXsysServicesFwSwitchRunning (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.9)	READ-ONLY	Currently running FW bank.
integraXsysServicesFwSwitchNext (.1.3.6.1.4.1.7571.100.1.1.7.10.4.46.10)	READ-WRITE	The next startup FW bank (set "1/2" to change the FW bank for the next startup)

RADIUS authentication

Configuration of the RADIUS server authentication

Always check your RADIUS server documentation before modifying the RADIUS configuration.

RADIUS vendor ID for Integra series equipment is **7571**.

The configuration of the FreeRADIUS software based on the Linux system (Ubuntu) is given below as an example. Keep in mind that there could be differences in command syntax and file locations between FreeRADIUS software versions; always check the FreeRADIUS documentation.

1) Add new user data to the users` configuration file: */etc/freeradius/users.* Add the following line to the users` list:

user_1 Cleartext-Password := "pass_1"

where user_1 is a user name and pass_1 is a password.

```
# This is a complete entry for "steve". Note that there is no Fall-Through
# entry so that no DEFAULT entry will be used, and the user will NOT
# get any attributes in addition to the ones listed here.


user_1  Cleartext-Password := "pass_1"

#
#steve  Cleartext-Password := "testing"
```

Figure 5-17 Configuration example in FreeRADIUS software (1)

2) Add client (Integra-X/-X2/-FIDU/-FIDU+) data by editing the client's configuration file: /etc/freeradius/clients.conf. Add the following lines specifying Integra-X/-X2/-FIDU/-FIDU+ IP address and the RADIUS secret:

client 192.168.205.10 {

secret = radiuspass_1

}

where *192.168.205.10* is the IP address of Integra-X/-X2/-FIDU/-FIDU+, *radiuspass_1* is the RADIUS secret word.

```
#  the "ipaddr" or "ipv6addr" fields.  For compatibility, the 1.x
#  format is still accepted.
#


client 192.168.205.10 {
secret = radiuspass_1
}
```

Figure 5-18 Configuration example in FreeRADIUS software (2)

3) Restart FreeRADIUS.
4) Set up the RADIUS configuration in Integra-X/-X2/-FIDU/-FIDU+ Web GUI:
   a. Open the RADIUS server configuration page (*System → Configuration → System services*).
   b. Configure the RADIUS port, RADIUS server IP address, and RADIUS secret parameters according to your setup.

RADIUS server should belong to the same subnet as Integra-X/-X2/-FIDU/-FIDU+ and should have the same secret word as Integra-X/-X2/-FIDU/-FIDU+.

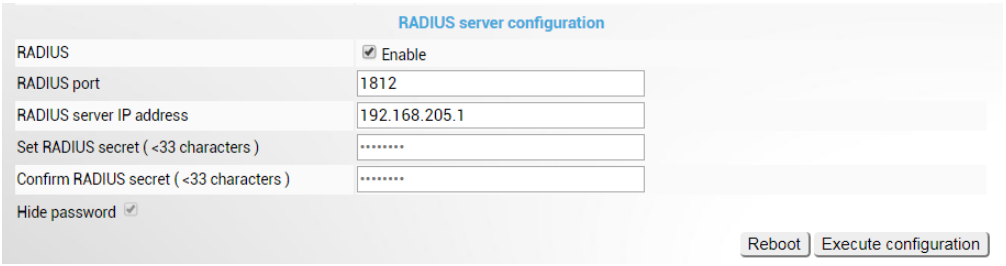


Figure 5-19 RADIUS server configuration in Integra-X/-X2/-FIDU/-FIDU+ WEB GUI

5) Execute a configuration, save the configuration changes, and reboot Integra-X/-X2/-FIDU/-FIDU+.
6) Log in to Integra-X/-X2/-FIDU/-FIDU+ using the secure HTTPS connection.
7) Proceed to assigning administrative rights to a user if needed, see the next chapter *Assigning administrator rights to a RADIUS user*.

You can log in with users defined both locally and on the RADIUS server.

Assigning administrator rights to a RADIUS user

1) Add the corresponding attribute to the main FreeRADIUS dictionary file. Open the file: /etc/freeradius/dictionary and add the following line under the "Miscellaneous attributes…":

ATTRIBUTE SAF-User-Level 52 string

```
#
#       If you want to add entries to the dictionary file,
#       which are NOT going to be placed in a RADIUS packet,
#       add them here.  The numbers you pick should be between
#       3000 and 4000.
#
ATTRIBUTE       SAF-User-Level          52      string
#ATTRIBUTE      My-Local-String         3000    string
#ATTRIBUTE      My-Local-IPAddr         3001    ipaddr
#ATTRIBUTE      My-Local-Integer        3002    integer
~
```

Figure 5-20 Configuration example in FreeRADIUS software (3)

2) To provide the specified attribute to the user who must be granted administrator rights, open the users` configuration file: /etc/freeradius/users and insert the following line below the definition of the user name and password:

SAF-User-Level = admin

For example:

user_1 Cleartext-Password := "pass_1"

SAF-User-Level = admin

```
# This is a complete entry for "steve". Note that there is no Fall-Through
# entry so that no DEFAULT entry will be used, and the user will NOT
# get any attributes in addition to the ones listed here.


user_1  Cleartext-Password := "pass_1"
        SAF-User-Level = admin

#
#steve  Cleartext-Password := "testing"
```

Figure 5-21 Configuration example in FreeRADIUS software (4)

3) Restart FreeRADIUS.

4) Log in to Integra-X/-X2/-FIDU/-FIDU+ using the secure HTTPS connection.

AES - Advanced Encryption Standard

Encryption helps to protect information by transforming the original message, called plaintext, into an encoded message, called ciphertext. For example, the plaintext message "*This is text*", encoded, might look like "*RtÜxø«5Ð$·hÍ*".

AES (Advanced Encryption Standard) is a standardized version of the Rijndael cipher algorithm. The AES algorithm is capable of using cryptographic keys of 128, 192, and 256 bits to encrypt and decrypt data in blocks of 128 bits. Based on key size, AES is named AES-128, AES-192, or AES-256.

AES-256 encryption is available in Integra-X2 and integra-FIDU/FIDU+ models.

SAF's AES-256 encryption fully complies with *Federal Information Processing Standards Publication 197 (2001)* and has been certified with *NIST (FIPS-197)* for Integra-X2 and Integra-FIDU/-FIDU+.

AES 256-bit key is a 64 hexadecimal values (0-9, A-F) sequence. This 64-hex pre-shared key can be entered manually or generated using "Generate random key" button. In the latter case, an internal software secure random number generator will be used for that purpose. The same key has to be used on both sides of the link.

The plaintext input 128-bit block is arranged in the form of a 4 x 4 square matrix of bytes. This block is copied into the state array, which is modified at each stage of encryption or decryption. After the final stage, the output state is copied to an output matrix.

Encryption/decryption starts with an initial single transformation (AddRoundKey), followed by 13 rounds each containing four distinct transformation functions: byte substitution (perform a byte-by-byte substitution of the block), ShiftRows (permutation), AddRoundKey (bitwise XOR of the current block with a portion of the round key), and MixColumns (a substitution that makes use of arithmetic over bytes). The final round contains only the first three transformations of the above.

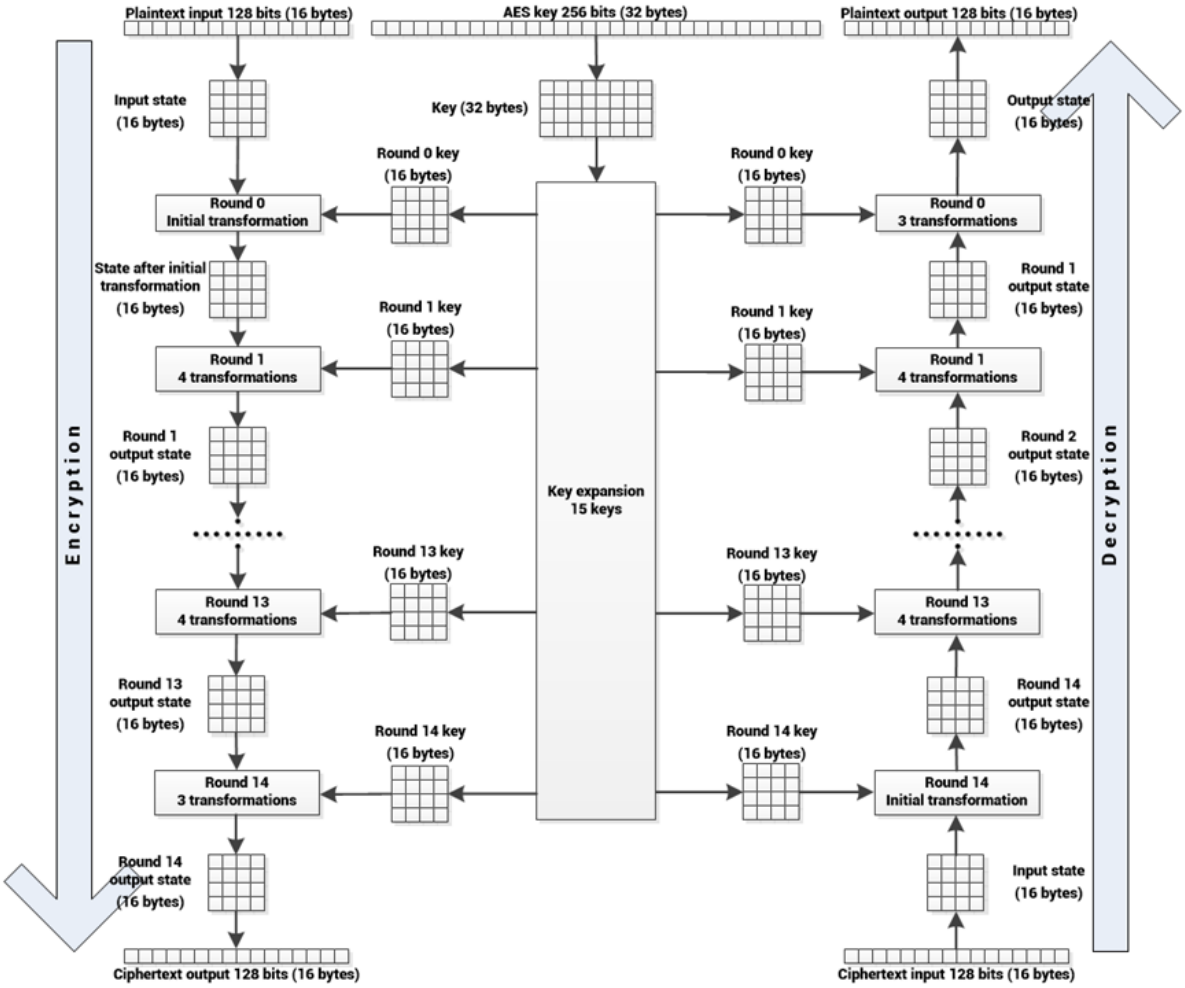


Figure 5-22 AES-256 algorithm illustration

Each transformation takes 4 x 4 matrices as input and produces a 4 x 4 matrix as output.

The key expansion function generates 15 round keys to be used at rounds. Each round key serves as one of the inputs to the AddRoundKey transformation.

The AES-256 algorithm is illustrated in *Figure 5-22*.

The Cipher Feedback (CFB) confidentiality mode (described in *NIST SP 800-38A recommendation* in chapter 6.3) is used in conjunction with AES-256 algorithm in Integra-X2 and Integra-FIDU/FIDU+ products. This 128-bit CFB mode features the feedback of successive ciphertext segments into the input blocks of the forward cipher to generate output blocks that are exclusive-ORed with the plaintext to produce the ciphertext, and vice versa. An unpredictable initialization vector (IV) provided by an internal operating system random number generator is used for CFB implementation.

The CFB mode is illustrated in *Figure 5-23*.

When the AES-256 is enabled the maximum throughput of the Integra-X2 and Integra-FIDU/FIDU+ radio link is 1.68 Gbps.

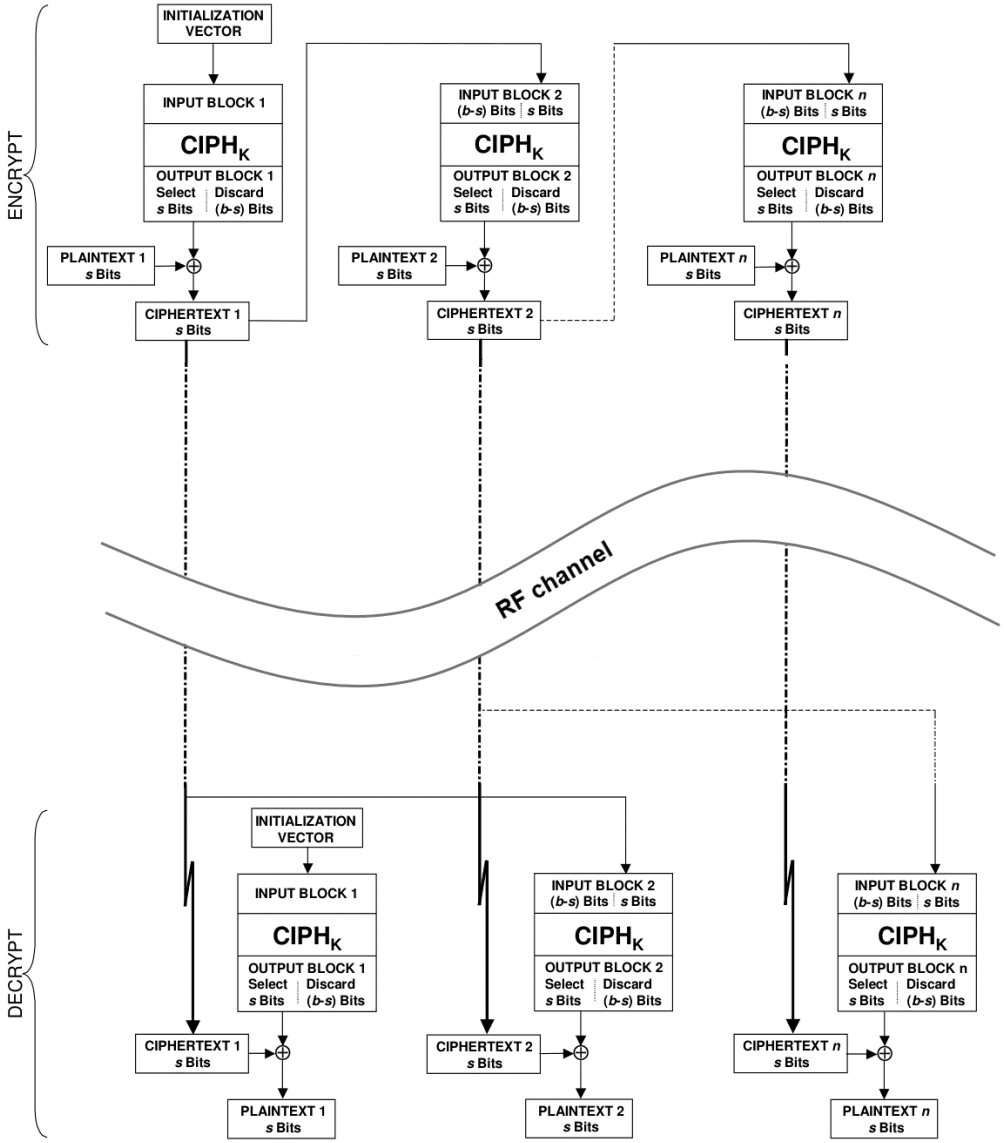


Figure 5-23 The CFB Mode

FIDU+ display panel description

Integra FIDU+ features a touchscreen display on the front panel. The display can be used only for monitoring local and remote terminal status, parameters, and alarms. The display consists of the following sections:

Figure 5-24 Display panel

Header

The display's header shows the following static information:

- Date and time
- FIDU's IP address
- System name

Parameters Pane

The Parameters Pane indicates the main parameters of the local terminal, the status of the local and remote terminal, and the alarm status of the local and remote terminal. This information is displayed based on the chosen menu button on the right side of the display.

Footer

The display's footer shows the following static information:

- Protection status on the Main screen and System temperature on other screens
- FIDU's mode
- FIDU Serial Number (S/N)
- FIDU Firmware version

Menu

The menu contains touchscreen buttons to switch among parameter panes. The following buttons/components are available:

Main – indicates the main parameters of one or both Channels of the terminal, such as Rx modulation, Rx level, Tx power, and modem MSE. It also indicates the main alarm status of the terminal with appropriate color marking – green when no active alarms are present, yellow when one or more minor alarms are active, and red when one or more critical alarms are active.
Some examples:

Figure 5-25 Main menu display

Local status – indicates status information of the local terminal. It contains the following parameters of one or both Channels: ODU Tx/Rx frequencies, information about active and/or standby Tx/Rx channels, actual modem bitrate, and channel bandwidth. Some examples:

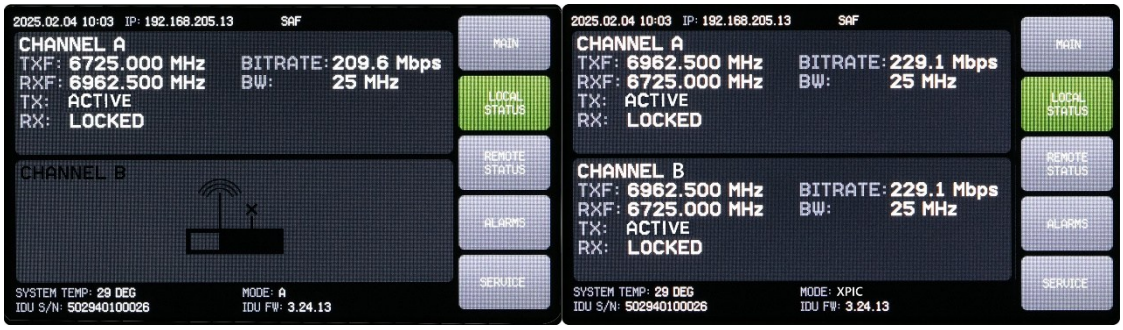


Figure 5-26 Local status display example

Remote status – indicates status information of the remote terminal. It contains the following parameters of one or both Channels: ODU Tx/Rx frequencies, information about active and/or standby Tx/Rx channels, actual modem bitrate, and channel bandwidth. Some examples:

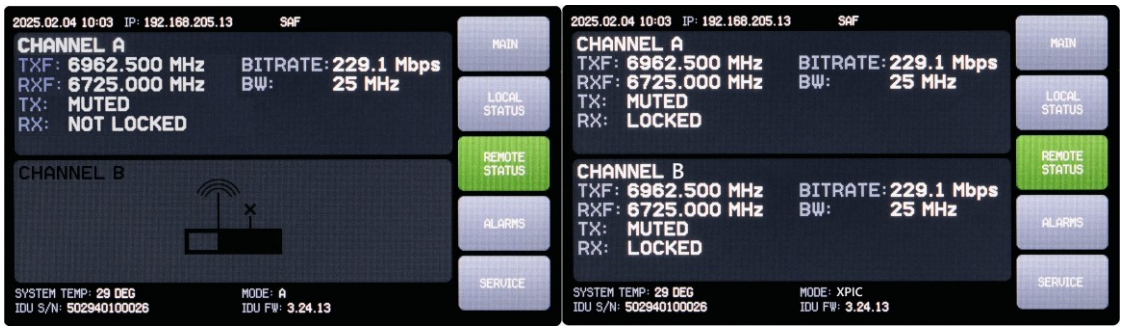


Figure 5-27 Remote status display example

Alarms – indicates active alarm information of the local and remote terminals. The main info panel will display two tabs – Local alarm tab and Remote alarm tab. The arrow buttons  and  on the left side will become active if the alarms list does not fit on a single screen. Arrow buttons will allow you to scroll up and down to view the whole alarm list:

Figure 5-28 Alarm status display examples

Service – indicates the protection information:

The button "**DISENGAGE**" allows switching between the secondary and primary paths. Pressing "DISENGAGE" will start the 10s timer and paths will be switched after the timer expires.

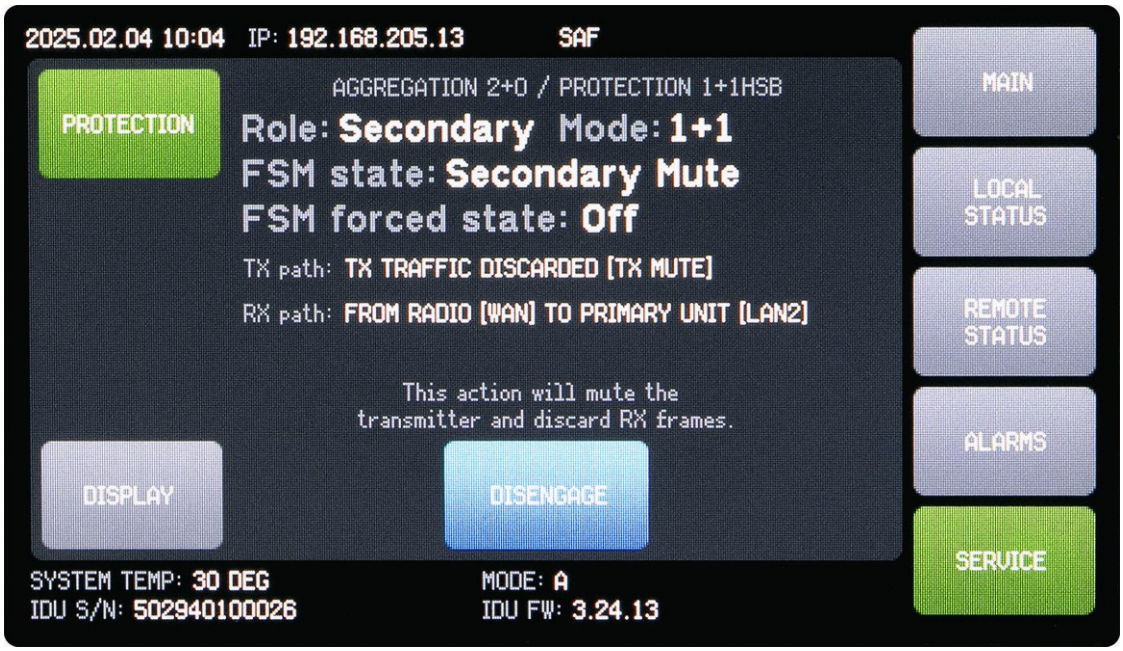


Figure 5-29 Display service menu

The button "**DISPLAY**" shows the current display panel firmware version. A new FW will be installed along with the radio FW installation. You can force reinstallation of the display FW by pressing the button "Install", the countdown will start from 10, and the display FW will be updated. The screen may be inaccessible for up to 5 minutes during the upgrade.

Figure 5-30 Service FW display

The Display **Service** screen contains a control board status command button which can be used only for troubleshooting purposes. By pressing this button, the status information and parameters list will be displayed:

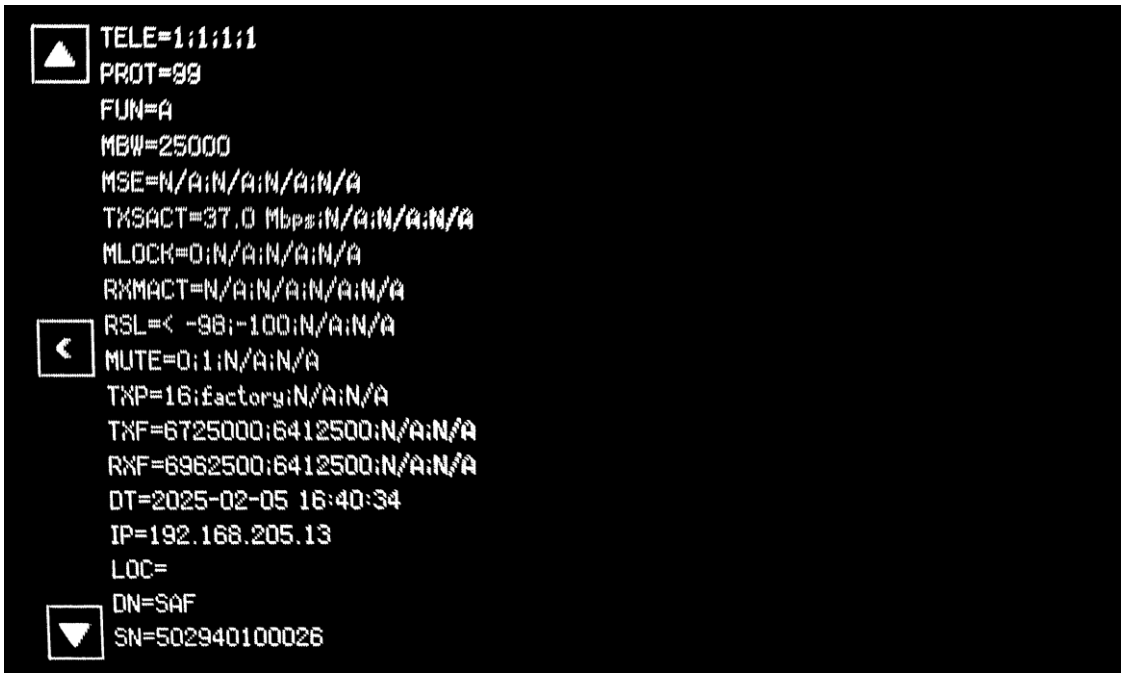


Figure 5-31 Display service screen control board status

The arrow buttons and allow scrolling up and down and viewing the whole parameter list. The button allows returning to the Display Service screen.

Chapter 6 EXAMPLES

Example 1 – 1+1 HSB mode (1x unit per site)

1+1 HSB (Hot Standby) protection configuration is supported by Integra-FIDU/FIDU+ without a diplexer (IBU required), Integra-X, and Integra-X2. It is not supported by Integra-FIDU/FIDU+ with a diplexer, as it only supports 1+0 and 2+0 configurations.
1+1 HSB protection provides hardware redundancy for a single traffic channel in case of equipment failure. At any given time, traffic is carried on only one channel (A or B), while the transmitter of the standby channel is automatically muted. The equipment provides a hitless switchover in case of receiver failure, and a short traffic interruption during switchover in the case of a transmitter failure.

Functional diagrams illustrate logical signal flow and redundancy behaviour.
Connection diagrams illustrate physical cabling, waveguides, and port usage.

The functional diagram for 1+1 HSB is shown in *Figure 3-13*.

1+1 HSB Integra-FIDU/FIDU+ connection diagram

1+1 HSB connection diagram for fully indoor use with Integra-FIDU and Integra-FIDU+, and IBU is shown in *Figure 6-1*.

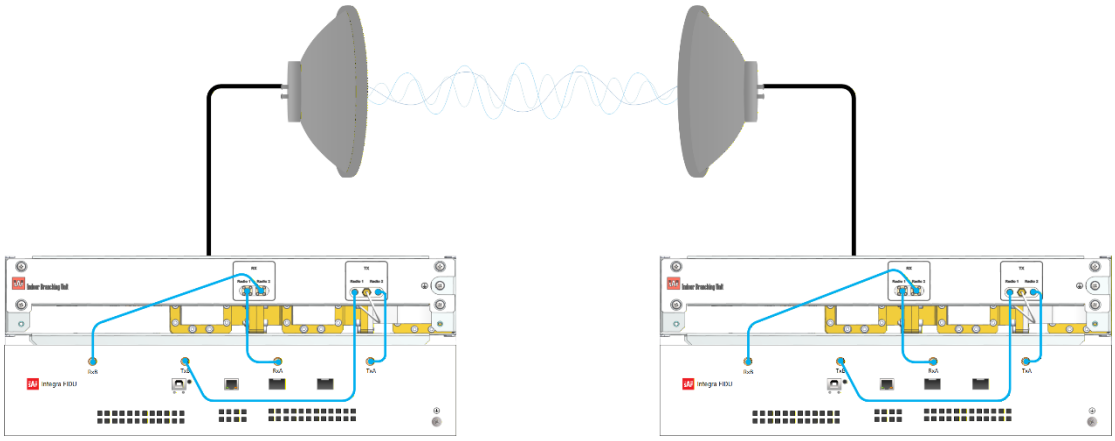


Figure 6-1 Integra-FIDU 1+1 HSB connection diagram

1+1 HSB Integra-X/X2 connection diagram

1+1 HSB scheme for Integra-X and Integra-X2 includes an antenna (1), a coupler (2), waveguides (3), a tower mountable OMT (4), and a single FODU (5). The 1+1 HSB connection diagram is shown in *Figure 6-2*.

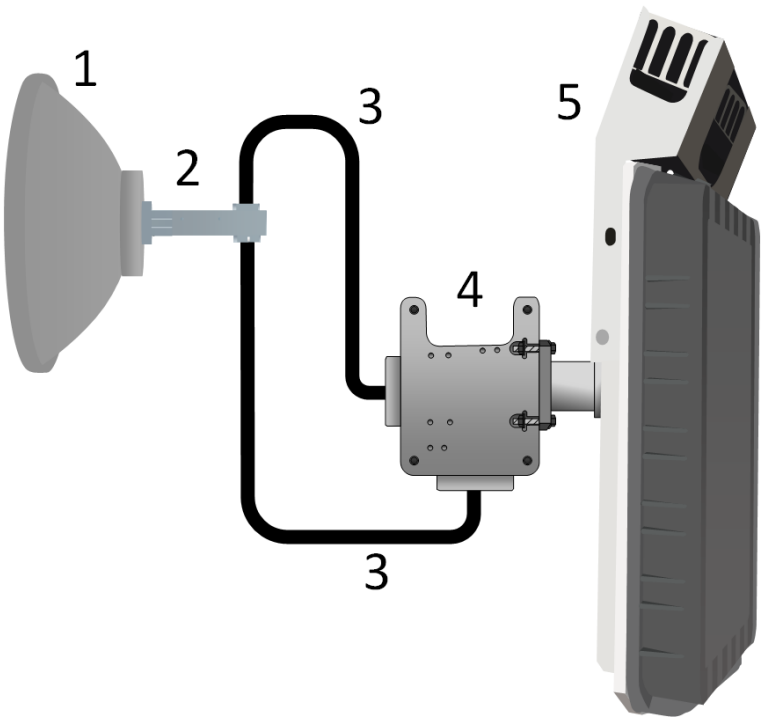


Figure 6-2 1+1 HSB connection diagram for Integra-X/X2

The 4(U) GHz Integra-X/X2 does not need the tower mountable OMT, as FODU in this frequency band features two N-Type interface ports. It can be directly connected to a single antenna with coaxial cables and a coupler (for more information, refer to *Attaching FODU to the antenna*. Integra-X/X2 4(U) GHz FODU 1+1 HSB connection to the antenna is shown in *Figure 6-3* 1+1 HSB connection diagram for Integra-X/X2 4(U) GHz frequency range. It includes an antenna (1), a coupler (3), waveguides (2), and a single FODU (4).

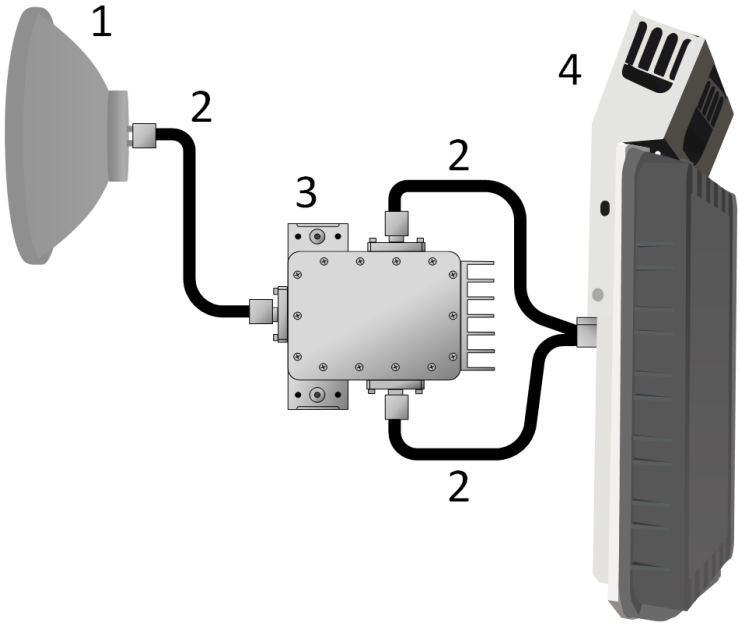


Figure 6-3 1+1 HSB connection diagram for Integra-X/X2 4(U) GHz frequency range

1+1 HSB Integra-FIDU/FIDU+, Integra-X/X2 configuration

The key steps for configuring 1+1 HSB in the Web GUI Main Menu are shown in *Figure 6-4 1+1 HSB configuration on the* Main page.

0 - Enter MODIFY mode. See details in *Main page*.
1 – Select HSB from the Mode drop-down menu.
2 – Select Channel A or Channel B from the Preferred Transmitter menu.
3 to 7 – For items 3, 4, 5, 6, and 7, refer to the *SD mode and HSB mode* section.
After completing the settings, execute and save the configuration.

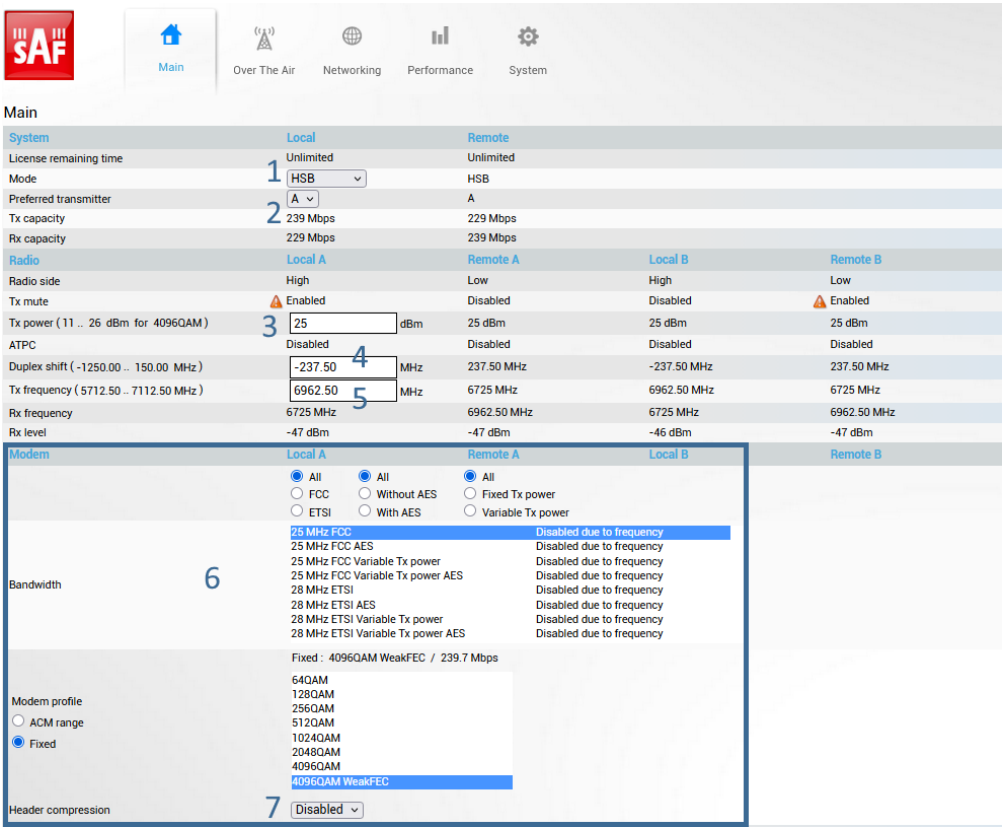


Figure 6-4 1+1 HSB configuration on the Main page

Example 2 – 1+1 SD mode (1x unit per site)

1+1 SD (Space Diversity) protection configuration is supported by Integra-FIDU/FIDU+ without a diplexer (IBU required), Integra-X, and Integra-X2. It is not supported by Integra-FIDU/FIDU+ with a diplexer, as it only supports 1+0 and 2+0 configurations. In 1+1 SD mode, traffic is carried over a single transmission channel.

The 1+1 SD protection scheme improves link reliability in the event of a transmission channel failure caused by hardware faults or adverse propagation conditions, such as multipath fading or surface reflections. In this configuration, one transmitter is active while the second transmitter is automatically muted, and two receivers simultaneously receive the same signal. The modem continuously evaluates the received signals and selects the better one for final data demultiplexing. Two antennas, spaced at a calculated distance and using the same polarization, are deployed—one for the main channel and one for the diversity channel. In the event of a hardware failure, the system provides hitless switchover for receiver failures, while a short traffic interruption may occur during switchover in the case of a transmitter failure.

The functional diagram for 1+1 SD configuration is shown in *Figure 3-12*.

1+1 SD Integra-FIDU/FIDU+ connection diagram

1+1 SD connection diagram for Integra-FIDU/FIDU+ with IBU for fully indoor use is shown in *Figure 6-5* below.

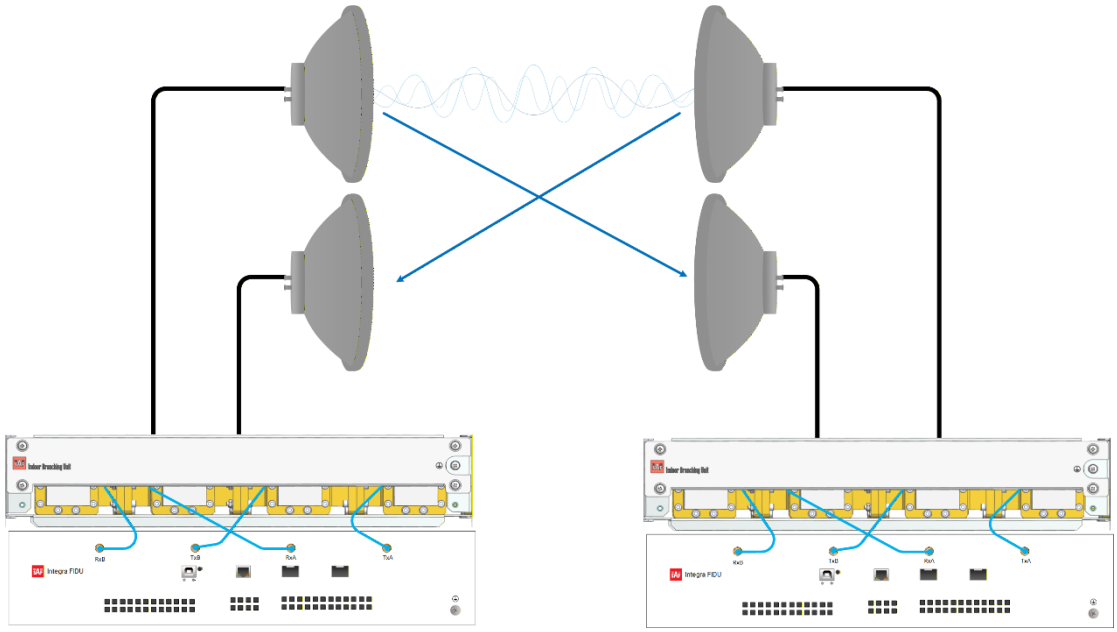


Figure 6-5 1+1 SD connection diagram for Integra-FIDU/FIDU+

1+1 SD Integra-X/X2 connection diagram

1+1 SD scheme includes antennas (1), waveguides (2), a tower mountable OMT (3), and a single FODU (4). 1+1 SD connection diagram is shown in *Figure 6-6* below.

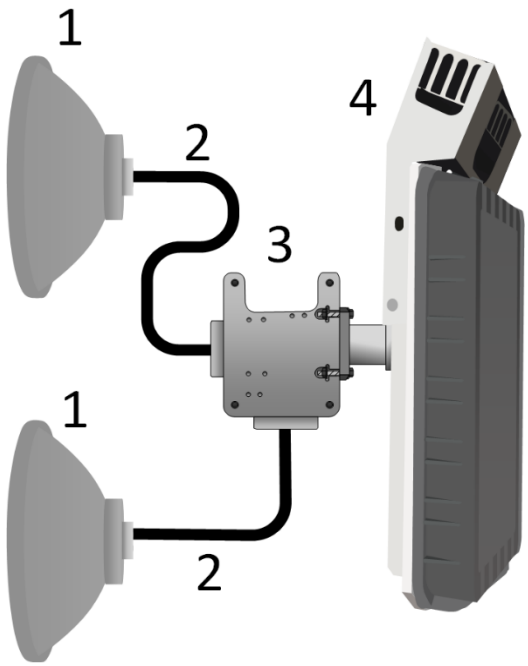


Figure 6-6 1+1 SD connection diagram 6-13 GHz

The 4(U) GHz Integra-X/X2 does not need the tower mountable OMT. It can be directly connected to antennas with a pair of coaxial cables (for more information, refer to Attaching FODU to the antenna). Integra-X/X2 4(U) GHz FODU 1+1 SD connection to the antenna is shown in *Figure 6-7* 1+1 SD connection diagram. It includes an antenna (1), waveguides (2), and a single FODU (3).

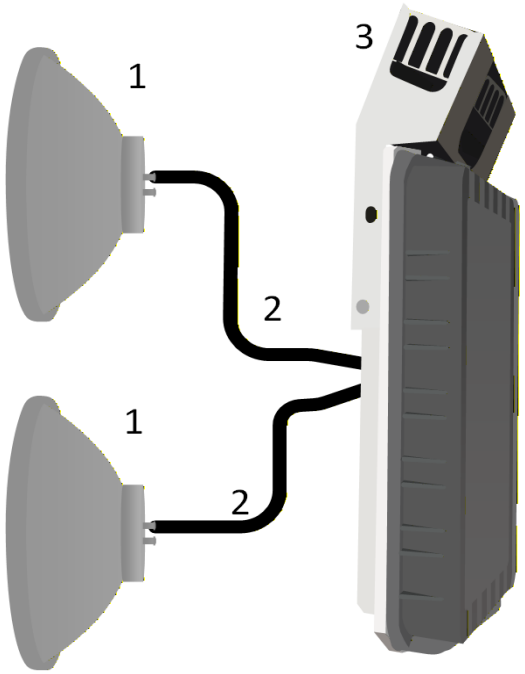


Figure 6-7 1+1 SD connection diagram 4(U) GHz

The recommended spatial separation between space diversity antennas is at least 200 λ (wavelengths). This corresponds to approximately 13 m at 4(U) GHz, 10 m at 6L GHz, 9 m at 6U GHz, 8 m at 7 GHz, 7 m at 8 GHz, and 5 m at 11 GHz frequency bands.

When using a single full outdoor unit with flexible waveguides, it should be noted that flexible waveguides are available in lengths of up to 3.5 m. This limits the maximum achievable antenna separation to approximately 7 m. For larger antenna separations requiring longer waveguides, waveguide dehydrators must be installed.

1+1 SD Integra-FIDU/FIDU+, Integra-X/X2 configuration

The key steps for configuring 1+1 SD in the Web GUI Main Menu are shown in *Figure 6-8*.

0 - Enter MODIFY mode. See details in *Main page*.
1 – Select SD from the Mode drop-down menu.
2 – Select Channel A or Channel B from the Preferred Transmitter menu.
3 to 7 – For items 3, 4, 5, 6, and 7, refer to the *SD mode and HSB mode* section.
After completing the settings, execute and save the configuration.

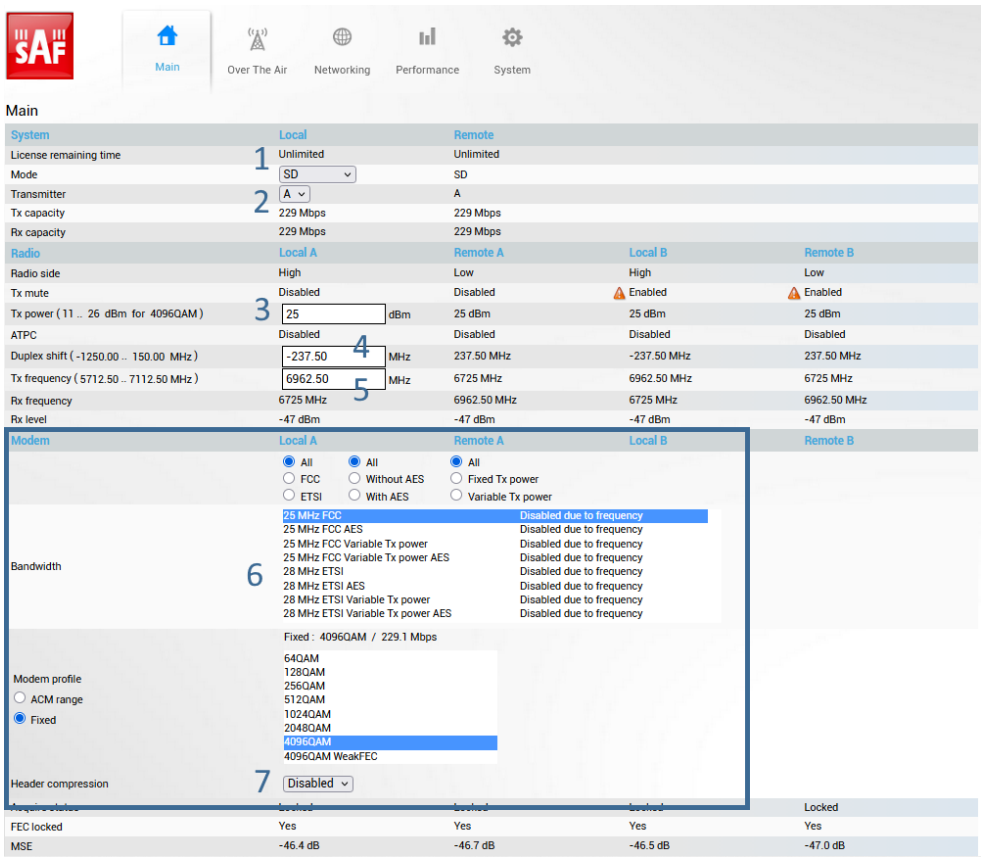


Figure 6-8 SD configuration on main page

Example 3 – 1+1 FD mode (1x unit per site)

1+1 FD (Frequency Diversity) protection configuration is supported by Integra-FIDU/FIDU+ without a diplexer (IBU required), Integra-X, and Integra-X2. It is not supported by Integra-FIDU/FIDU+ with a diplexer, as it only supports 1+0 and 2+0 configurations.

The 1+1 FD protection scheme improves link reliability in the event of a transmission channel failure caused by hardware faults or adverse propagation conditions, such as multipath fading or surface reflections. In this mode, two separate frequency channels are used—one for Channel A and one for Channel B. Both transmitters are active simultaneously on different frequencies and carry identical payload data, while both receivers receive the signals in parallel. The modem continuously evaluates the received signals and selects the better channel for final data demultiplexing. In the event of a hardware failure, the system provides hitless switchover for receiver failures, while a short traffic interruption may occur during switchover in the case of a transmitter failure.

The functional diagram of 1+1 FD mode is shown in *Figure 3-14*.

1+1 FD Integra-FIDU/FIDU+ connection diagram

1+1 FD connection diagram for fully indoor use with Integra-FIDU/FIDU+ and IBU is shown in *Figure 6-9*. If the antenna supports both frequency channels, a single antenna can be used.

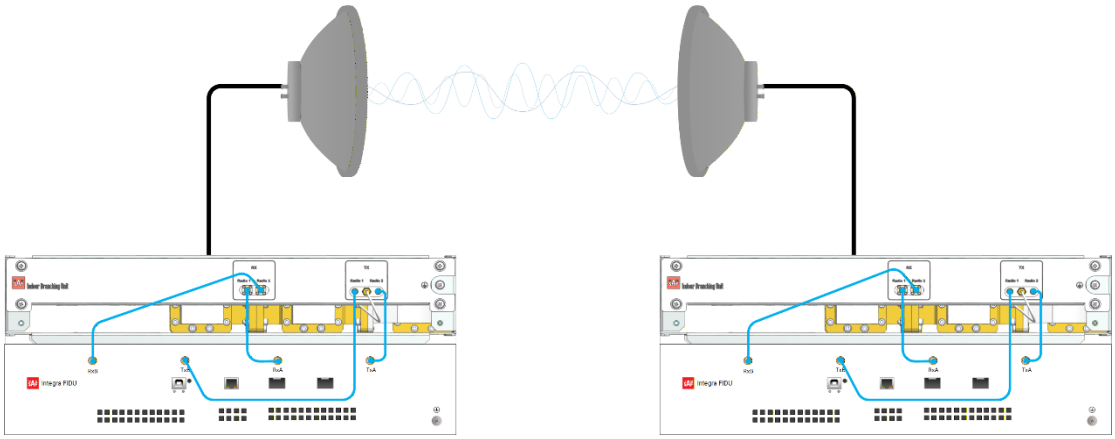


Figure 6-9 1+1 FD Integra-FIDU/FIDU+ connection diagram

1+1 FD Integra-X/X2 connection diagram

If H and V polarizations are used, and the antenna supports both frequency channels, Integra-X/X2 can be connected directly to the antenna with SAF2R interface. Refer to *Attaching FODU to the antenna*.

If only one polarization is used, and the antenna supports both frequency channels, a single antenna can be used. For such 1+1 FD configuration with Integra-X/X2 FODU, an antenna (1), a coupler (2), waveguides (3), a tower mountable OMT (4), and a single FODU (5) are required. 1+1 FD connection diagram is shown in *Figure 6-10*.

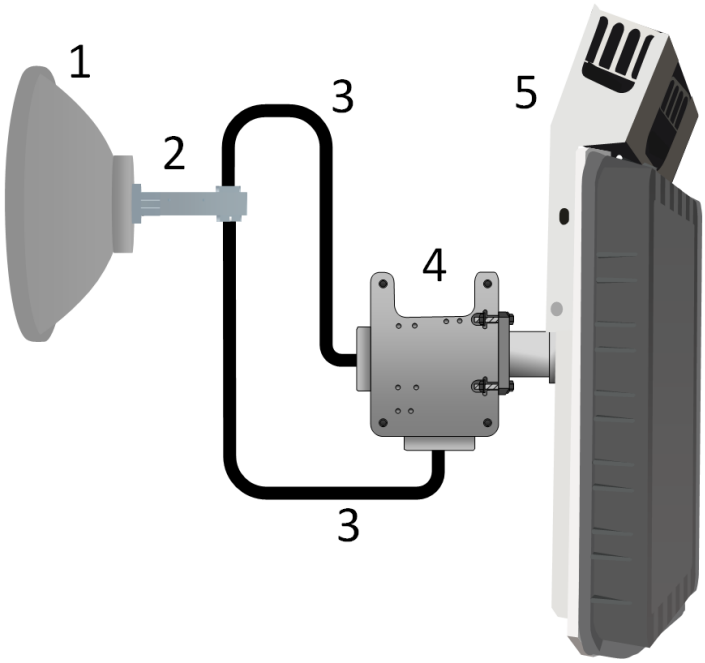


Figure 6-10 1+1 FD Integra-X/X2 connection diagram

1+1 FD Integra-FIDU/FIDU+, Integra-X/X2 configuration

On the “Main” page in the Web GUI, in the “Mode” dropdown menu, select “FD” - see *Figure 6-11* FD configuration on the main page

0 - Enter MODIFY mode. See details in *Main page*.
1 – Select FD from the Mode drop-down menu.

2 to 6 – For items 2, 3, 4, 5, and 6, refer to the *FD mode* section.
After completing the settings, execute and save the configuration.

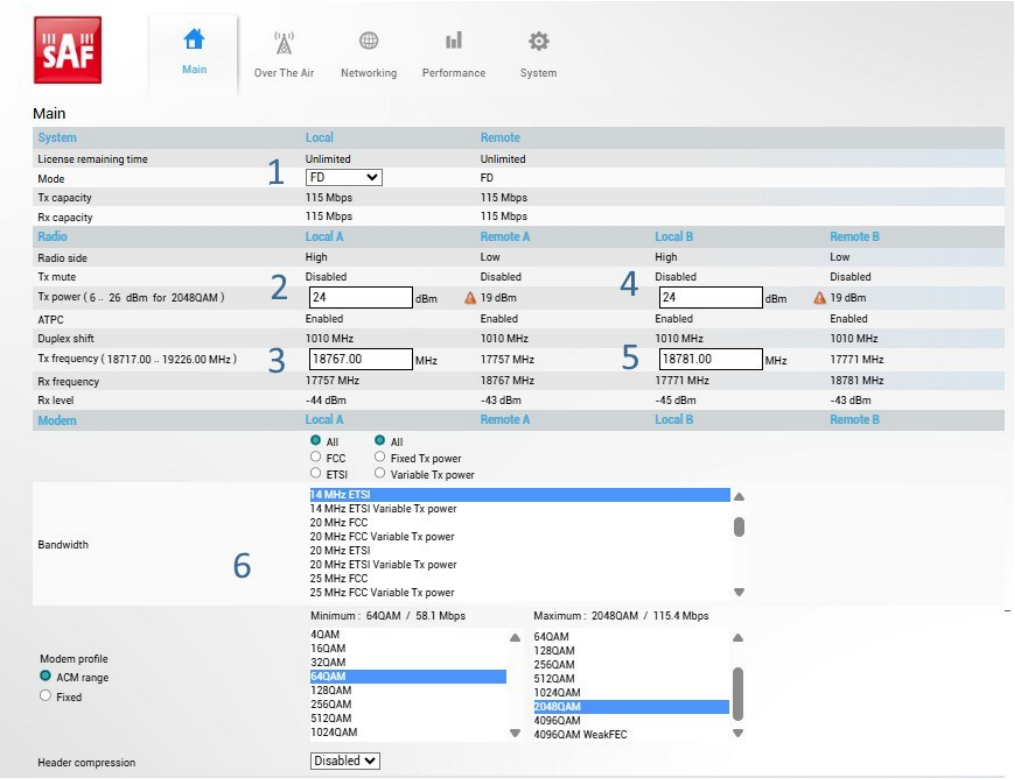


Figure 6-11 FD configuration on the main page

Example 4 – 1+1 HSB full redundancy mode (2x units per site)

1+1 HSB (Hot Standby) full redundancy configuration is supported by Integra-FIDU/FIDU+ without a diplexer (IBU required), Integra-FIDU/FIDU+ with a diplexer, and Integra-X/X2. An external Layer 2 (L2) switch is required to ensure power redundancy and management connection is necessary in each side. In this mode, 1+1 HSB full redundancy provides hardware and power-supply redundancy for a single traffic channel. Traffic is carried over only one unit at a time—either Channel A or Channel B—while the transmitter of the standby unit is automatically muted. The system ensures a hitless switchover in the event of a receiver (Rx) failure, while a short traffic interruption may occur during switchover in the case of a transmitter (Tx) failure. For proper operation, all four radio management IP addresses must reside within the same broadcast domain.

1+1 HSB full redundancy Integra-FIDU/FIDU+ connection diagram

1+1 HSB full redundancy connection diagram for fully indoor use with Integra-FIDU/FIDU+ and IBU is shown in *Figure 6-12*. 1+0 units would be considered as feasible in this configuration.

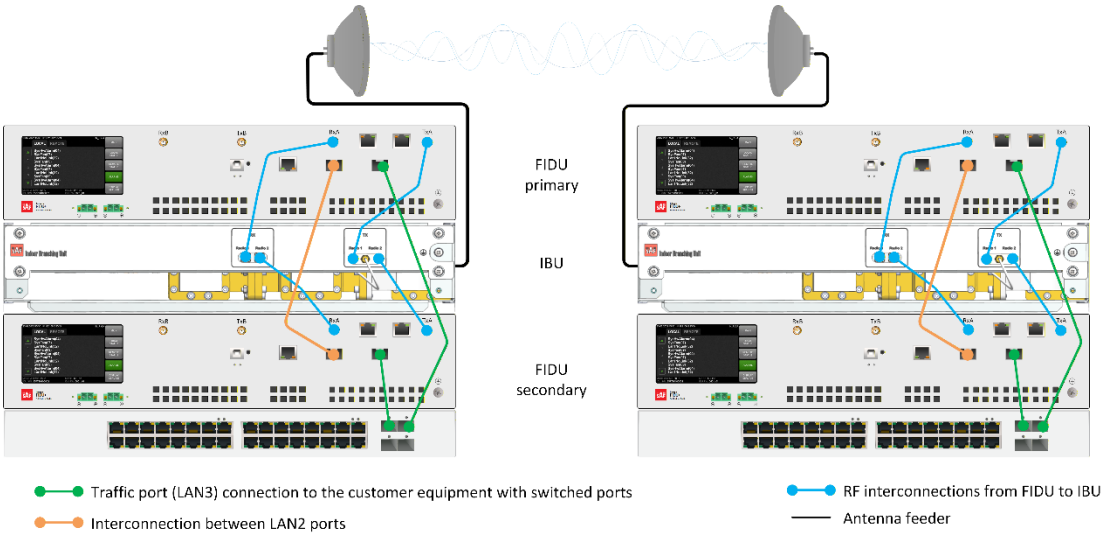


Figure 6-12 Integra-FIDU 1+1 HSB full protection connection diagram

1+1 HSB full redundancy Integra-X/X2 connection diagram

Figure 6-13 shows a top view of two Integra-X units connected to a coupler. The LAN2 ports must be interconnected to ensure proper operation, while the LAN1 and LAN3 ports are used for client traffic and connected to a L2 switch in a CPE. Either Channel A or Channel B may be used. The choice depends on the required polarization, which is typically determined by the client's operational needs and applicable licensing conditions.

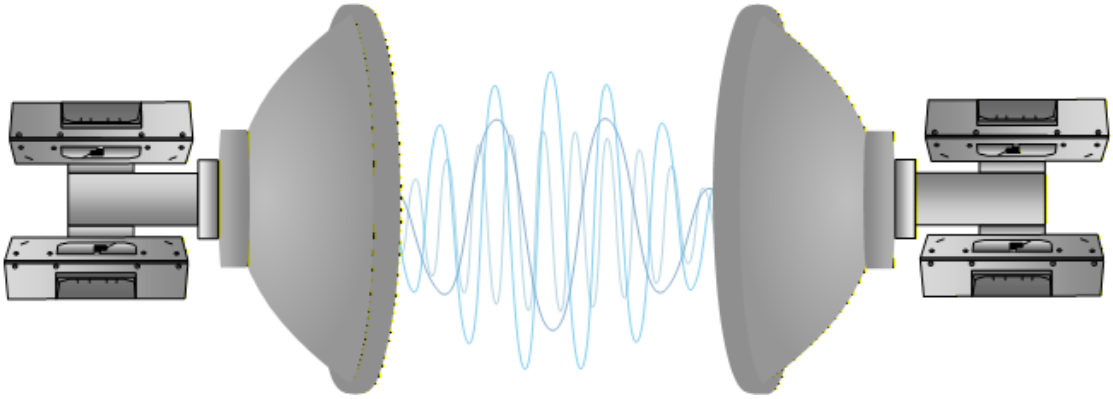


Figure 6-13 Integra-X 1+1 HSB full protection

1+1 HSB full redundancy Integra-FIDU/FIDU+, Integra-X/X2 configuration

Ensure the FIDUs are disconnected from the switch and the IBU throughout the configuration process, and reconnect them only after all settings are finalized and saved.

In 1+1 Full Redundancy mode, the LAN2 port is reserved exclusively for FIDU interconnection. Configure each Integra-FIDU individually before making any LAN2 or external Ethernet connections.

The configuration of the 1+1 HSB Full Redundancy feature is done in three steps.

STEP1: Main parameter configuration on the Main page, see the *Figure 6-14*:

0 - Enter MODIFY mode. See details in *Main page*.
1 – Select Channel A or Channel B from the Preferred Transmitter menu.
2 to 5 – For items 2, 3, 4, and 5, refer to the *Single polarization mode* section.
After completing the settings, execute and save the configuration.

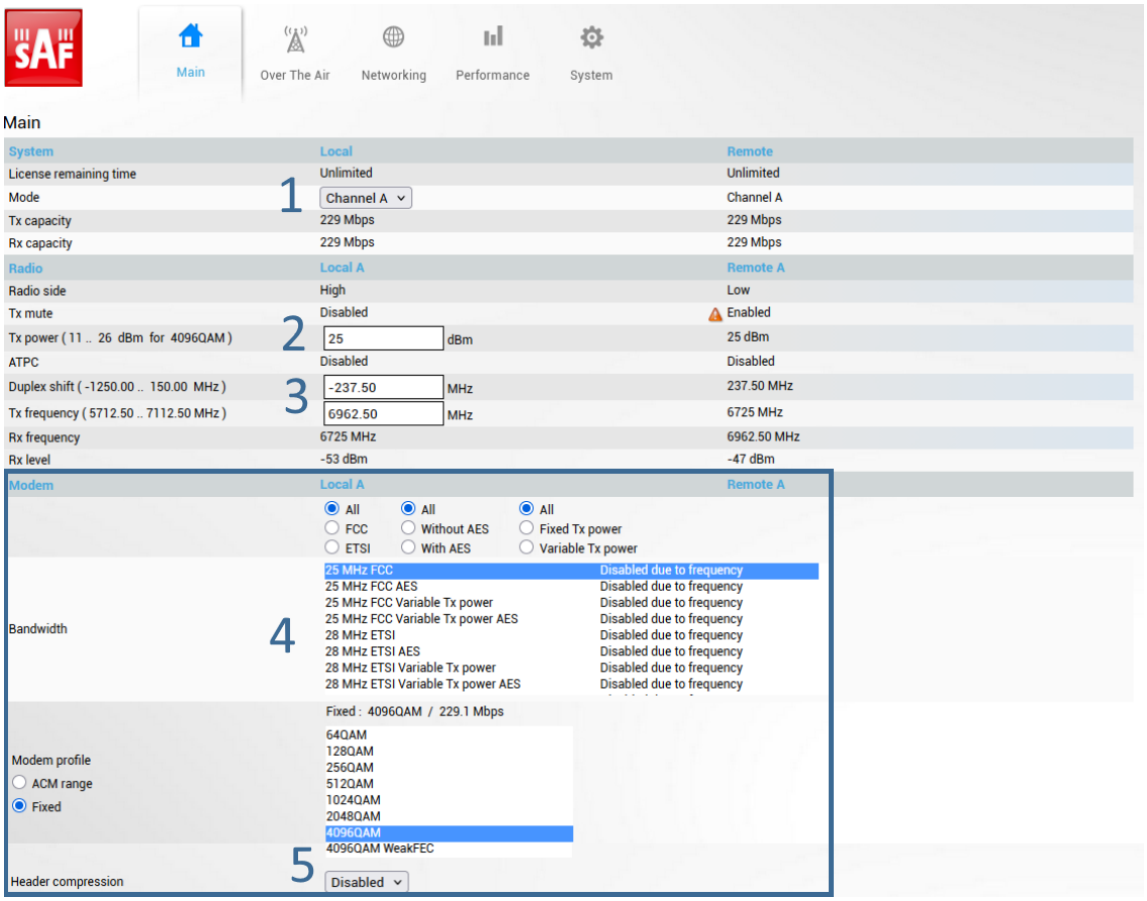


Figure 6-14 1+1 HSB Full redundancy configuration step on Main page

STEP 2: Networking/Aggregation/Protection configuration, see *Figure 6-15*

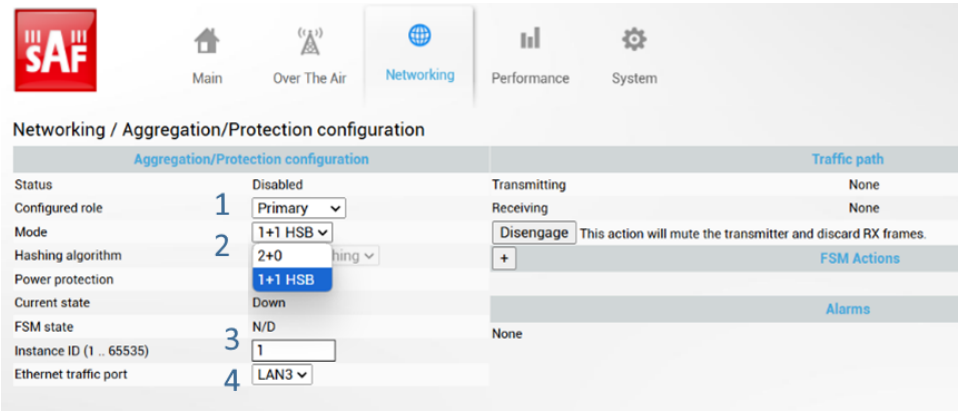


Figure 6-15 Configuring the unit role in the link

0 - Enter MODIFY mode. See details in *Networking à Ethernet à Aggregation/protection configuration*.
1 - Select the FIDU role from the Configured role drop-down box in the link: one unit must be Primary and the other - Secondary.

Additional Aggregation/Protection configuration fields will then appear.

2 - From the *Mode* drop-down list, select '*1+1 HSB*' for Full Redundancy.
3 - Set the *Instance ID*. The *instance ID* must be the same for both units in the same link, but must differ for separate links.
4 - Select the Ethernet traffic port. Since LAN2 is reserved for FIDU interconnection, LAN1 and LAN3 are available for traffic.
After completing the settings, execute and save the configuration.

We recommend using the LAN3 optical port for traffic. You may use LAN1, but in this case, switching times may exceed 500 ms.

STEP 3: System IP address configuration.

For configuring IP address, refer to *System -> Configuration -> IP configuration* Note that Auto" must be ticked out, see *Figure 6-16* with disabled "Auto" function (1).

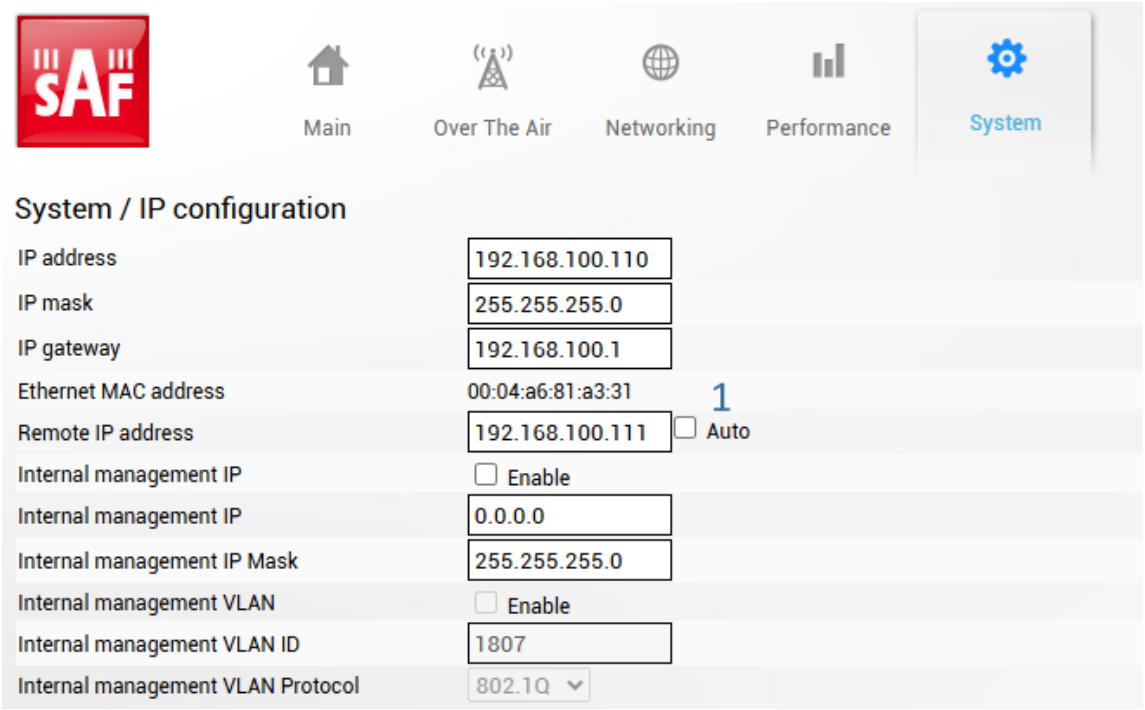


Figure 6-16 IP address setting

Repeat these steps for all FIDUs. Then, reconnect the FIDUs to the external switch and the IBU.

Properly configured and operating 1+1 HSB Full Redundancy Aggregation/Protection page is shown in *Figure 6-17*.

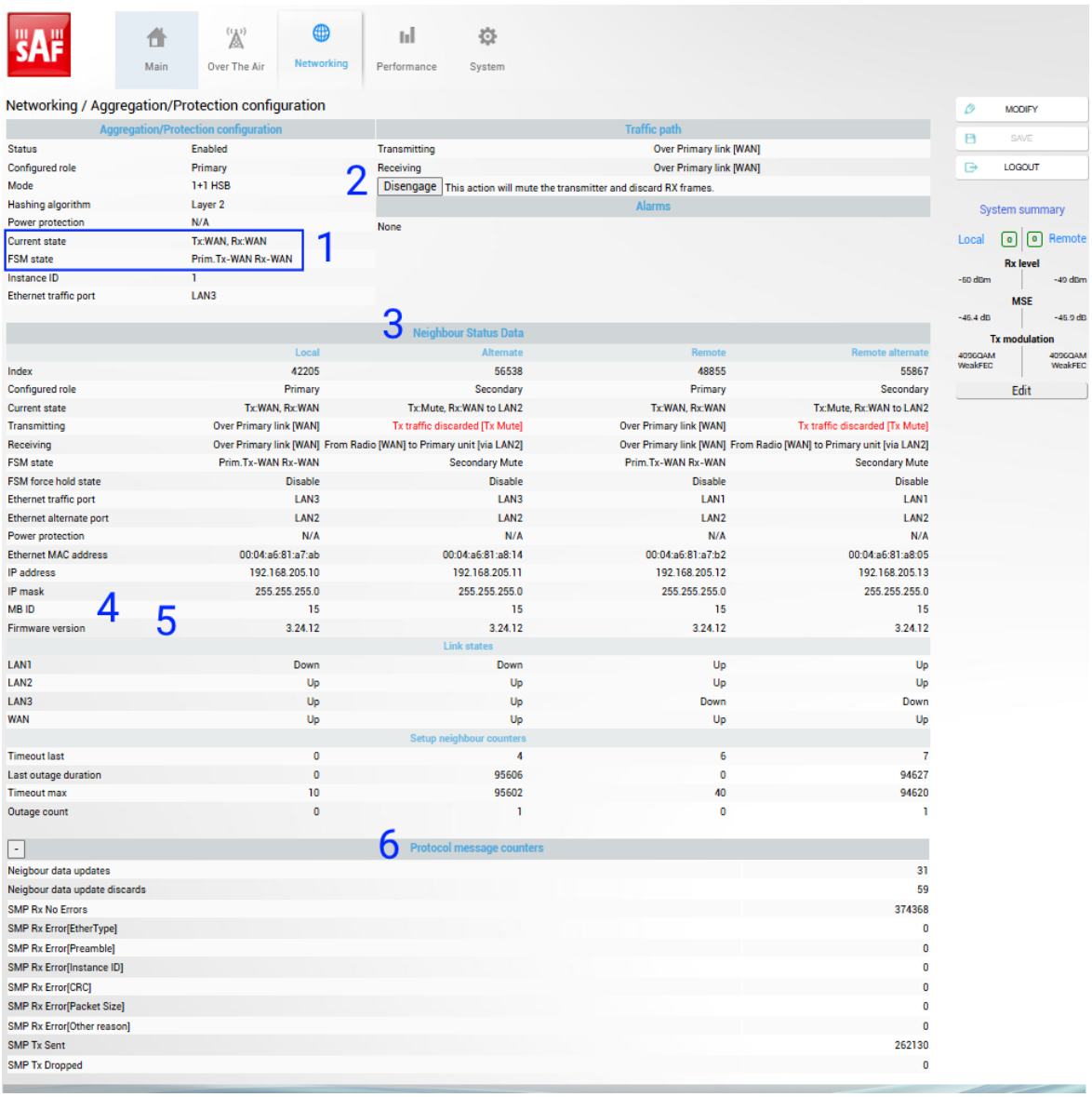


Figure 6-17 Status of the properly configured and working HSB Full redundancy setup

1) Current state indication and FSM state for Primary Tx: WAN, Rx: WAN
2) *Disengage* – immediately switches both Rx and Tx to the alternate path.
3) *Neighbour Status Data* – displays all radios in the link.
4) *MB ID* – motherboard revision; it should be identical on all units in the link.
5) *Firmware version* – the firmware version; it must match across all units in the link.
6) Protocol message counters – status of internal communication between FIDUs.

Example of status after the Disengage operation

Disengage function can be used in the event of a role change, should one of the setup members need to be serviced. By pressing the Disengage button (see 1 on *Figure 0-- 21*), roles are changed, and the traffic path is displayed, see 2 on *Figure 0-- 21*.

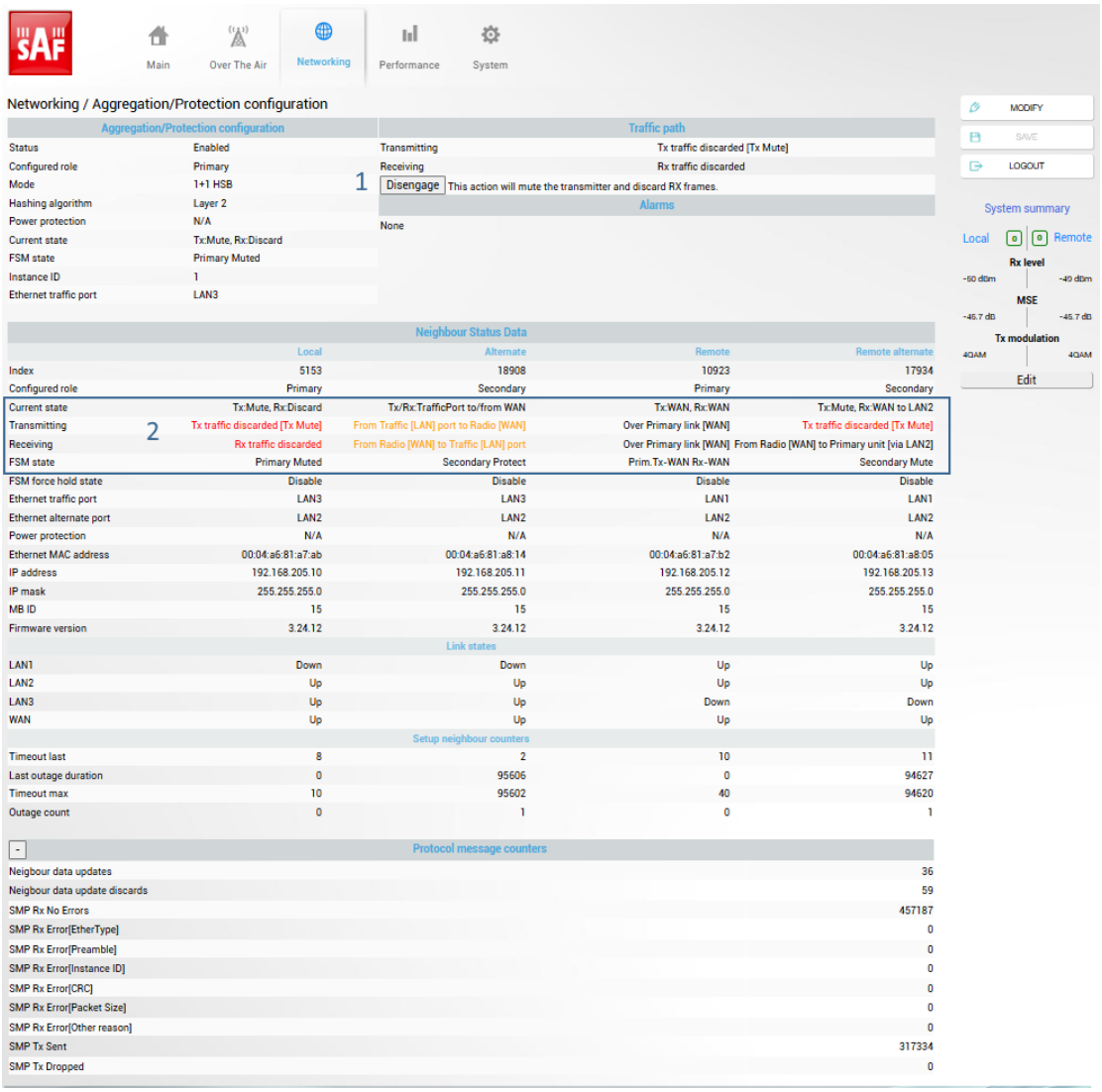


Figure 6-18 Example of 1+1 HSB Full redundancy configuration and status after Disengage

Transmitting and receiving statuses have changed.

Advanced “FSM actions” menu

> Use caution with the “Change state” and “Force state” options; incorrect usage may lead to traffic loss.

By pressing *Modify*, advanced FSM (Finite State Machine) actions become available by clicking the “+” icon under the *Disengage* button. These settings allow directing the Ethernet traffic path to the preferred FIDU for safe maintenance without interrupting traffic.

Change state

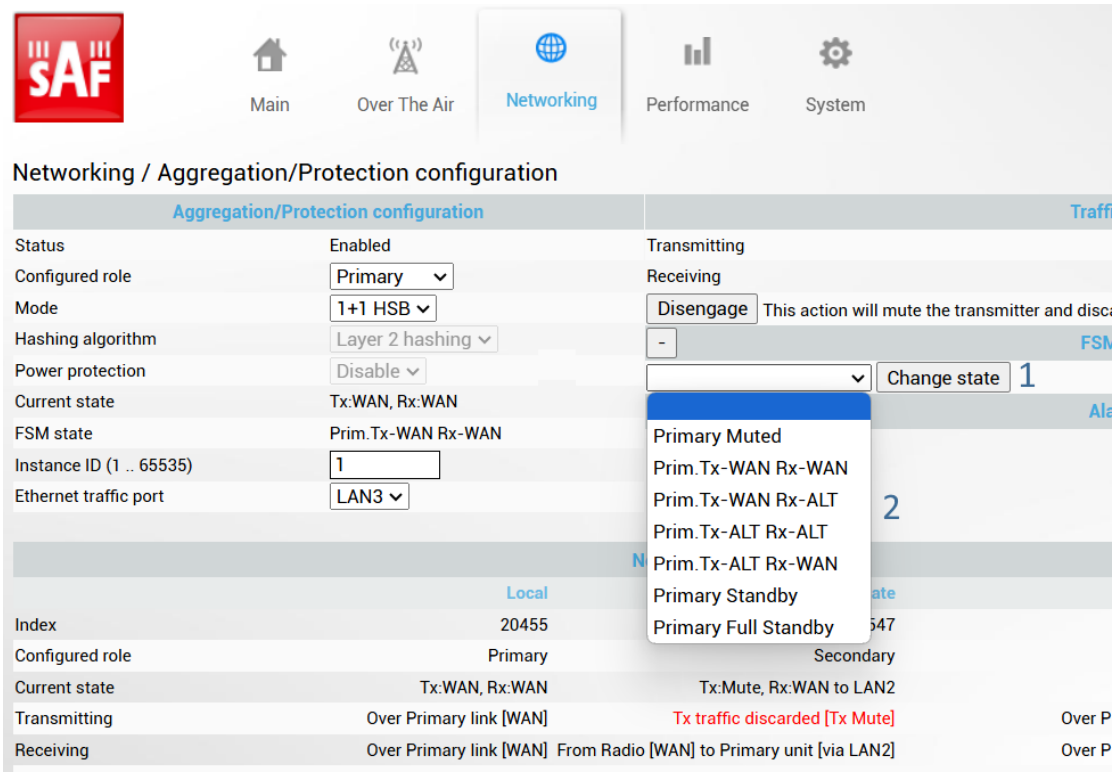


Figure 6-19 Accessing the Change State menu

Use *Change state* (see 1 in *Figure 6-19*) for an immediate switch between local Primary/Secondary roles, provided no alarms prevent switching. The following states are available (see 2 in *Figure 6-19*):

- Primary muted – traffic is carried by the Secondary path (Tx and Rx).
- Prim. Tx-WAN Rx-WAN – traffic uses the Primary path for both transmit and receive.
- Prim. Tx-WAN Rx-ALT – traffic is transmitted on Primary and received on Secondary.
- Prim. Tx-ALT Rx-ALT – Primary is active but muted. Secondary transmits traffic passed from Primary and returns traffic to Primary.
- Prim. Tx-ALT Rx-WAN – Primary is active but muted. Traffic is transmitted on the Secondary path and received on the Primary path.
- Primary Standby – Primary is active but muted. The Secondary handles all traffic, with data passed via LAN2.
- Primary Full Standby – Primary discards Rx/Tx traffic; the Secondary handles traffic entirely.

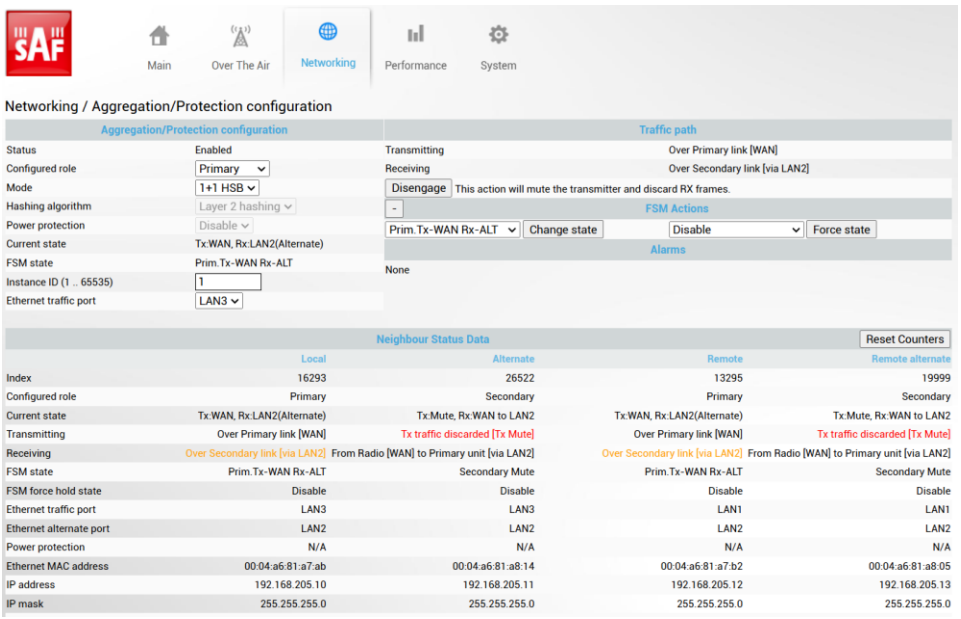


Figure 6-20 Example: Primary Tx, Alternate receiving

Force state

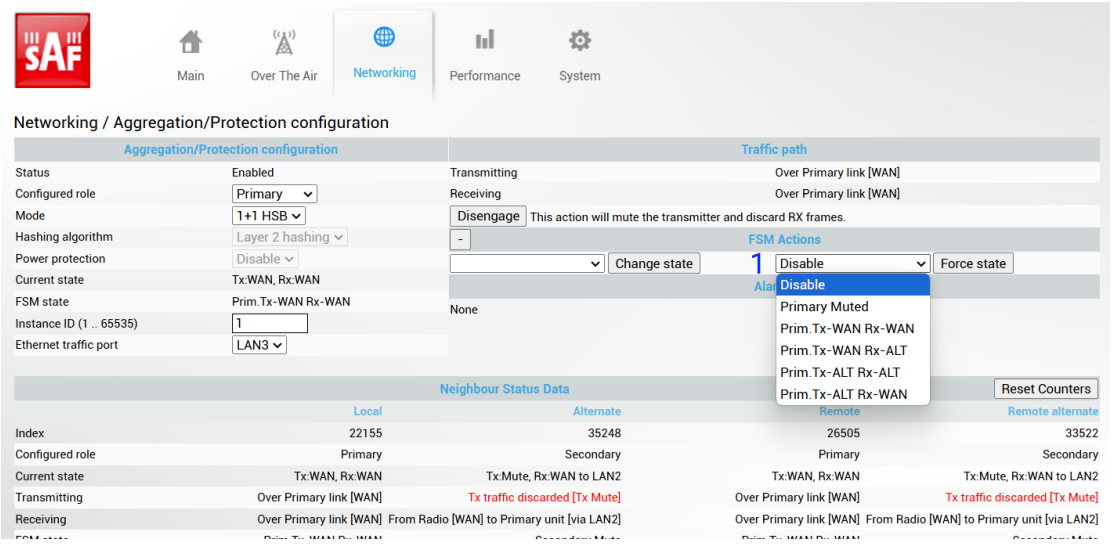


Figure 6-21 Accessing Force state menu

Use *Force state* (see 1 in *Figure 6-21*)for an immediate switch between Primary/Secondary, regardless of existing alarms. The following states are available:

- Disable – *Force state* disabled.
- Primary Muted – all traffic switched to the Secondary unit.
- Prim. Tx-WAN Rx-WAN – traffic uses the Primary path for both transmit and receive.
- Prim. Tx-WAN Rx-ALT – traffic transmitted on Primary, received on Secondary.
- Prim. Tx-ALT Rx-ALT - Primary is active but muted. Secondary is transmitting traffic passed from Primary and also returns traffic back to Primary.
- Prim. Tx-ALT Rx-WAN - Primary is active but muted. Traffic is transmitted on Secondary and received on Primary.

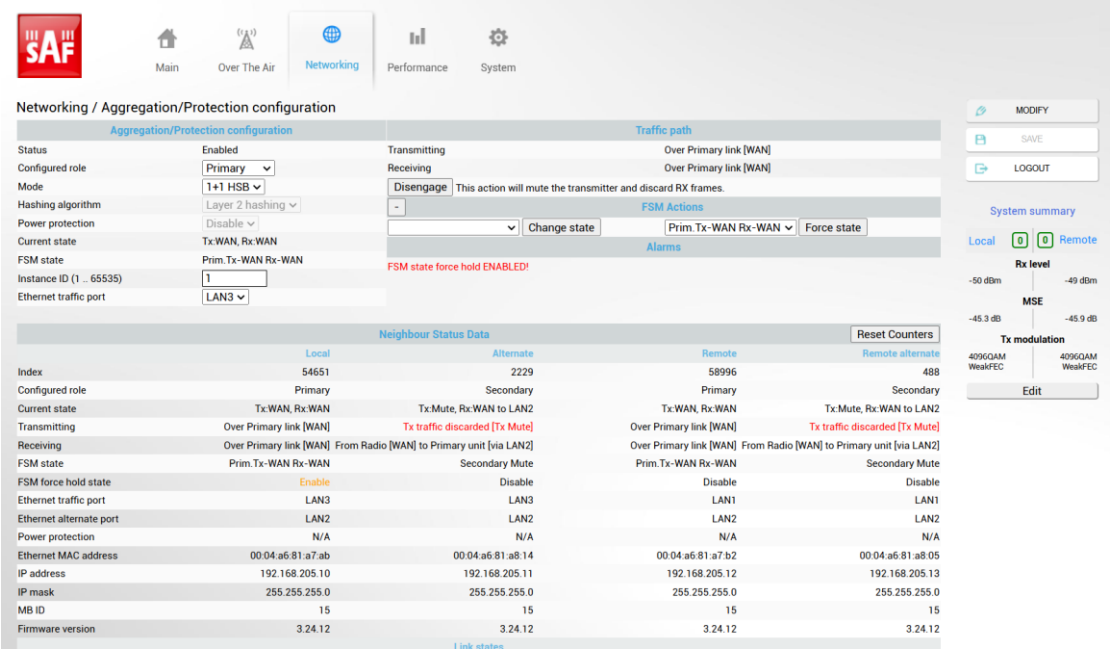


Figure 6-22 Example: Forced Primary Rx and Tx

Example 5 - 2+2 XPIC HSB full redundancy (2x units per site)

A 2+2 XPIC HSB full-redundancy link is supported by Integra-FIDU/FIDU+ (without a diplexer; IBU required) and Integra-X/X2 (Hybrid OMT required). An external Layer 2 (L2) switch is required to ensure power redundancy and management connection is necessary in each side. All four radio management IP addresses must reside within the same broadcast domain. In the event of a hardware component failure in the active link, the standby link is automatically activated.

LAN2 ports are reserved exclusively for interconnection between radio units, while the LAN1 and LAN3 ports may be used for payload traffic.

2+2 XPIC HSB full redundancy Integra-FIDU/FIDU+ connection diagram

Two Integra-FIDU/FIDU+ without the diplexer with two IBUs (active IBU is shown in the example, see IBU configuration document), and an external switch are required at each side of the link. The connection diagram is shown in *Figure 6-23.*

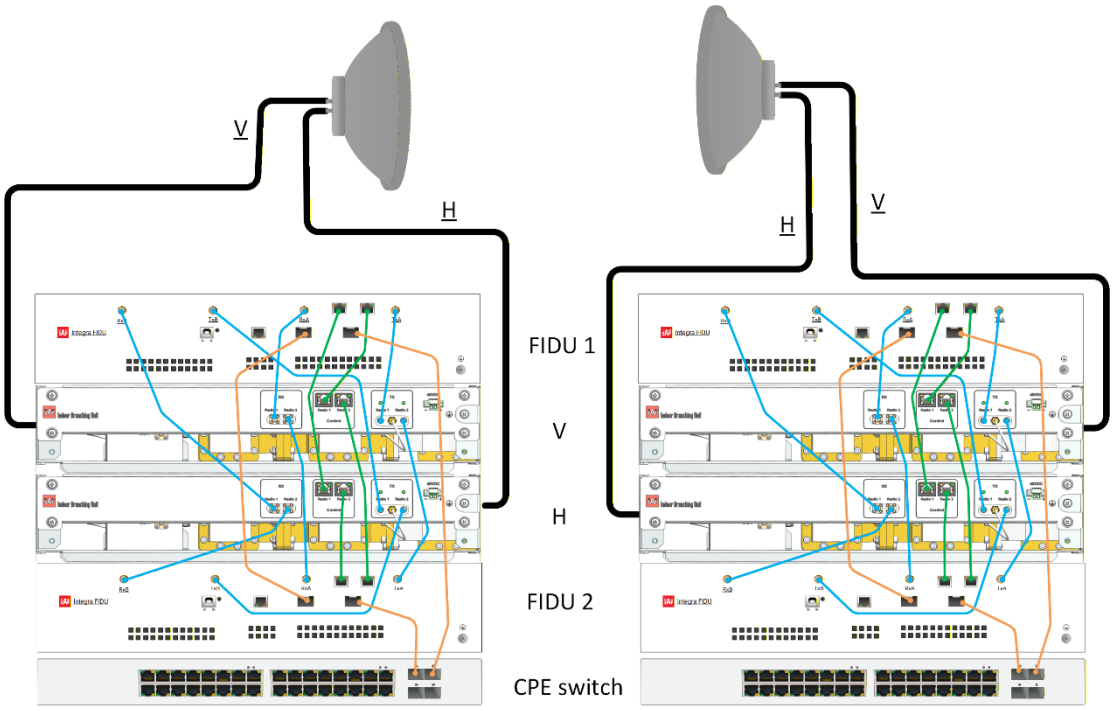


Figure 6-23 2+2 XPIC full redundancy Integra-FIDU connection diagram

2+2 XPIC HSB full redundancy Integra-X/X2 connection diagram

Two Integra-X/X2 with hOMT (hybrid OMT) and an external L2 CPE switch are required at each side of the link. The connection diagram is shown in *Figure 6-24* 2+2 XPIC full redundancy Integra-X/X2 connection diagram below.

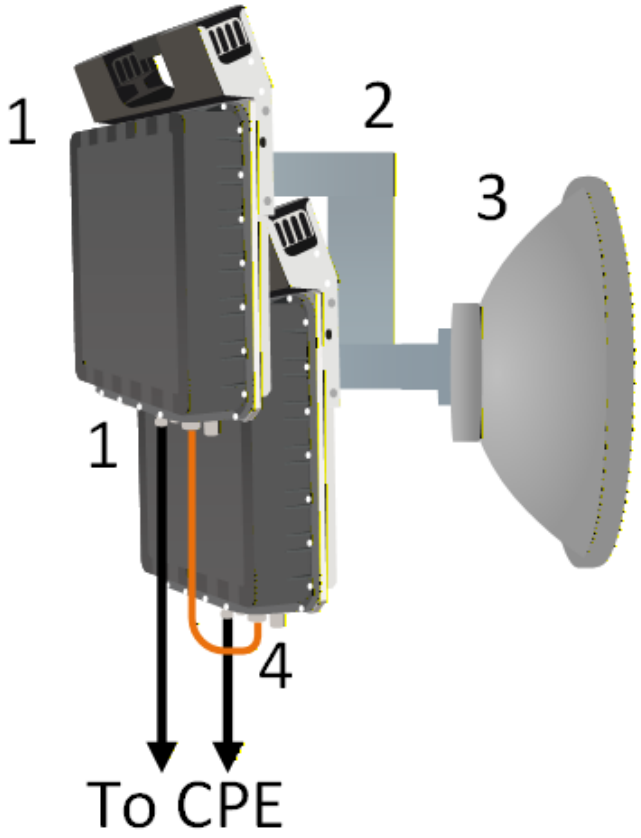


Figure 6-24 2+2 XPIC full redundancy Integra-X/X2 connection diagram

1 – Integra-X/X2 radio,

2 – hybrid OMT,

3 – antenna with SAF2R adaptation,

4 – interconnection between LAN2 ports.

2+2 XPIC HSB full redundancy configuration

2+2 XPIC HSB full redundancy configuration is similar to 1+1 HSB full redundancy configuration - it also consists of three steps.

STEP1: Main parameter configuration on the Main page, see the *Figure 6-14*:

0 - Enter MODIFY mode. See details in *Main page.*
1 – Select XPIC from the Mode menu.
2 to 5 – For items 2, 3, 4, and 5, refer to the *XPIC mode* section.
After completing the settings, execute and save the configuration.

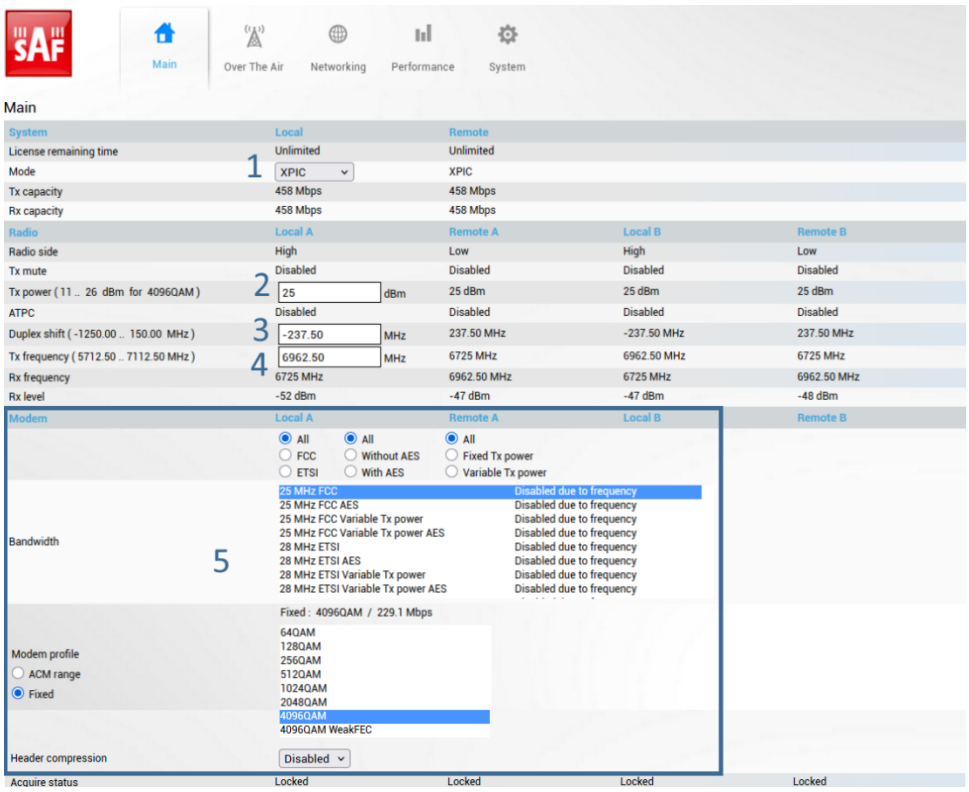


Figure 6-25 2+2 XPIC main parameter configuration

AES and Header Compression cannot be used with 1+1 HSB Full Redundancy.

The **STEP 2** and **STEP 3** are the same as described in the *1+1 HSB full redundancy Integra-FIDU/FIDU+, Integra-X/X2 configuration*. The proper operation and Disengage, and FSM actions are the same as in the chapter *1+1 HSB full redundancy Integra-FIDU/FIDU+, Integra-X/X2 configuration*.

Example 6 – 2+2 ACCP/ACAP HSB full redundancy (2x units per site)

A 2+2 ACCP HSB full-redundancy link is supported by Integra-FIDU/FIDU+ without a diplexer (IBU required). An external Layer-2 (L2) switch is required for traffic switching, and all four radio management IP addresses must reside within the same broadcast domain. In the event of a hardware component failure in the active link, the standby link is automatically activated. LAN2 ports are reserved exclusively for interconnection between radio units, while the LAN1 and LAN3 ports may be used for payload traffic.

2+2 ACCP HSB full redundancy Integra-FIDU/FIDU+ connection diagram

Two Integra-FIDU/FIDU+ without the diplexer, with two IBUs (active IBU is shown in the example), and an external switch are required at each side of the link. The connection diagram is shown in *Figure 6-26.* Both IBUs at each end are interconnected using a flexible waveguide.

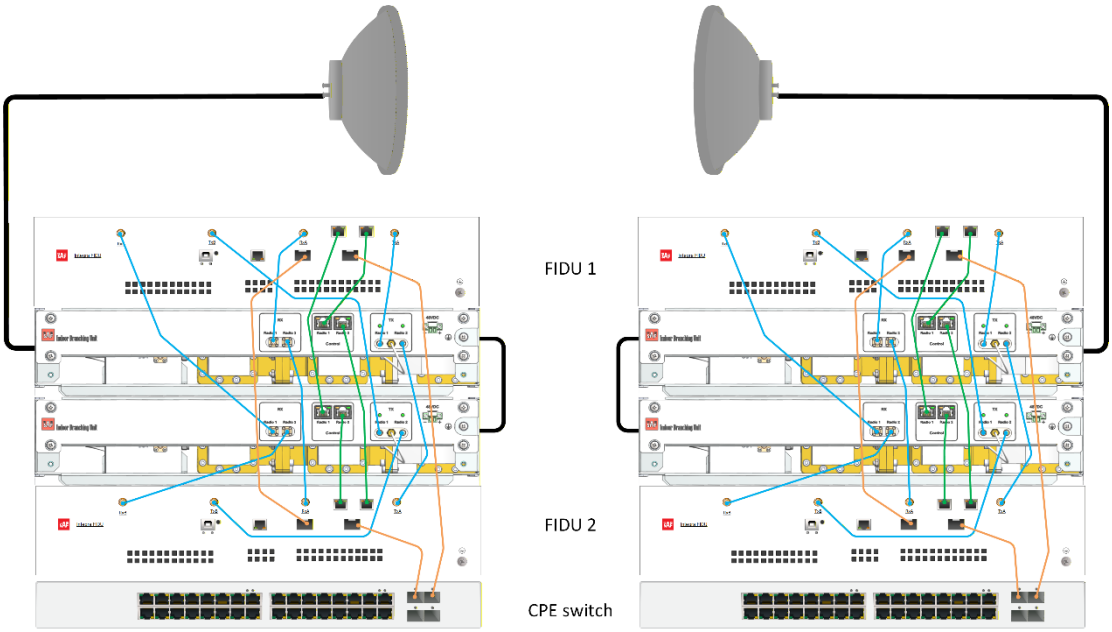


Figure 6-26 2+2 ACCP HSB full redundancy Integra-FIDU/FIDU+ connection diagram

2+2 ACCP/ACAP HSB full-redundancy configuration

2+2 ACCP HSB full configuration is similar to 1+1 HSB full redundancy configuration - it also consists of three steps.

STEP1: Main parameter configuration on the Main page, please see *Figure 6-27*.

0 - Enter MODIFY mode. See details in *Main page*.
1 – Select ACAP from the Mode menu.
2 to 8 – For items 2, 3, 4, 5, 6, 7, and 8, refer to the *ACAP mode and ACCP mode* section.
After completing the settings, execute and save the configuration.

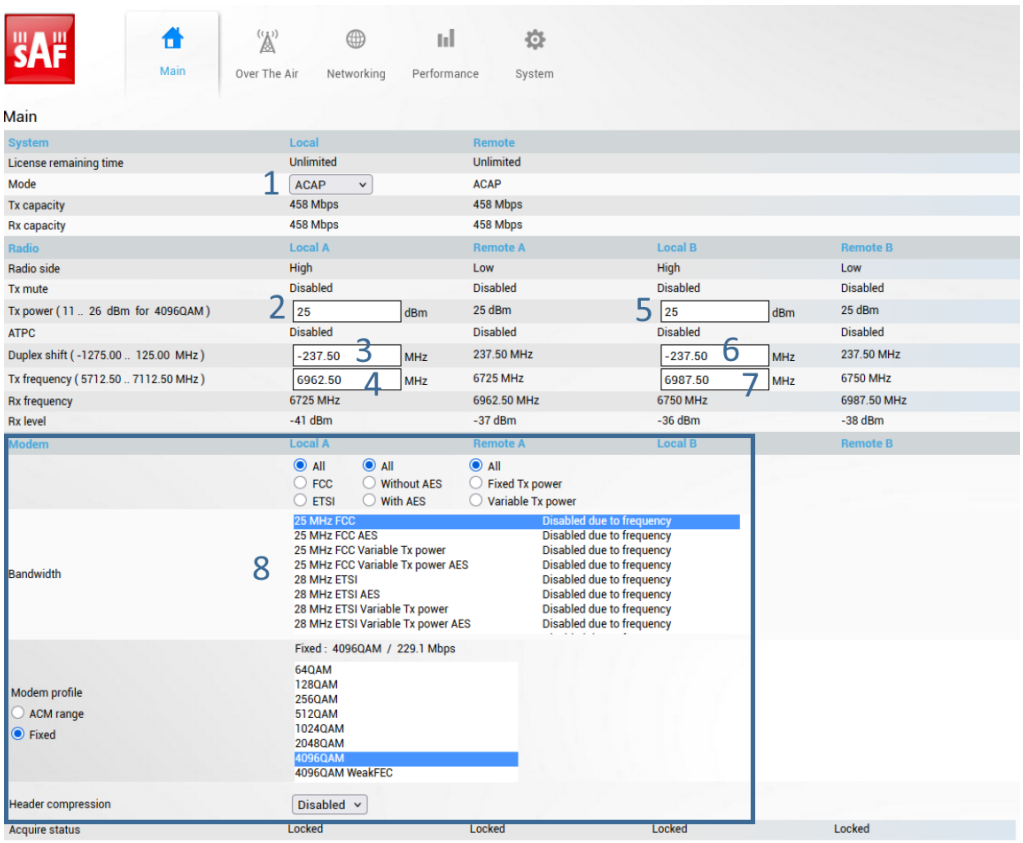


Figure 6-27 2+2 ACAP HSB full redundancy configuration

Example 7 - 4+0 XPIC link with internal aggregation (2x units per site)

A 4+0 XPIC link with internal aggregation is supported by Integra-FIDU/FIDU+ (without a diplexer; IBU required) and Integra-X/X2 (Hybrid OMT required). This configuration consists of two parallel Integra-FIDU/FIDU+ or Integra-X/X2 links, each operating on its own frequency channel and connected to a single antenna. Traffic from both links is aggregated internally, and LAN2 ports are reserved for radio interconnection. All four radio management IP addresses must reside within the same broadcast domain.

4+0 XPIC link with internal aggregation Integra-FIDU/FIDU+ connection diagram

Two Integra-FIDU/FIDU+ without the diplexer, with two IBUs are required at each link side. The connection diagram is shown in *Figure 6-28* below.

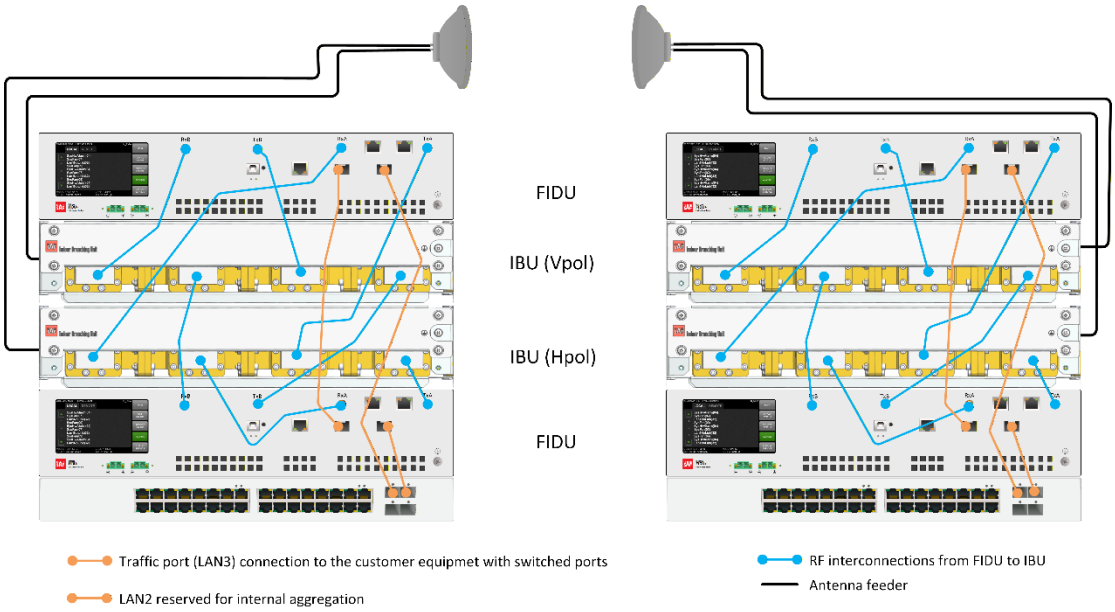


Figure 6-28 Integra-FIDU 4+0 link connection diagram

4+0 XPIC link with internal aggregation Integra-X/X2 connection diagram

Two Integra-X/X2 without the diplexer, with two IBUs are required at each link side. At each end of the link, two Integra-X/X2 units, one hOMT (Hybrid OMT) and L2 CPE switch are required. LAN2 ports are reserved exclusively for interconnection between radio units, while the LAN1 and LAN3 ports may be used for payload traffic. The connection diagram is shown in *Figure 6-29* 4+0 Integra-X/X2 XPIC link with internal aggregation below.

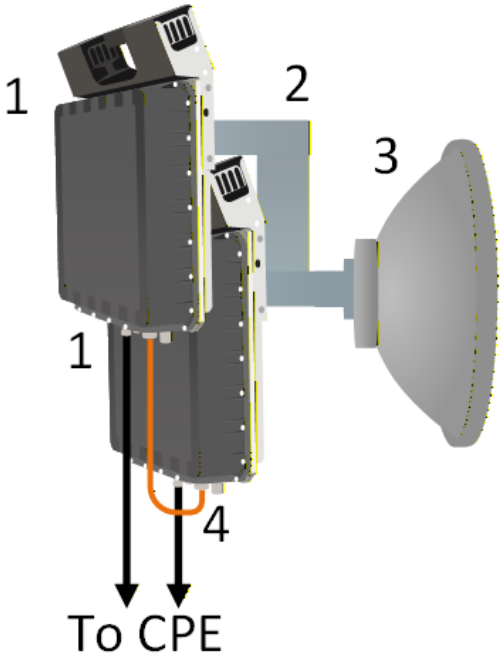


Figure 6-29 4+0 Integra-X/X2 XPIC link with internal aggregation

1 – Integra-X/X2 radio,

2 – hybrid OMT,

3 – antenna with SAF2R adaptation,

4 – interconnection between LAN2 ports.

4+0 XPIC link with internal aggregation configuration

STEP1: Main parameter configuration on the Main page, please see *Figure 6-30*.

0 - Enter MODIFY mode. See details in *Main page*.
1 – Select XPIC from the Mode menu.
2 to 5 – For items 2, 3, 4, and 5, refer to the *XPIC mode* section.
After completing the settings, execute and save the configuration.

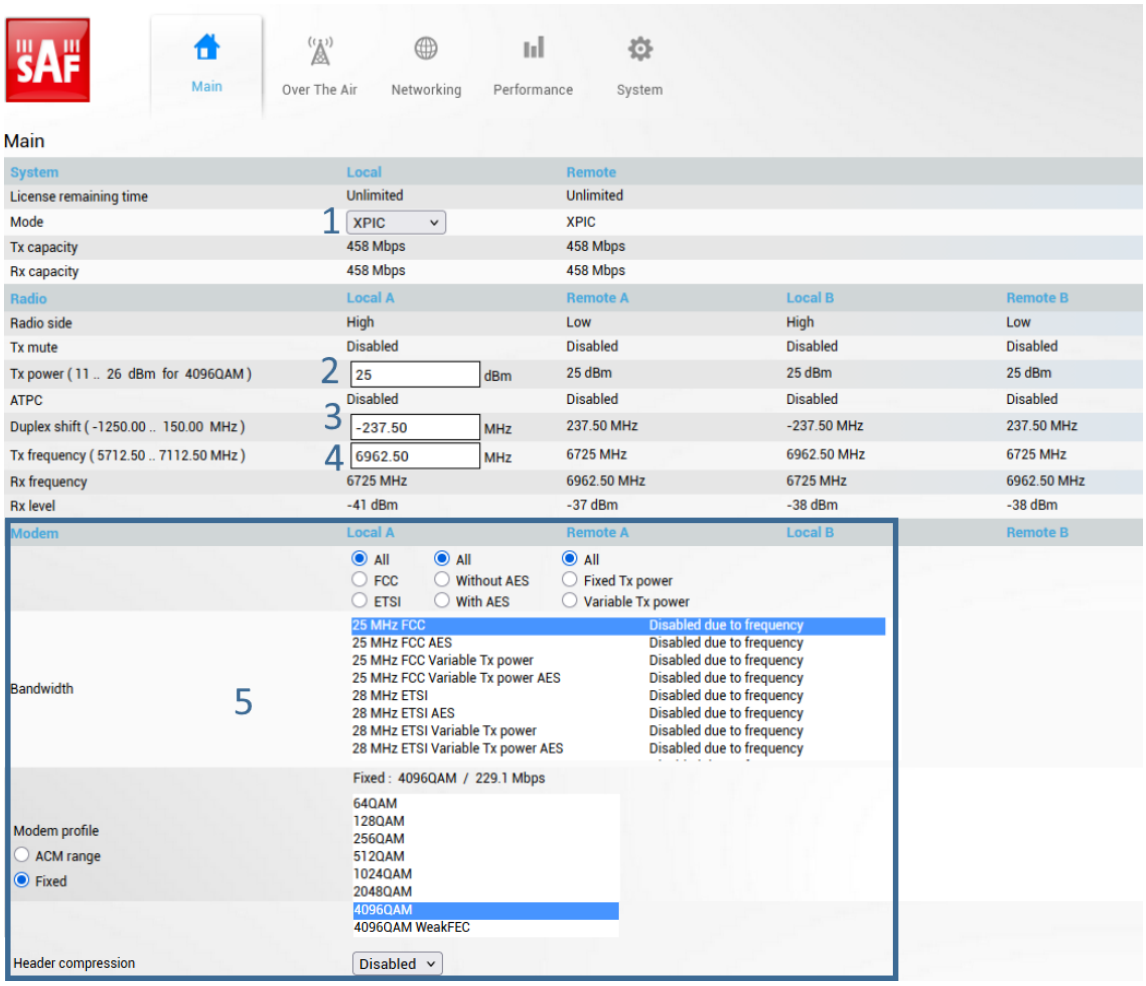


Figure 6-30 4+0 Integra-X/X2 XPIC link with internal aggregation main page configuration

STEP2: Aggregation configuration on the Networking /Aggregation/Protection page, please see *Figure 6-31*.

1 – for 4+0 aggregation please choose 2+0 from the dropdown menu.

For further configuration, please refer to *Networking à Ethernet à Aggregation/protection configuration*

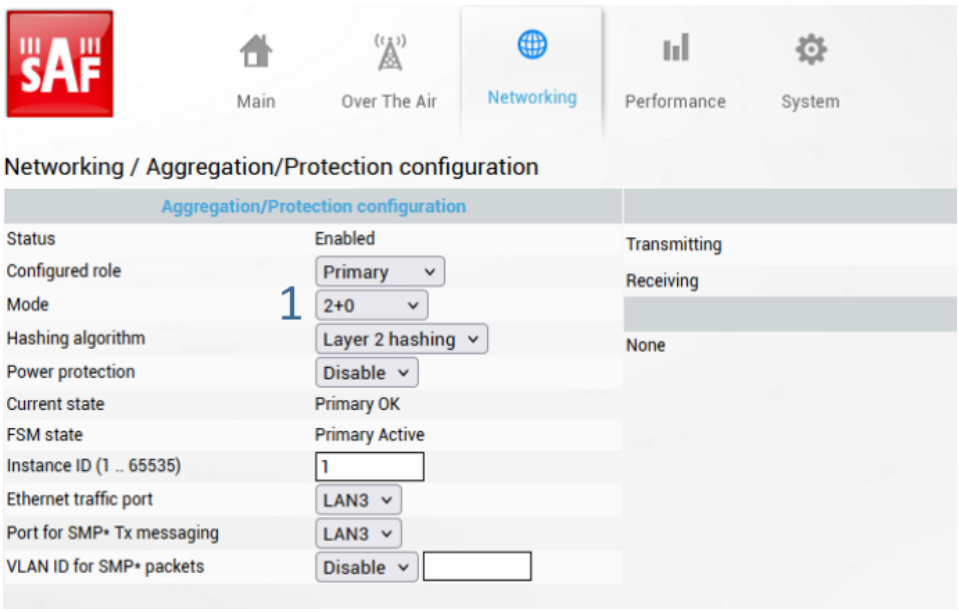


Figure 6-31 4+0 aggregation configuration on Networking /Aggregation/Protection page

Chapter 7 TOOLS

Link Layer Discovery tool

The Link Layer Discovery Tool is a command-line application for MS Windows. It sends requests to the LLD server application, which runs on all Integra series devices. The tool is used to discover Integra devices and reset their passwords or settings.

The application runs on the following versions of Windows: Windows Vista, Windows 7, Windows 8, Windows 10, and Windows 11.

WinPCAP must be installed to use the Link Layer Discovery Tool.

The Link Layer Discovery Tool for the Integra series can be downloaded at https://saftehnika.com/en/downloads in the "Tools" section. Login required.

1) Unzip the LLD.zip file you downloaded to a directory of your choice, for example, C:\SAF\LLD\.
2) The application is started via the command prompt (on your Windows machine Start menu→Run→type "cmd"→press ENTER). The command-line console window should appear, see *Figure 7-1*

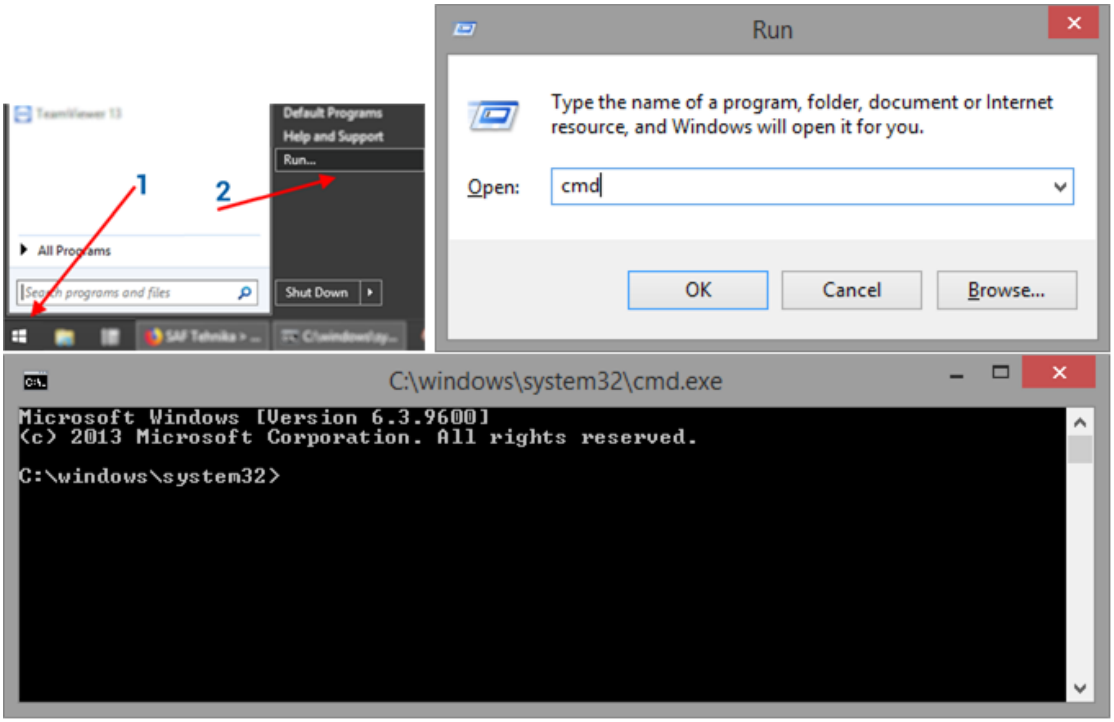


Figure 7-1 Windows cmd console

3) The default directory in the console is the current user directory. To change it, type: cd <directory path>, for example: cd c:\saf\lld.
4) Run the recovery tool by typing "lld" without quotes in the console prompt and press ENTER.

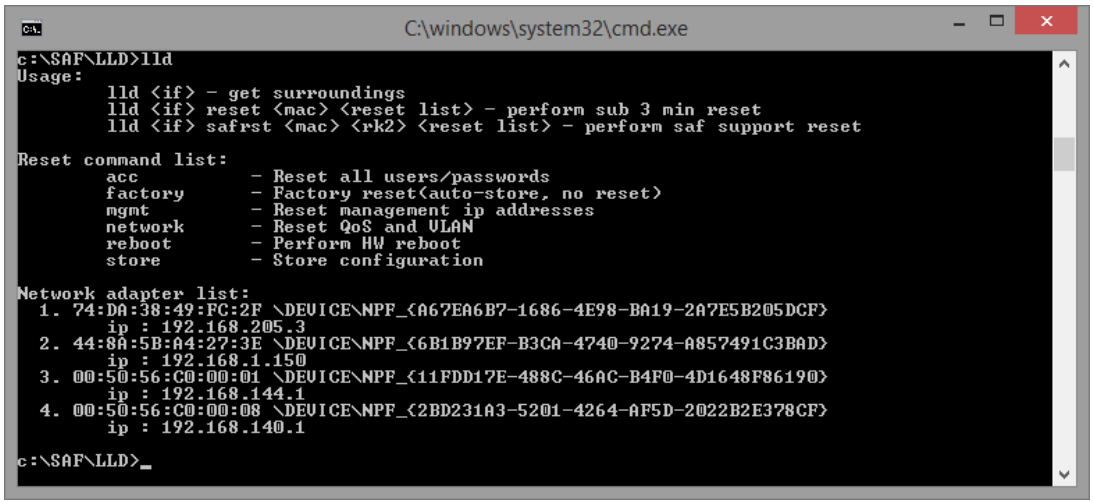


Figure 7-2 “lld” command output

5) The available commands and network adapter list should be shown. To scan for Integra series devices, the command should be run as follows:

lld <network interface>

For example:

lld \DEVICE\NPF_{A67EA6B7-1686-4E98-BA19-2A7E5B205DCF}

To copy the interface address from the network adapter list, click the right mouse button over the console and select “Mark”:

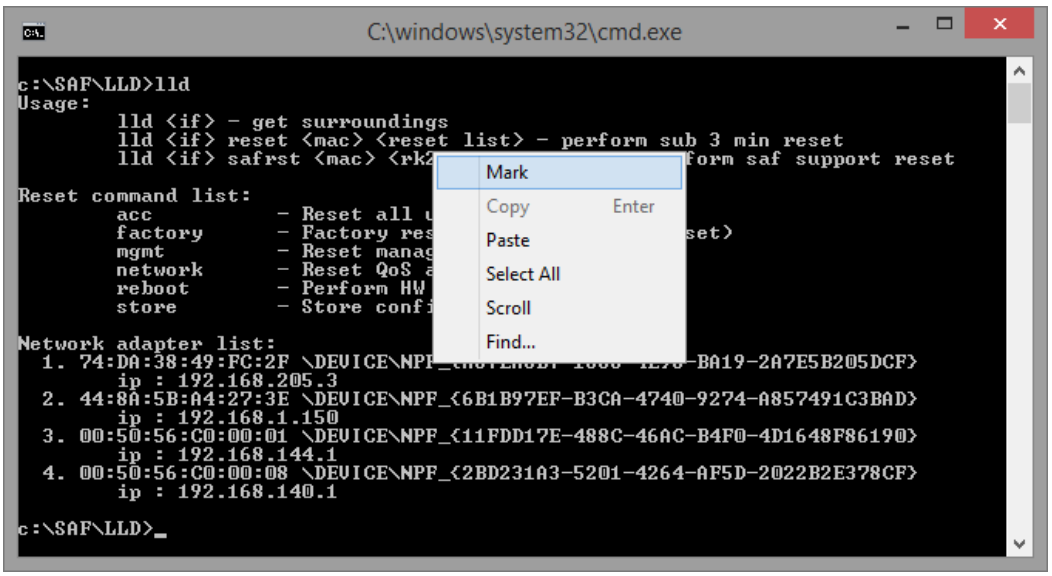


Figure 7-3 Command output

Then, while holding the left button, select the interface address:

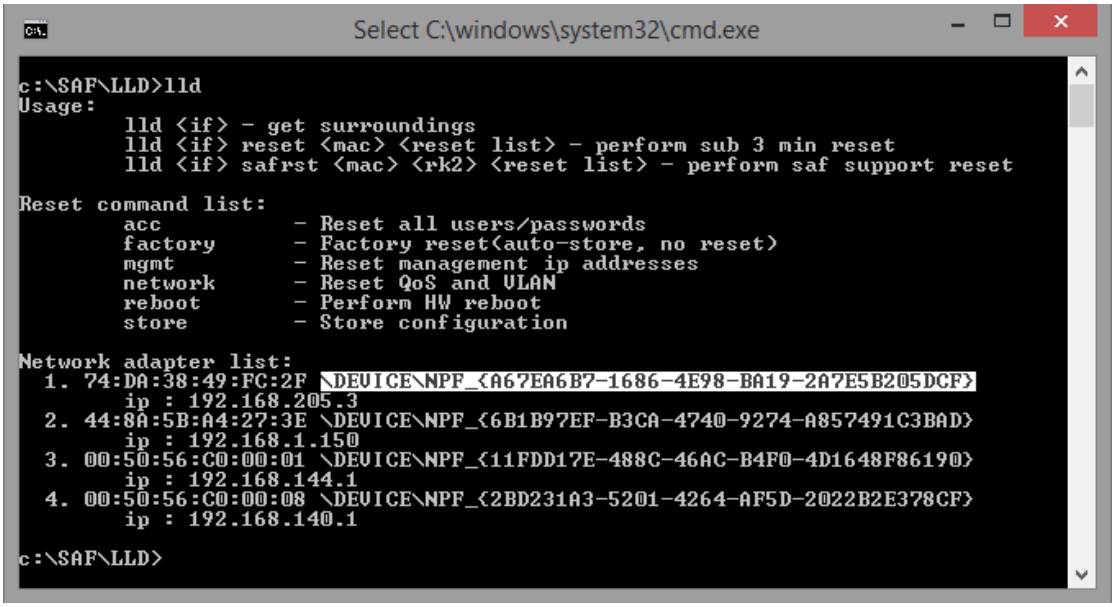


Figure 7-4 Selecting interface address

After selecting, release the left button and click the mouse right button anywhere on the console. The address should be copied.

Type “lld“ and paste the address by clicking the right button anywhere on the console:

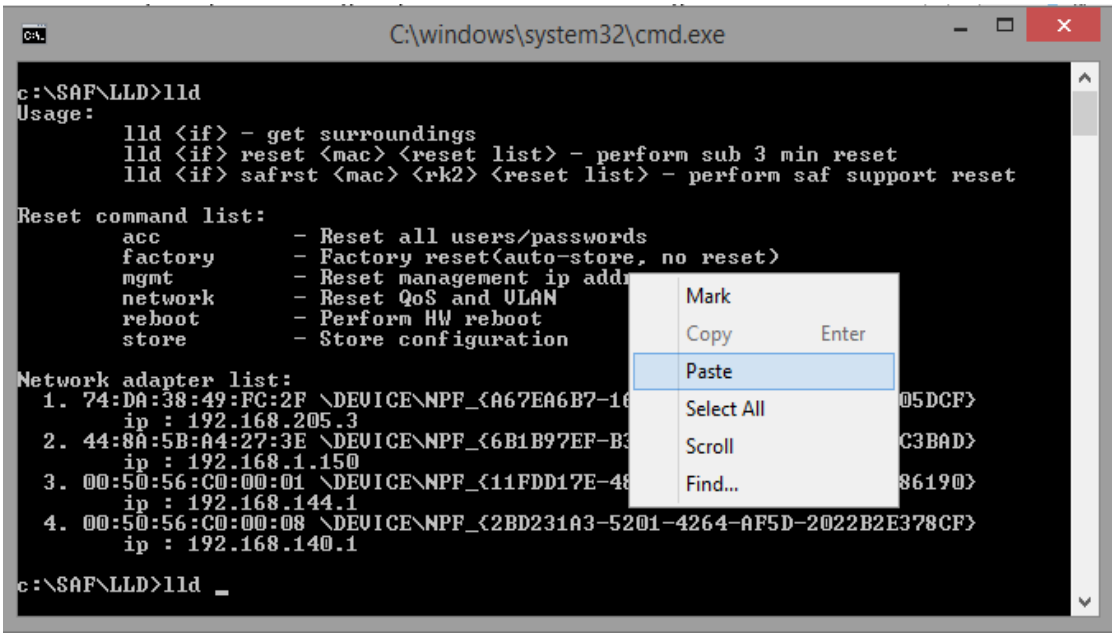


Figure 7-5 Pasting the interface address

The result should be similar to that in the image below, see *Figure 7-6*.

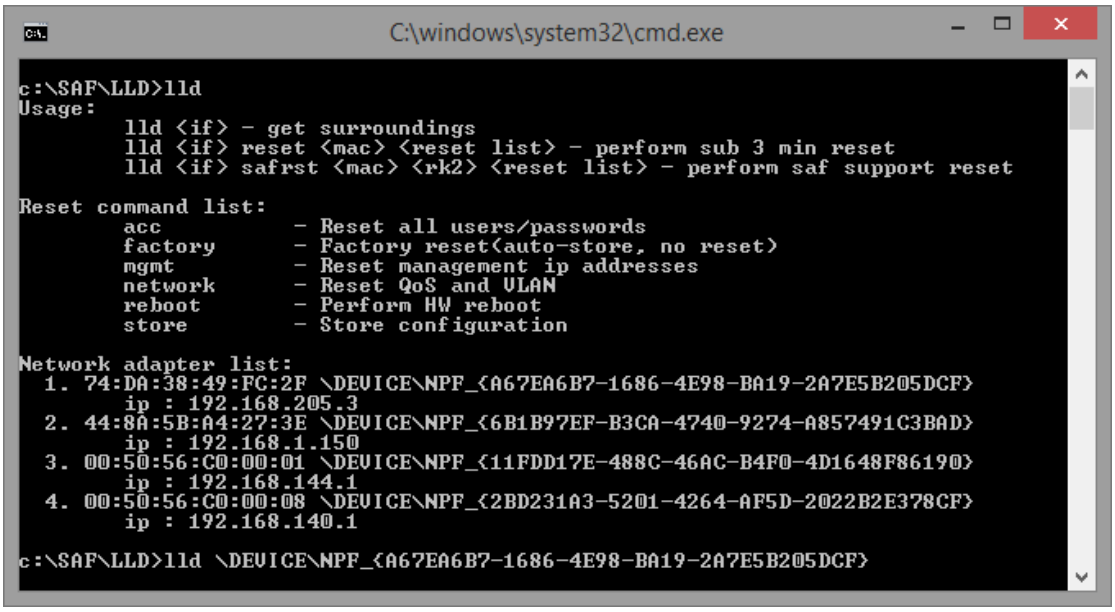


Figure 7-6 Pasted interface address

6) Press ENTER, and the recovery tool will now scan for Integra series devices. Available devices and their information will appear in the console. Make sure that the device has finished booting up.

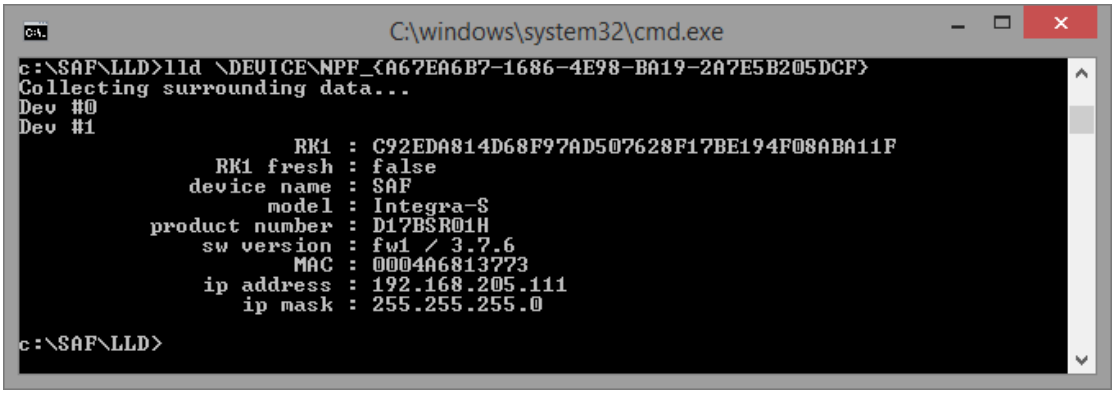


Figure 7-7 Found Integra series device

7) Use the MAC address of the device with the reset command to reset this specific device. The MAC address can be copied in the same way as the interface address.

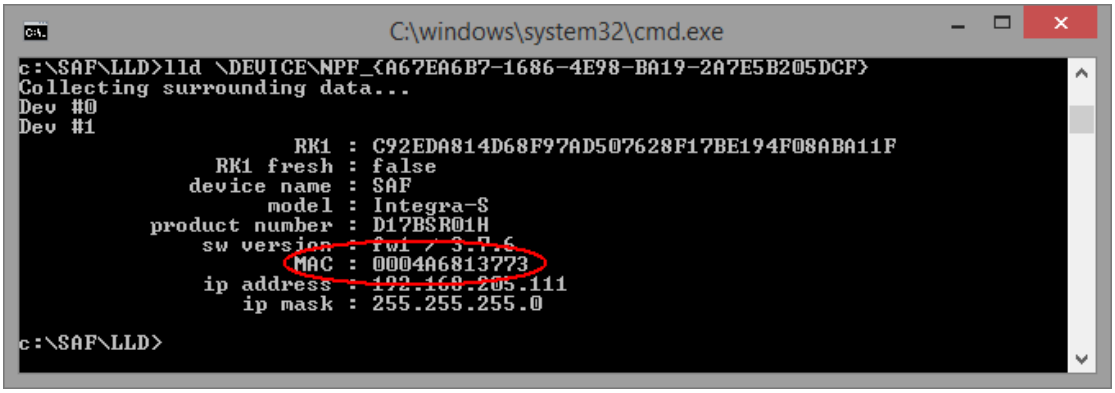


Figure 7-8 Integra series device MAC address

8) The device is reset by using the required reset command with the recovery tool:

lld <interface> reset <MAC> <reset command>

where *<interface>* – network interface from the network adapter list;
<MAC> – required Integra series device address;
<reset command> – reset options.

Different reset options are available depending on the reset requirement. Reboot and store options are also available. Store option saves the device's current configuration so it will be restored after a system reboot. The commands are available in the reset command list. Use the command after the MAC address of the device, as shown in the previous reset command example.

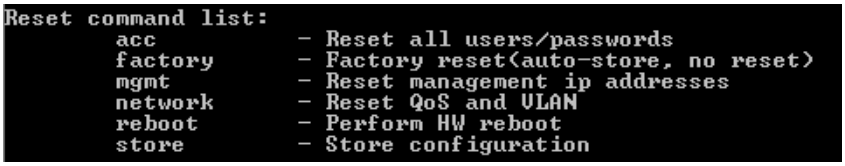


Figure 7-9 Reset command list

For example, to reset users and passwords on Integra series device #1, use:

lld \DEVICE\NPF_{A67EA6B7-1686-4E98-BA19-2A7E5B205DCF} reset 0004A6813773 acc

Make sure the command is run within 3 minutes after Integra series device reboot ("*RK1 fresh*" must be "*true*" in the console), otherwise, the error shown in the screenshot below will occur. The recovery tool will continue to retry the command. In such a situation, the device needs to be rebooted to execute the reset command successfully again.

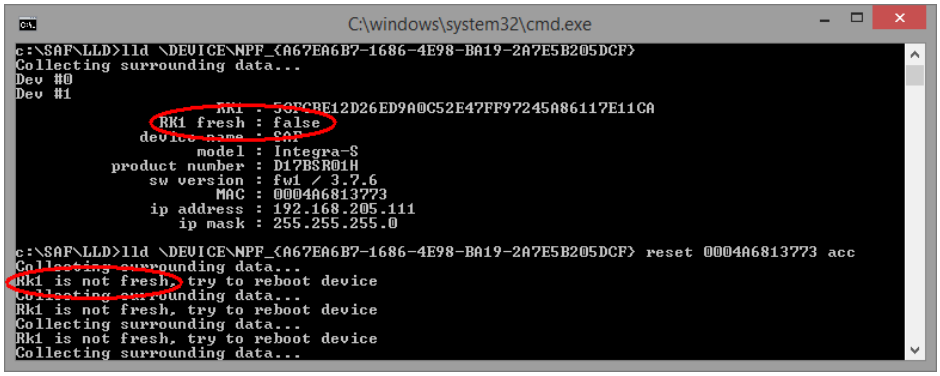


Figure 7-10 Command response past 3 min from Integra series device reboot

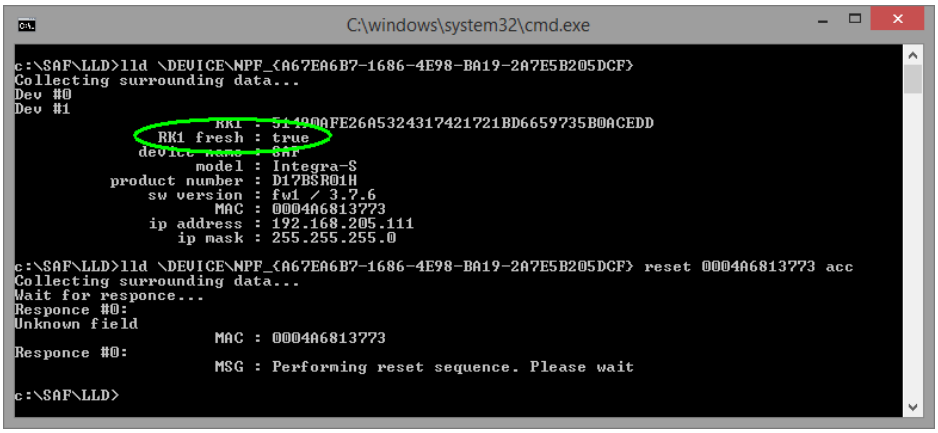


Figure 7-11 Command response prior to 3 min from Integra series device reboot

9) Power down the Integra series device and power it up again; the reset should be completed soon. If the reset cannot be completed, redo step 8).

10) Store changes by command (must be done within the time frame of 3 minutes after a bootup) or by using Web GUI (any time before the Integra series device is powered off) "SAVE" button.
For example:

lld \DEVICE\NPF_{A67EA6B7-1686-4E98-BA19-2A7E5B205DCF} reset 0004A6813773 store

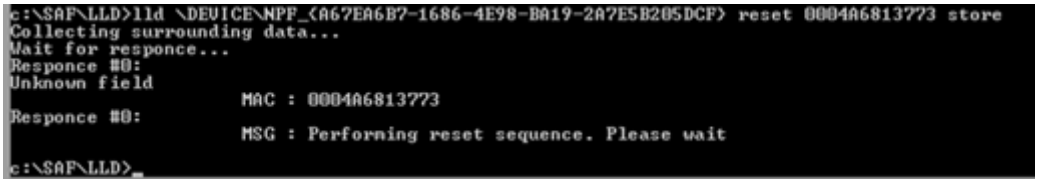


Figure 7-12 Successful command response

MIB files

Relevant MIB files can be downloaded directly from the Integra-X/-X2/-FIDU/-FIDU+ Web GUI. See *System → Configuration → SNMP configuration* for further details.

Chapter 8 INTERFACES

RJ-45 port

The RJ-45 port, see *Figure 8-1*, complies with IEEE 802.3-2005 1000Base-T, 100Base-T, and 10Base-T Ethernet and IEEE 802.3at Power over Ethernet standards.

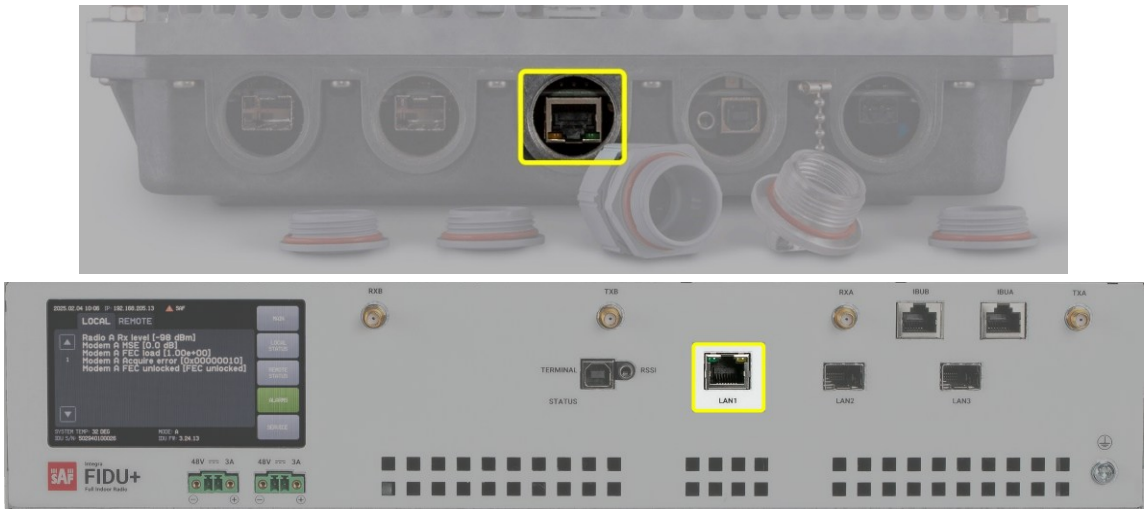
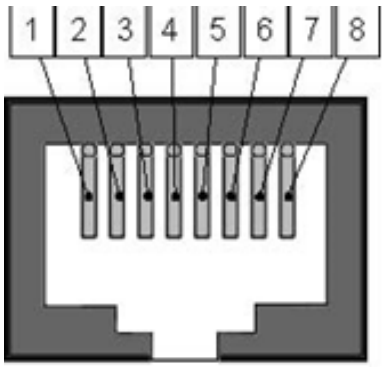


Figure 8-1 RJ45 port

The pinouts of that socket are as in *Table 8-1*:

Table 8-1



Pin	Data	PoE
1	Bi-directional A+	VB1+
2	Bi-directional A-	VB1+
3	Bi-directional B+	VB1-
4	Bi-directional C+	VB2+
5	Bi-directional C-	VB2+
6	Bi-directional B-	VB1-
7	Bi-directional D+	VB2-
8	Bi-directional D-	VB2-

In case an Ethernet cable is used for power & data (with PoE injector), the combined Ethernet cable length from PoE injector to Integra-X/X2 and from PoE injector to CPE is limited to 100m/328ft.

Refer to *Table 8-2* for maximum Ethernet cable lengths for **55V power only connection** from SAF-produced PoE injectors to Integra-X/X2 based on the used Ethernet cable AWG wire size and Integra-X/X2 power consumption.

Table 8-2 Cable lengths for PoE connection from SAF-produced injector to Integra-X/-X2 radio

AWG	Lmax@85W, 55V, 20°C (68°F)	Lmax@95W, 55V, 20°C (68°F)	Lmax@100W, 55V, 20°C (68°F)
26	120m/ 394ft	108m/ 353ft	102m/ 335ft
25	152m/ 497ft	136m/ 445ft	129m/ 423ft
24	191m/ 627ft	171m/ 561ft	162m/ 533ft
23	241m/ 790ft	216m/ 707ft	205m/ 672ft
22	304m/ 997ft	272m/ 892ft	258m/ 848ft

Maximum cable length calculation is done using copper resistance and PSU voltage 55V.

2-wire DC power port

It is possible to power up Integra-X/X2 using a screw-type terminal block, pluggable, 2 pins, centerline 5.08mm/0.2 inch port. See *Figure 8-2*.

Figure 8-2 DC power port

This port can be used simultaneously with a PoE connection just for power redundancy or as the only main power source for Integra-FIDU/-FIDU+ radio. For details, please see *Connecting Integra radio power supply* section. Refer to *Table 8-3* below for maximum power cable length based on AWG wire size or cross-section area and Integra-FIDU/FIDU+ power consumption when the power source is -48V or +48 V DC.
Integra-FIDU/FIDU+ has two 48V DC power ports. The positive terminals of the ports are shared, while the negative terminals are separated by diodes to prevent reverse current flow between power sources.

When both power supplies are connected, the device will automatically draw power from the one with the higher voltage. This ensures safe and uninterrupted operation without interference between the two sources.

Table 8-3 Maximum power cable lengths

AWG	Cross-section area, mm^2	Lmax@85W, 48V, 20°C (68°F)	Lmax@95W, 48V, 20°C (68°F)	Lmax@100W, 48V, 20°C (68°F)
26		17m/ 55ft	15m/ 49ft	14m/ 47ft
24		27m/ 87ft	24m/ 78ft	23m/ 74ft
	0.25	33m/ 109ft	30m/ 98ft	28m/ 93ft
22		42m/ 138ft	38m/ 124ft	36m/ 118ft
20	0.5	67m/ 218ft	60m/ 195ft	57m/ 185ft
	0.75	100m/ 327ft	89m/ 293ft	85m/ 278ft
18		107m/ 350ft	95m/ 313ft	91m/ 298ft
	1	130m/ 426ft	116m/ 381ft	110m/ 362ft
16		170m/ 557ft	152m/ 498ft	144m/ 473ft
	1.5	194m/ 638ft	174m/ 570ft	165m/ 542ft
14		270m/ 885ft	241m/ 792ft	229m/ 752ft

SFP ports

SFP ports provide SFP transceiver connectivity. Both SFP ports comply with the following Gigabit Ethernet standards:

1) copper twisted pair 1Gbps SFP modules 1000BASE-T.
2) optical fiber SFP modules 1000BASE-SX, 1000BASE-LX, 1000BASE-EX and 1000BASE-ZX.
3) optical fiber SFP+ modules 10GBASE-SR, 10GBASE-LR, 10GBASE-ER and 10GBASE-ZR.

Please inquire SAF representative about the possibility of purchasing SAF-approved SFP modules. In the case of third-party vendors, you can inquire SAF representatives about the necessity of additional testing according to SAF standards.

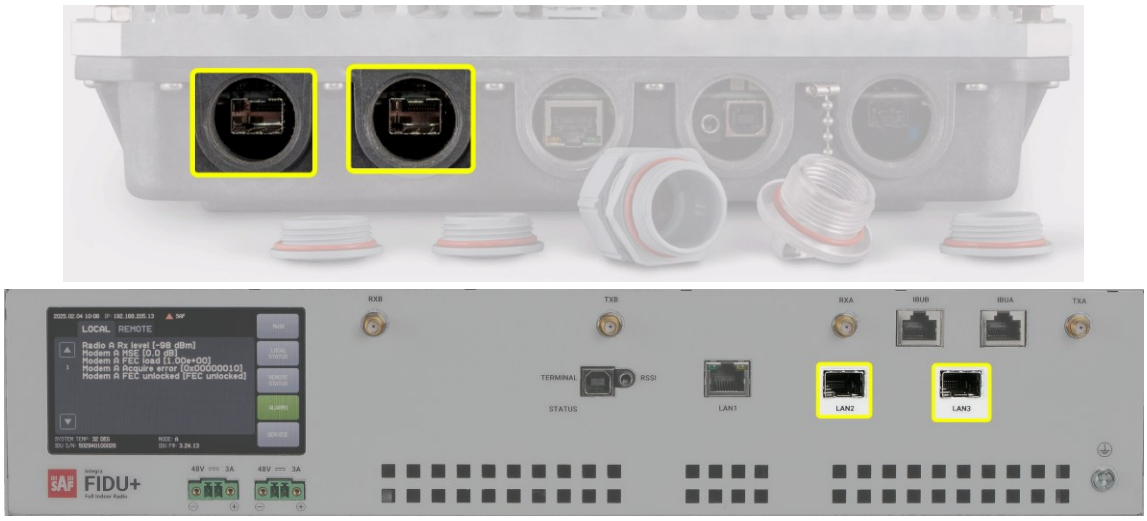


Figure 8-3 Location of SFP ports on Integra-X/-X2/-FIDU/-FIDU+ radios

USB port

The USB port provides serial terminal access to CLI. The socket is B type.

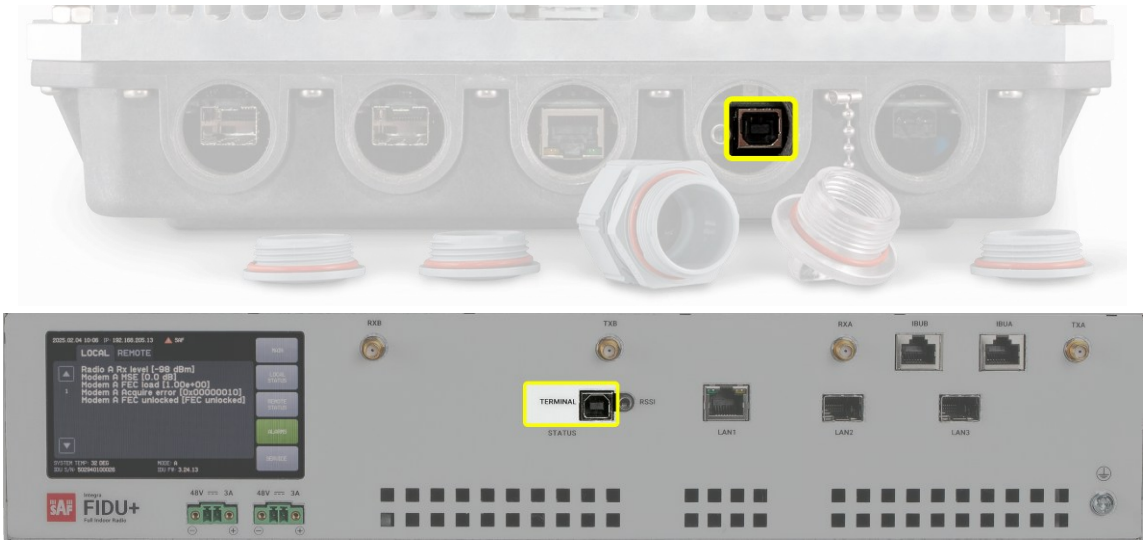
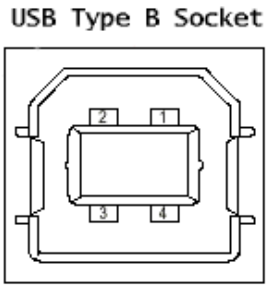


Figure 8-4 USB-B port



1=Vbus (5V)

2=D–

3=D+

4=GND

Figure 8-5 USB B socket pinout

RSSI LED

The RSSI/Status LED can be activated in three operational modes – Mode 1, Mode 2, and Mode 3. By default, RSSI/Status LED is enabled in Mode 1. For further details refer to the *Over The Air → Radio → Configuration*.

The corresponding Rx signal levels and LED blinking pattern for each mode is represented in *Figure 8-7*.

Figure 8-6 RSSI LED placement on Integra-X/-X2/-FIDU/-FIDU+ radios

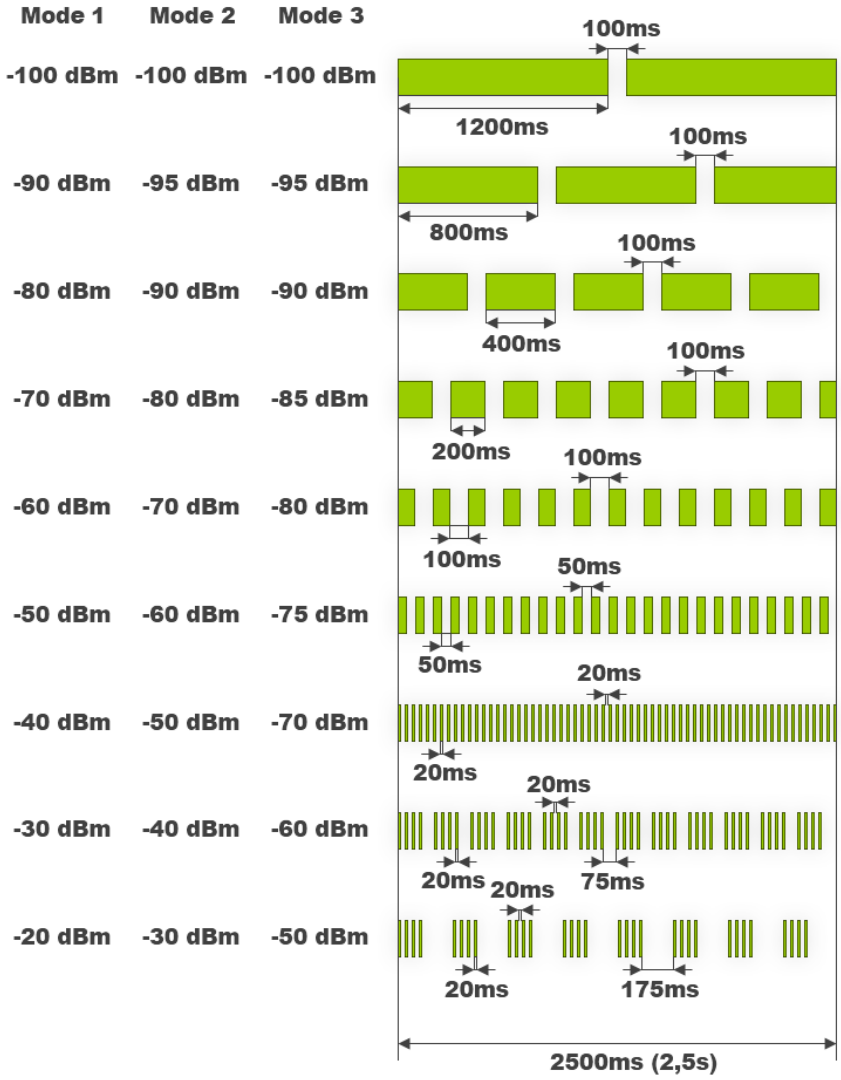


Figure 8-7 LED blink pattern

RSSI/audio port

The RSSI (Received Signal Strength Indicator) port is used to adjust the alignment of the antenna for best performance (for both rough and fine adjustment); this can be done using a digital multimeter or headphones connected to the RSSI port. The RSSI port is a 3.5mm socket. The output of the RSSI port is DC voltage and audio frequency and varies depending on the received signal level. Both are linear curves.

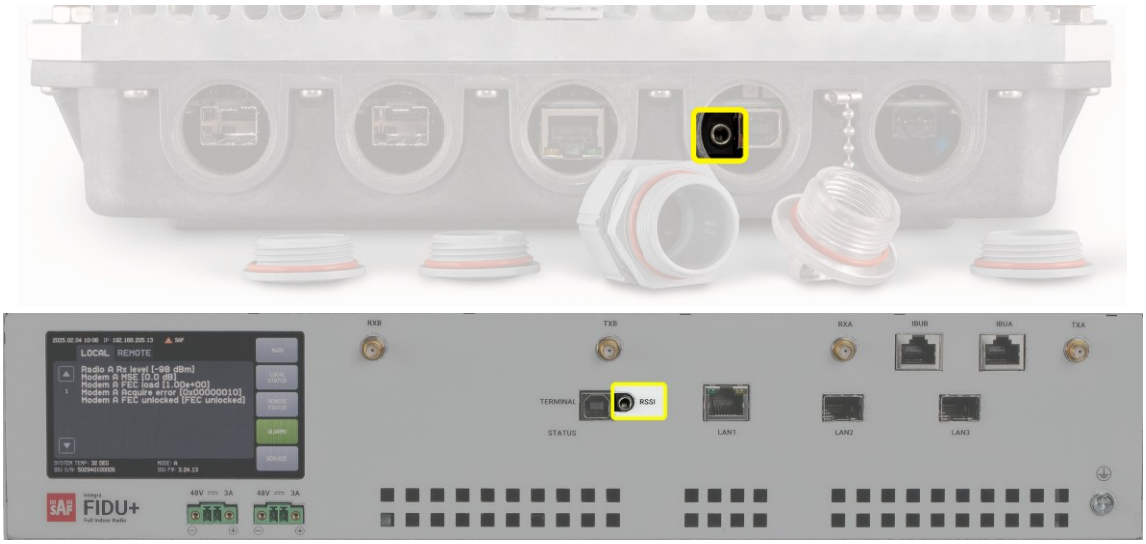


Figure 8-8 RSSI/audio port

To connect a voltmeter, you will require the appropriate RSSI cable (P/N D0ACRS01) which has a 3.5mm RSSI/audio jack with a pinout shown in *Figure 8-10*:

Figure 8-9 RSSI cable

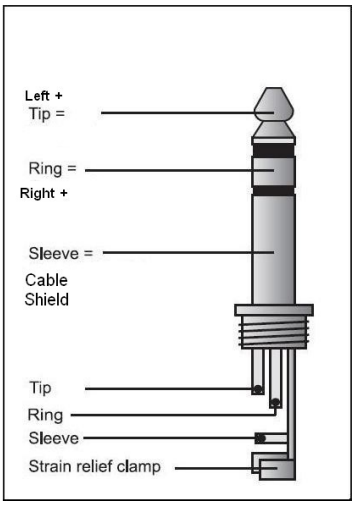
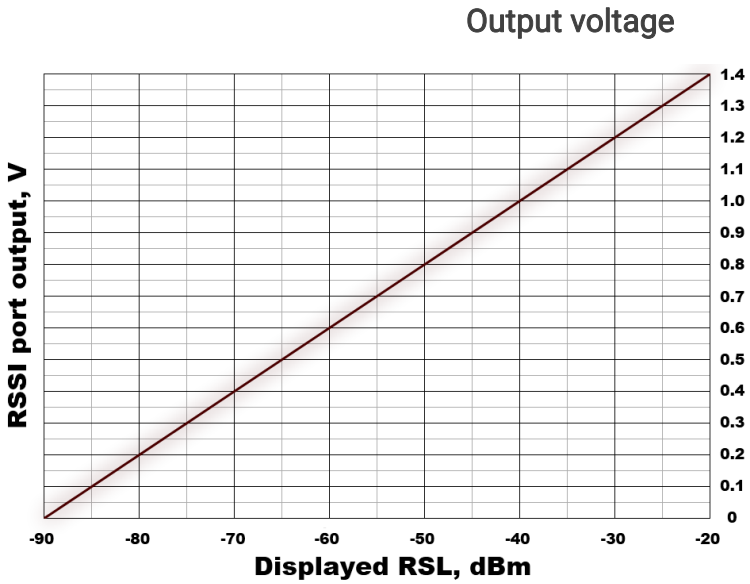


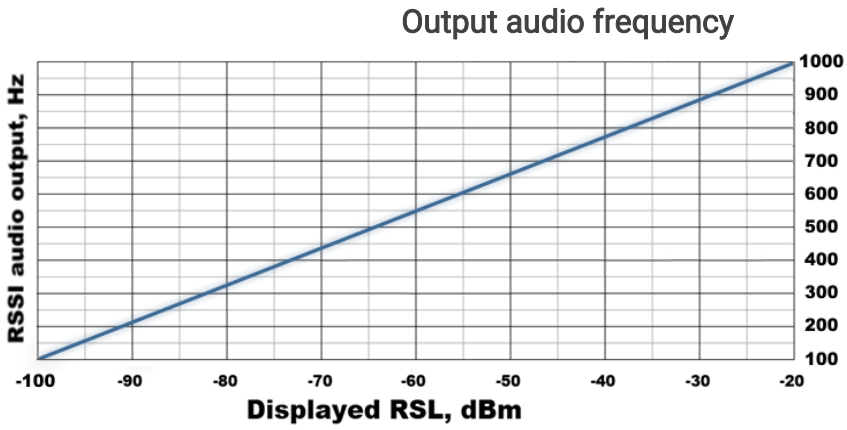
Figure 8-10 RSSI cable 3.5mm RSSI/audio jack pinout

Figure 8-11 shows the typical relationship of the received signal level (Rx level) displayed by the Integra-X/-X2/-FIDU/-FIDU+ radio vs. the RSSI port output voltage (RSSI – Received Signal Strength Indicator). The table below shows the relevance between the received signal level (Rx level) and audio output frequency. RSSI port location in the FODU is shown in *Figure 8-8*. The evaluated Rx level has an error of ±2 dB.



Rx level (dBm)	RSSI voltage (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	1.0
-35	1.1
-30	1.2
-25	1.3
-20	1.4

Figure 8-11 RSSI vs output voltage



Rx level (dBm)	Audio frequency (Hz)
-100	100
-96	145
-92	190
-88	235
-84	280
-80	325
-76	370
-72	415
-68	460
-64	505
-60	550
-56	595
-52	640
-48	685
-44	730
-40	775
-36	820
-32	865
-28	910
-24	955
-20	1000

Figure 8-12 Audio frequency vs RSSI

Grounding connection

Always provide a good connection from the FODU grounding screw to the tower/mast/building grounding circuit. You must choose one, the most convenient, of 2 screws for grounding connection. See *Figure 8-13*.

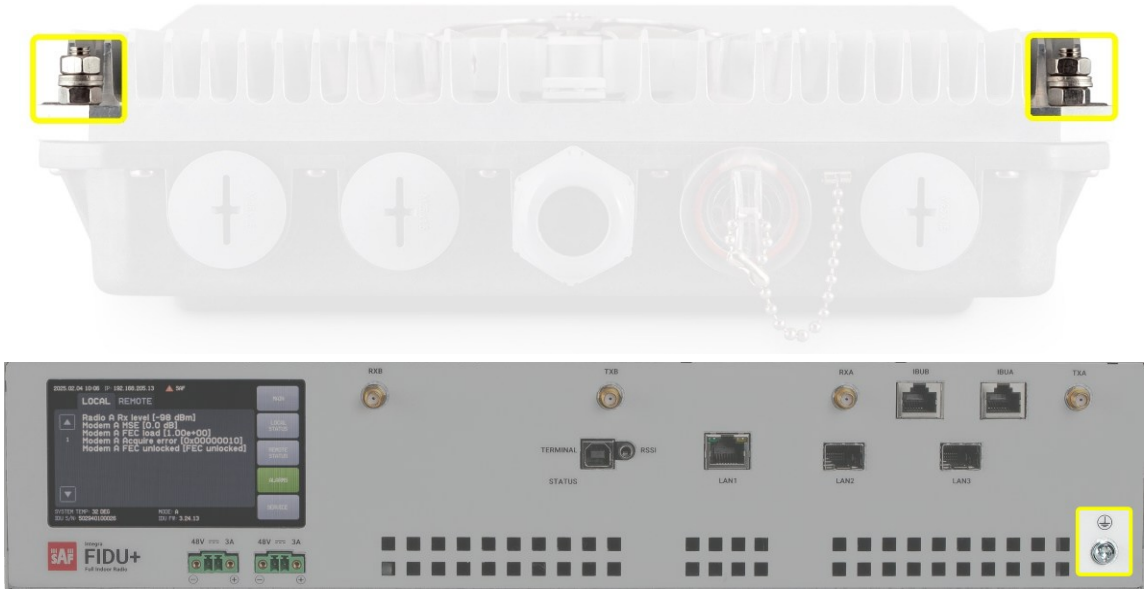


Figure 8-13 grounding connection placement

Tx/Rx radio ports (Integra-FIDU/FIDU+)

Integra-FIDU/FIDU+ without diplexer has four SMA connectors for radio Tx (2) and Rx (2) connection. Those ports are intended for connection to the branching unit.

Integra-FIDU/FIDU+ with diplexer does not have those Tx/Rx SMA ports.

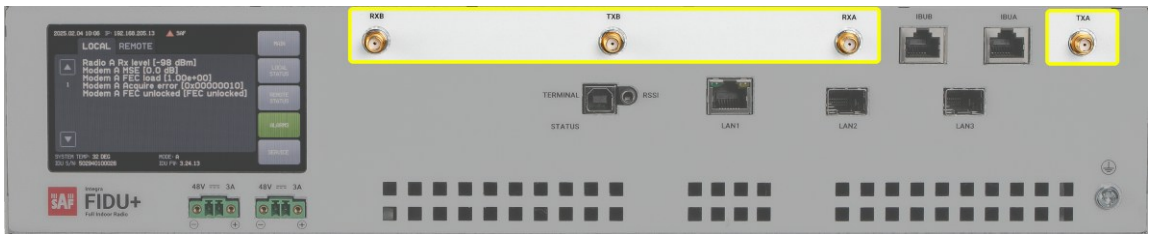


Figure 8-14 Tx/Rx ports on the Integra-FIDU/FIDU+ without diplexer

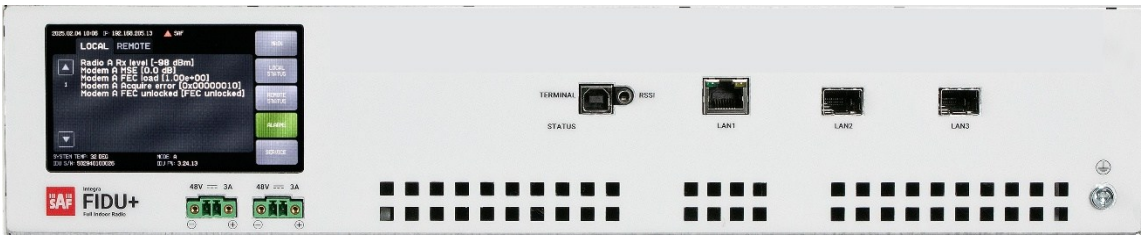


Figure 8-15 Front panel of Integra-FIDU/FIDU+ with diplexer

Antenna port on Integra-FIDU/FIDU+ with diplexer

The antenna port on the Integra-FIDU/FIDU+ with diplexer is located on the back panel of the radio. A rectangular standard waveguide flange is provided for waveguide connection:

Figure 8-16 Antenna port on the back panel of Integra-FIDU/FIDU+ with diplexer

Active IBU control ports Integra-FIDU/FIDU+

Integra-FIDU/FIDU+ can have control ports for an Active IBU connection.

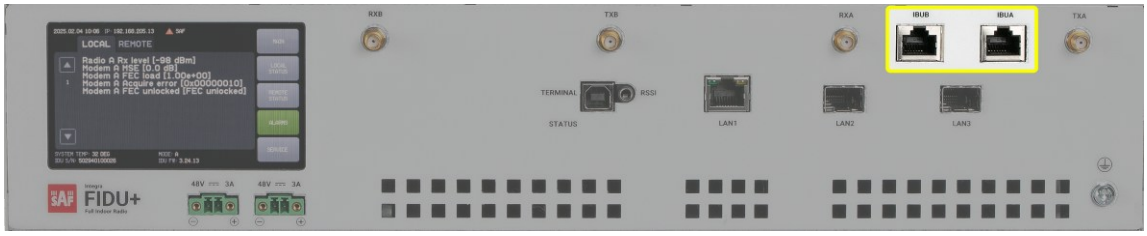


Figure 8-17 Active IBU control port location

Appendix: Integra-X/-X2/-FIDU/-FIDU+ technical specifications

For technical specifications of Integra-X, Integra-X2, Integra-FIDU and Integra-FIDU+ please refer to the datasheets at https://old.saftehnika.com/en/downloads (login/registration required).

ABBREVIATIONS

ACAP – Adjacent Channel Adjacent Polarization
ACI – Adjacent-Channel Interference
ACM – Adaptive Coding and Modulation
ADPD – Adaptive Digital Pre-Distortion
ATPC – Automatic Transmit Power Control
BER – Bit-Error Ratio
CCI – Co-Channel Interference
CLI – Command-Line Interface
CPE – Customer Premises Equipment
CPU – Central Processing Unit
CRC – Cyclic Redundancy Check
DC – Direct Current
DiffServ – Differentiated Services
DSCP - Differentiated Services Code Point
ETSI – European Telecommunications Standards Institute
FCC - The Federal Communications Commission
FCS - Frame check sequence
FDD – Frequency Division Duplex
FEC – Forward Error Correction
FIDU/FIDU+ – Full Indoor Unit
FO – Fiber Optics
FODU – Full Outdoor Unit
FTP – File Transfer Protocol
GUI – Graphical User Interface
IBU – Indoor Branching Unit
IEEE - Institute of Electrical and Electronics Engineers
IF – Intermediate Frequency
ISP – Internet Service Provider
ITU-T – International Telecommunication Union – Telecommunication Standardization Sector
LACP - Link Aggregation Control Protocol
LAG – Link Aggregation Group
LAN – Local Area Network
LED – Light-Emitting Diode
LSP – Link State Propagation
MAC – Media Access Control
MSE – Mean Square Error
NMS – Network Management System
PC – Personal Computer
PD – Powered Device
PLL – Phase-Locked Loop
PoE - Power over Ethernet
QAM - Quadrature amplitude modulation
QoS – Quality of Service

RSL – Received Signal Level
RSS – Radio Standards Specification
RSSI – Received Signal Strength Indicator
Rx – Receive
SES - Severely Errored Second
SNMP - Simple Network Management Protocol
SNR – Signal-to-Noise Ratio
STP – Spanning Tree Protocol
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 – Transmit
USB – Universal Serial Bus
VLAN – Virtual Local Area Network
WAN – Wide Area Network
WF – Weak FEC
PD – Cross Polarization discrimination
XPIC - Cross Polarization Interference Cancellation

Global headquarters

SAF Tehnika JSC

VAT No. LV40003474109

OFFICE, MANUFACTURING AND LEGAL ADRESS:

24a, Ganibu Dambis

Riga, LV-1005, Latvia

E-MAIL:

info@saftehnika.com

TECHNICAL SUPPORT E-MAIL:

techsupport@saftehnika.com

PHONE: +371 670 468 40

FAX: +371 670 468 09

North America office

SAF North America LLC

OFFICE ADDRESS:

3250 Quentin Street,

Unit 128, Aurora CO 80011

E-MAIL:

salesna@saftehnika.com

TECHNICAL SUPPORT E-MAIL:

techsupport@saftehnika.com

PHONE: 720 502 0724