User manual

Integra

Integra-S

Integra-G

Integra-GS

VER 3.0

FW 3.23.15

Proprietary notice

The specifications or information contained in this document are subject to change without notice due to 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.

FODU does not contain serviceable parts. Warranty will not be applicable in the event FODU 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, pursuant 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 in accordance with 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 the receiver.
- Connect the equipment to 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 license-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.

Contents

Chapter 1: OVERVIEW

Labeling

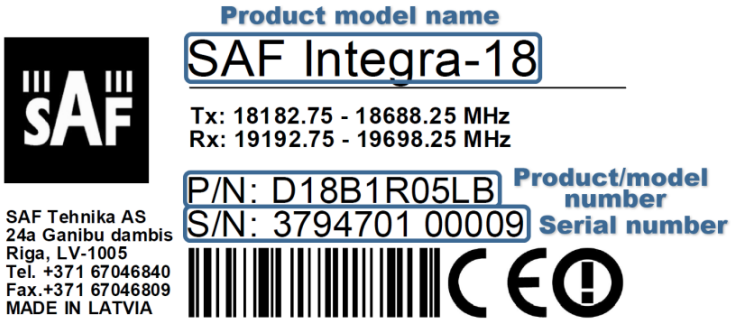
The label contains the following information (see samples in the picture below):

Product model name ("SAF Integra-18"). The FODU model name example is:

- SAF Integra-18 for Integra 18GHz FODU,
- SAF Integra-GS-23 for Integra-GS 23GHz FODU, etc

Product Number / Model Number (P/N or M/N) (D18B1R05LB): product/model number contains various information about the unit. Please see the translation below.

Serial Number (3794701 00009): the serial number uniquely identifies the unit.



P/N or M/N translation:

"**D**" designates Integra series product.

"**18**" designates the frequency band (18 GHz) of the radio.

"**B**" designates Integra/Integra-S/Integra-G/Integra-GS product type.

- "**G**" - designates Integra-G/Integra-GS product type.

"**1**" designates 1ft antenna diameter and ETSI Class 3.

- "**0**" - <1ft (20cm) antenna diameter and ETSI Class 3;
- "**2**" - 2ft antenna diameter and ETSI Class 3;
- "**3**" - 3ft antenna diameter and ETSI Class 3;
- "**4**" - 4ft antenna diameter and ETSI Class 3;
- "**5**" - <1ft (20cm) antenna diameter and ETSI Class 4;
- "**6**" - 1ft antenna diameter and ETSI Class 4;
- "**7**" - 2ft antenna diameter and ETSI Class 4;
- "**8**" - 3ft antenna diameter and ETSI Class 4;
- "**9**" - 4ft antenna diameter and ETSI Class 4;
- "**S**" - split-mount, without an integrated antenna.

"**R**" designates Integra with full capacity license[1].

- "**N**" - 10 Mbps Basic License;
- "**L**" - 100 Mbps Basic License;
- "**K**" - 220 Mbps Basic License;
- "**X**" - without AES encryption.

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

"**L**" designates low side radio.

- "**H**" - high side radio.

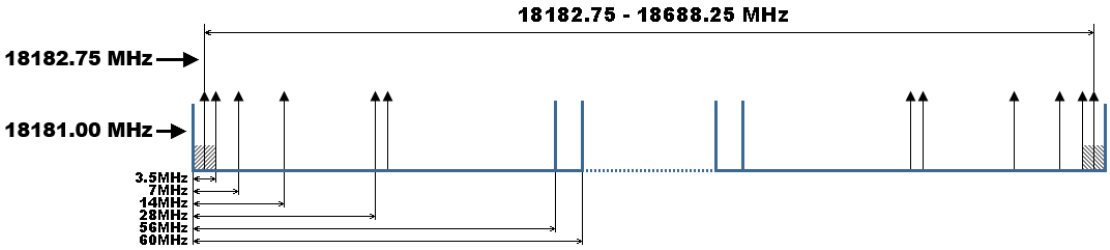
"**B**" designates B subband radio.

[1] Contact SAF representatives for detailed license information.

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

Please note that the frequency range is set from the central frequency of the first 3.5 MHz channel to the central frequency of the last 3.5 MHz channel (see the diagram below).

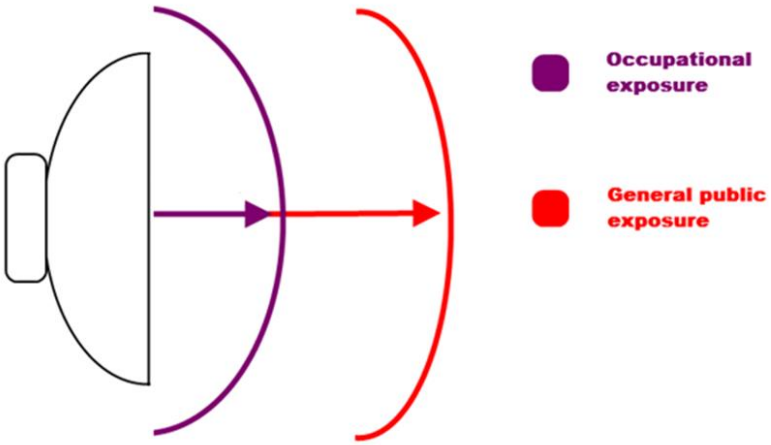
The frequency range of subband B low side Integra 18 GHz FODU:



The minimum available bandwidth is 1.75 MHz. (Inquire SAF representative for more information)

Microwave Radiation

In April 1998, ICNIRP (International Commission on Non-Ionizing Radiation Protection) published its ´Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300GHz)´. As shown in Table 2.2-1, the guidelines (Tables 6 and 7) specify the ´Reference levels on power density for occupational exposure and general public exposure to time-varying electric and magnetic fields (unperturbed rms values)´ between 2 and 300 GHz.



ICNIRP Reference levels

Frequency range	Exposure characteristics	Equivalent plane wave power density Seq (W/m2)	Average time period (min)
5.8 GHz	occupational 458 cm (181 in)	50	$68/f^{1.05}$ (f in GHz)
	general public 1025 cm (404 in)	10	$68/f^{1.05}$ (f in GHz)
24 GHz	occupational 41 cm (16 in)	50	$68/f^{1.05}$ (f in GHz)
	general public 91 cm (36 in)	10	$68/f^{1.05}$ (f in GHz)

Note: For pulsed signals, it is suggested that the peak equivalent plane wave power density, as averaged over the pulse width, does not exceed 1000 times the Seq exposure levels given in the table.

Note: Within the frequency range the 10 – 300 GHz the basic restrictions are identical to the reference levels.

Remarks on the definition of basic restrictions:

1. Power densities are to be averaged over any 20 cm^2 of exposed area and any 68/f1.05 minute period (where f is in GHz) to compensate for progressively shorter penetration depth as the frequency increases.

2. Spatial maximum power densities, averaged over 1 cm^2, should not exceed 20 times the values above.

Compared to the ICNIRP restrictions, FCC CFR 47 and ISED (Canada) specifies the Maximum Permissible Exposure (MPE) levels for the occupational/controlled environment and general public/uncontrolled environment, as shown in the table below.

FCC MPE limits

Frequency range	Exposure characteristics	Equivalent plane wave power density Seq (W/m2)	Average time period (min)
5.8 GHz	occupational 458 cm (181 in)	f/300	6
	general public 1025 cm (404 in)	f/1500	30
24 GHz	occupational 41 cm (16 in)	50	6
	general public 91 cm (36 in)	10	30

ISED (Canada) MPE limits

Frequency range	Exposure characteristics	Equivalent plane wave power density Seq (W/m2)	Average time period (min)
5.8 GHz	occupational 464 cm (183 in)	$0.6455f^{0.5}$	6
	general public 1041 cm (410 in)	$0.02619f^{0.6834}$	30

Quite a few other documents specify or refer to exposure limits comparable to those given above, e.g.:

- 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 (withdrawed in December 1999 by CENELEC)

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

Integra-G 5.8 & 24 GHz FCC & IC IDs

Integra-G 5.8 GHz:
FCC ID: W9Z-INTEGRA5G8
IC ID: 8855A-INTEGRA5G8

Integra-G 24 GHz:
FCC ID: W9Z-INTEGRA24
IC ID: 8855A-INTEGRA24

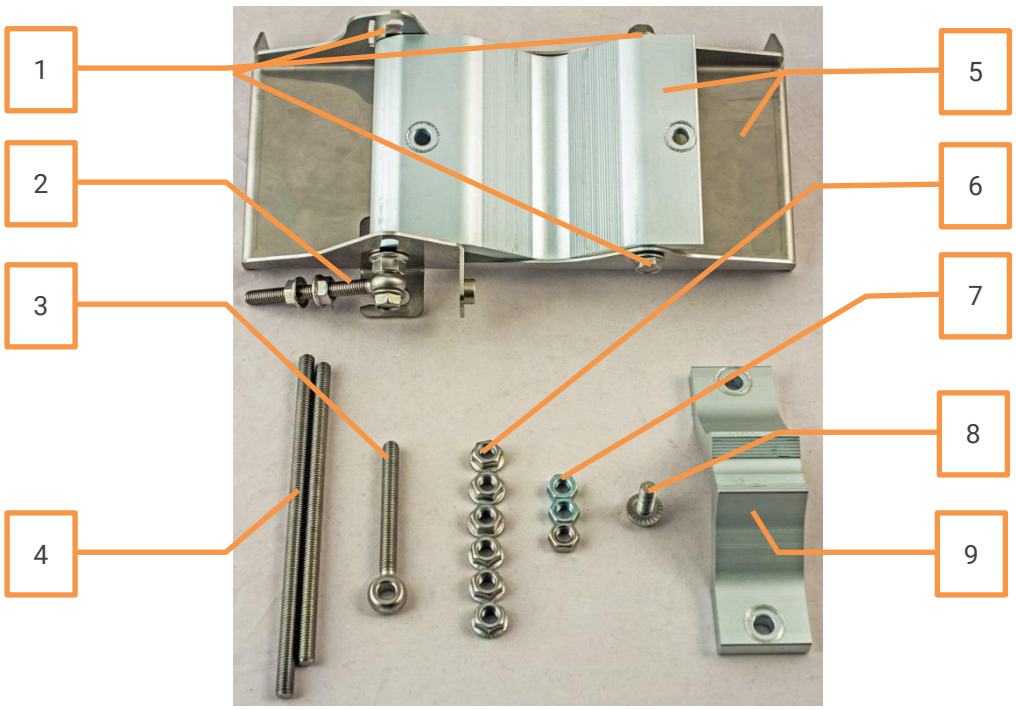
Chapter 2: INSTALLATION

Package contents

Integra/Integra-G	Integra-S/Integra-GS
- Integra FODU D**B1*****, D**B2*****, D**G1***** or D**G2*****, - Mounting bracket D0SPKR02 - Locking key for Integra D0ALK001 - Kit of replacement parts D0AZIP01 - RJ-45 connector 8P shield solid FOACNR02 - Installation manual D0DB2RM1	- Integra D**BS***** or D**GS***** - Locking key for Integra-S D0ALK002 - RJ-45 connector 8P shield solid FOACNR02 - Installation manual D0DBSRM1

Integra/Integra-G FODU: assembling mounting bracket and installing with an antenna on a pole

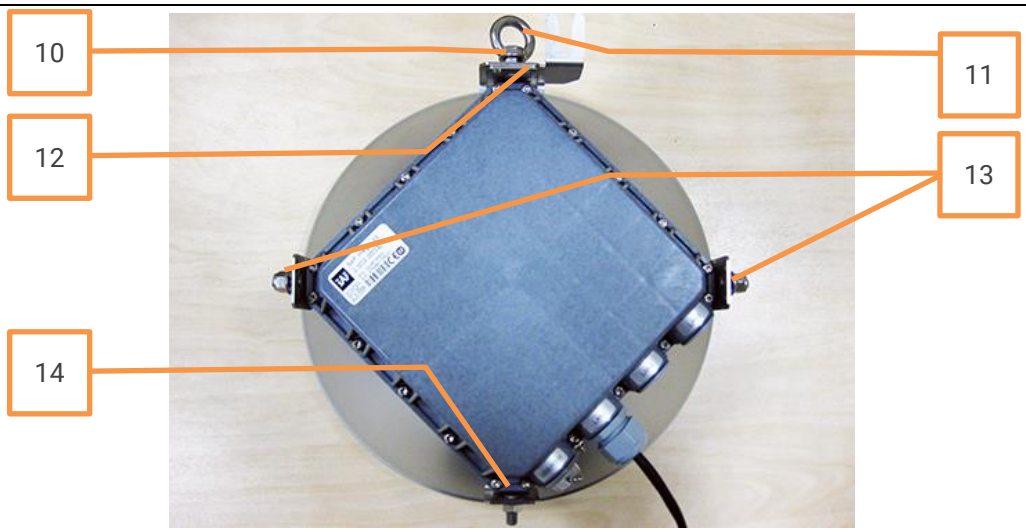
Disassembled mounting bracket and tools required for assembly



Parts of the disassembled mounting bracket

#	Parts of the disassembled mounting bracket
1	Three M8x1.25x16 hex flange bolts are already attached to clamps for housing and pipe [5]
2	One hex flange bolt M8x1.25x30, one M10x1.5 hex flange nut, and one M8x80 eye screw are already attached to clamps for housing and pipe [5]

3	One M8x80 eye screw
4	M8x160 and M8x130 threaded rods
5	Clamps for housing and pipe interconnected with three M8x1.25x16 hex flange bolts [1] and an eye screw for horizontal alignment [2]
6	Six M8x1.25 hex flange nuts
7	Three M8x1.25 hex nuts
8	One hex flange bolt M8x1.25x20
9	Mounting bracket clamp



#	Parts of Integra/Integra-G FODU
10	Spacer hex flange nut
11	Lifting eye nut
12	Fixation plate
13	Side screw flange nuts
14	Grounding flange nut

The numbers of the mounting bracket and Integra/Integra-G FODU parts in the next sections will be mentioned in square brackets [ ].

Changing the polarization of Integra/Integra-G FODU and antenna

Tools required: 13mm (0.512") wrench (comes in the package)

The default polarization for licensed frequency band radios is vertical.

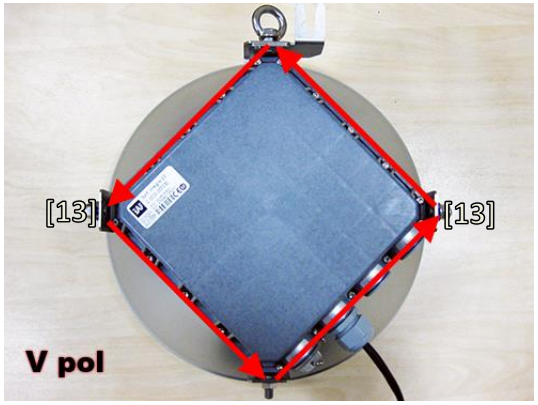
Integra series 17/24GHz FODUs should be installed in opposite polarizations.

By default, Integra series 17/24GHz FODU radios are shipped with opposite polarizations pre-installed for low and high side units.

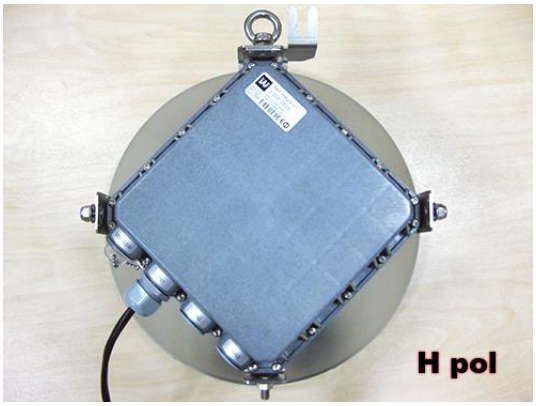
1 Remove Integra/Integra-G FODU with an antenna from the mounting bracket.

The default polarization is vertical.

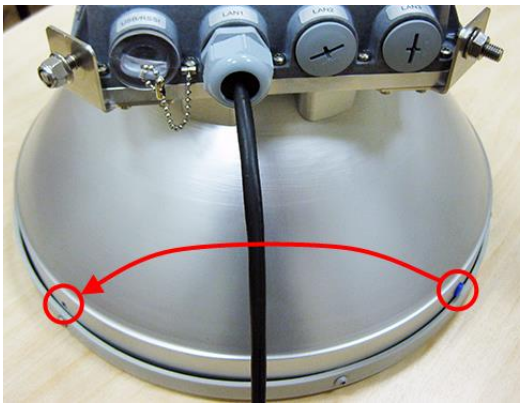
2 Using a 13mm wrench, remove indicated nuts and fixation plate [10, 11, 12, 13, 14].



3 Removed parts must be attached back with a 90-degree offset (see above). The gap between side screw flange nuts [13] and fastening angles should be 5mm.



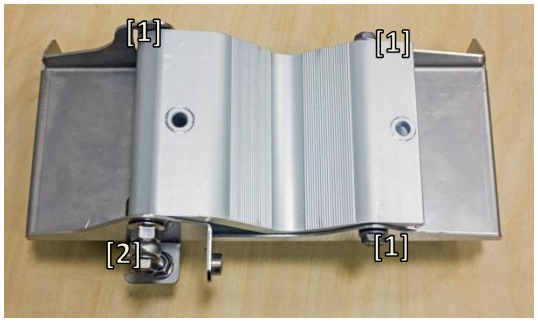
4 View of Integra/Integra-G FODU with swapped polarization.



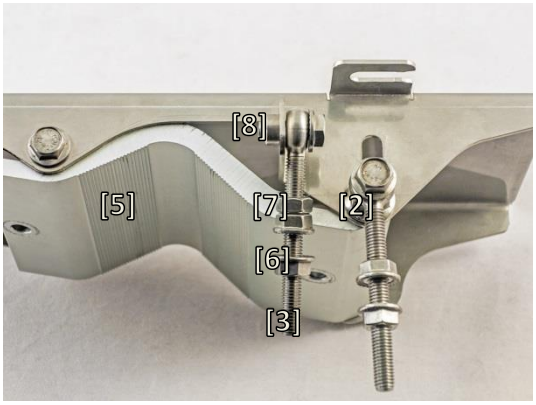
5 When polarization is changed, make sure that the drain hole cap located at the grounding flange nut is removed and inserted into the previous drain hole.

Assembly procedure

Tools required: 13mm (0.512”) wrench (comes in the package)

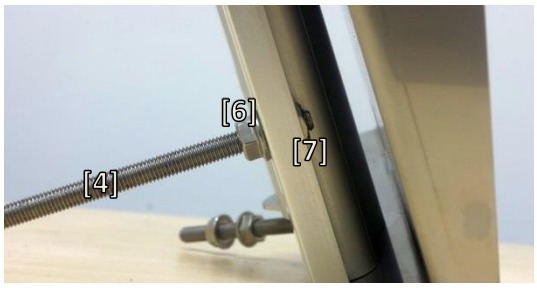


1 Using a 13mm wrench, slightly loosen three hex flange bolts [1] and hex flange bolt, nut, and eye screw [2] interconnecting clamps for housing and pipe [5].

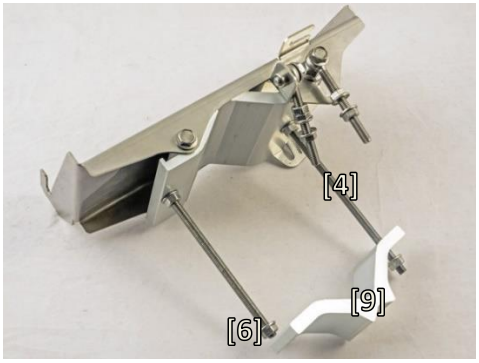


2 Attach vertical alignment eye screw [3] to clamps for housing and pipe [5] using hex flange bolt [8] and screw on one hex nut [7] and two hex flange nuts [6]. Make sure that both eye screws are positioned as shown in the image (turned to the back side of the clamps). The gap between each two flange nuts on eye screws should be 15..20 mm (0.6..0.8 in.). Do not tighten both hex flange bolts [8] and [2].

3 Screw one hex flange nut [6] on each of the threaded rods [4]. Note that flange nuts should be screwed on exposing approx. 20mm (0.8 in.) of threaded rods.

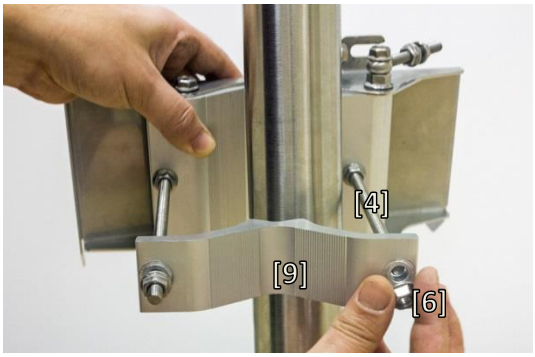


4 Insert both threaded bolts into two available holes of the mounting clamp. Put hex nuts [7] on the other side of the clamp and screw on the threaded bolts until it is visible from the other side of the clamp no more than 2mm. Tighten hex flange nuts [6] with torsion 20...25 N·m.



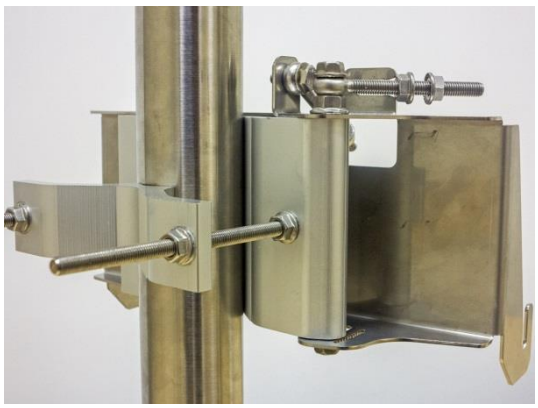
5 Attach the mounting bracket clamp [9] on the longest threaded rod [4] as shown in the picture and afterward screw on the remaining two hex flange nuts [6] on both threaded rods. No parts should remain unassembled.

Bracket clamps in the following position support mast Ø 55..120mm. Reversing clamps allow support of smaller masts Ø 25..75mm.



6 Unscrew the hex flange nut [6] from the shortest threaded rod [4]. Make sure that hex flange nuts on the longest threaded rod are not too far; otherwise, adjust the nut's position accordingly. Put another end of the mounting bracket clamp [9] on the free threaded rod and screw on the hex flange nut.

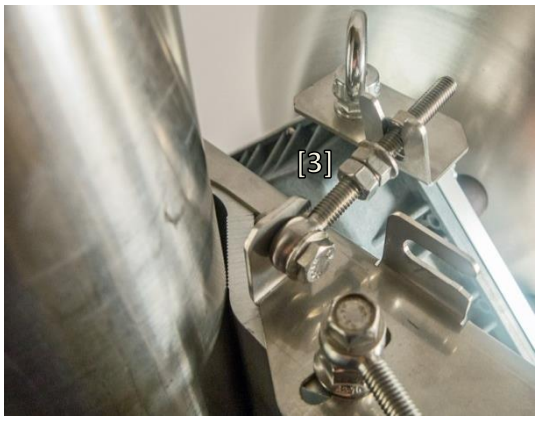
7 Hex flange nuts should be evenly aligned on threaded bolts so that the mounting bracket clamp [9] is tightly attached to the pipe. Tighten hex flange nuts with torsion not exceeding 20 N·m.



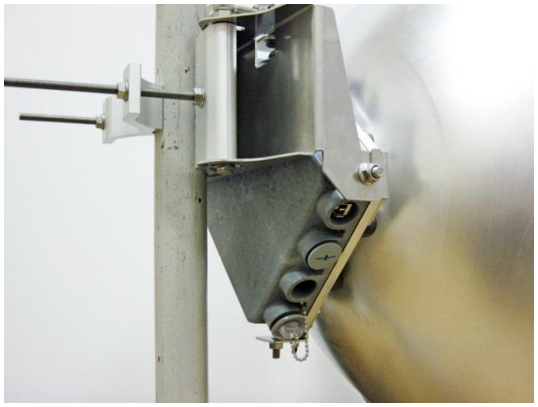
8 View of the assembled mounting bracket on the mast pole.

9 Make sure that both horizontal and vertical alignment eye screws are turned to the mast before attaching Integra/Integra-G FODU.

10 Attach Integra/Integra-G FODU with the antenna to the mounting bracket so that side screws fit into the grooves of the housing clamp [5].



11 Connect the vertical alignment eye screw [3] to the upper groove on Integra/Integra-G housing.



12 View of the assembled bracket on the mast pole with Integra/Integra-G FODU attached and secured.

It is recommended to protect the installed radio from direct sunlight.

Antenna alignment

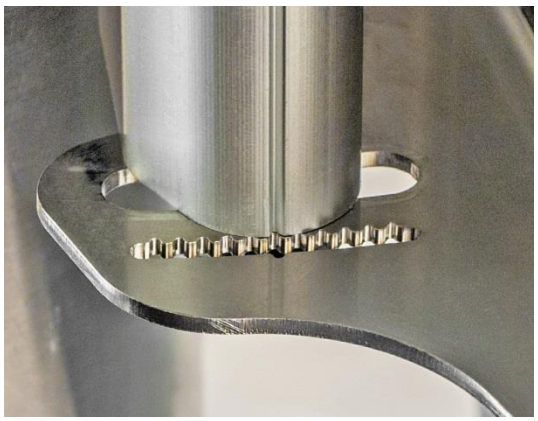
Tools required: 13mm (0.512”) wrench (comes in the package)

1 Before aligning the antenna, make sure that screws marked with red dots on the right side view of the mounting bracket are loosened - hex flange nuts and bolts of azimuth and elevation eye screws, right side screw on Integra/Integra-G FODU, and hex flange bolt on azimuth angle indicator.

2 Additionally loosen the following screws marked with red dots on the left side view of the mounting bracket: the left side screw on Integra/Integra-G FODU and two hex flange bolts between both mounting bracket clamps for housing and pipe.

3 For initial alignment make sure that elevation is approximately at zero degrees angle by adjusting hex flange nuts [9] on the vertical alignment eye screw so that Integra/Integra-G housing is parallel with the bracket.

4 Adjust the azimuth angle by manually moving the mounting bracket in the horizontal axis. Note that all azimuth position fixing hex flange bolts, as well as the horizontal alignment eye screw with flange bolts need to be loosened ensuring free movement in the horizontal axis.



5 Each notch corresponds to one degree of azimuth angle. The half distance between notches (each lip) corresponds to 0.5 degrees.

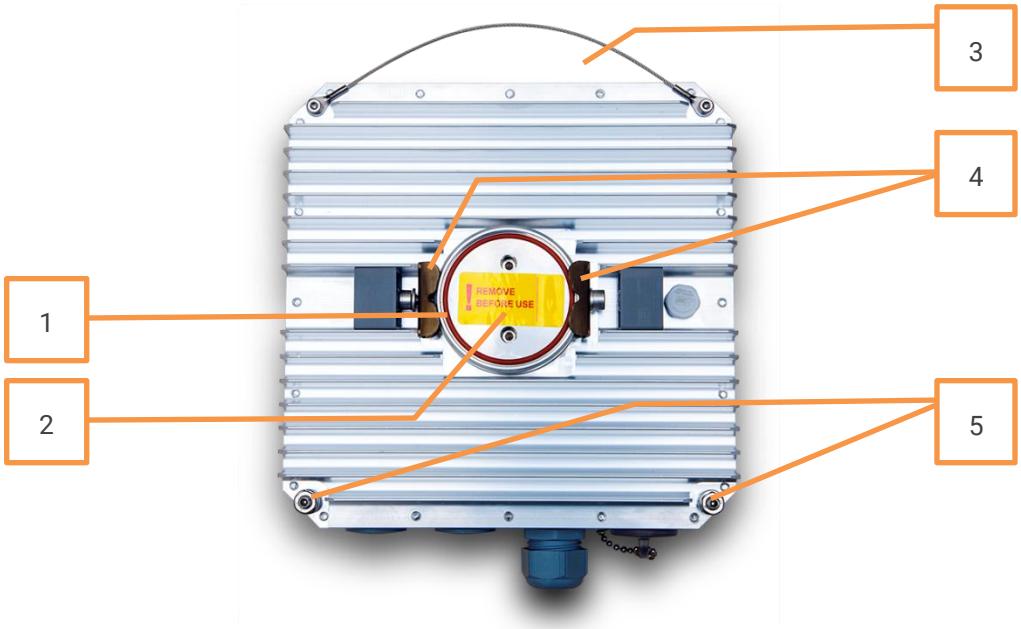
6 Fix the azimuth angle on the horizontal axis by adjusting the position of flange nuts [6] on both horizontal and vertical alignment eye screws.

7 When alignment is finished, tighten screws marked with red dots on the right side view of the mounting bracket: hex flange nuts and bolts of azimuth and elevation eye screws, right side screw on Integra FODU, and hex flange bolt on azimuth angle indicator with torsion 20...25 N·m.

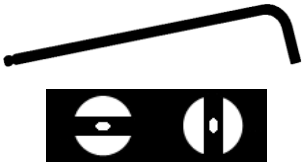
8 Additionally tighten the following screws marked with red dots on the left side view of the mounting bracket: the left side screw on Integra/Integra-G FODU and two hex flange bolts between both mounting bracket clamps for housing and pipe with torsion 20...25 N·m.

Integra-S/Integra-GS 15-42GHz* FODU: attaching to the antenna

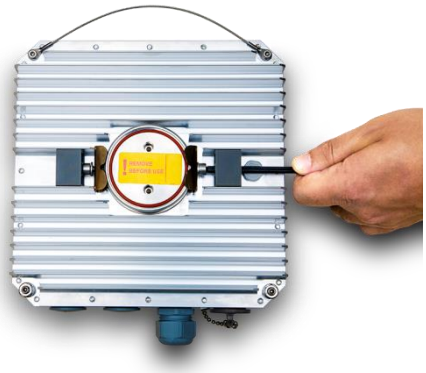
Parts of Integra-S/Integra-GS FODU: **1** – O-ring; **2** – flange protecting sticker; **3** – wire handle; **4** – fixation clamps; **5** – grounding screws.



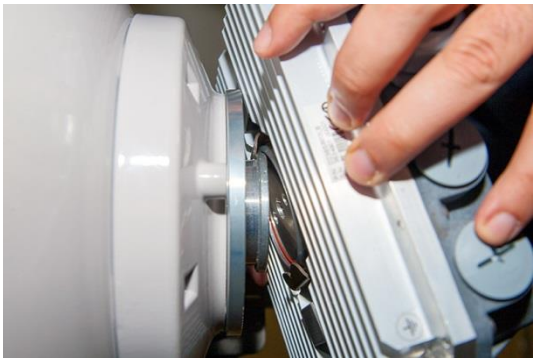
Tools required: Size 5 Allen wrench



Level (not supplied)



1 Using a size 5 Allen wrench, loosen one clamp completely and the second clamp by a half-turn.



2 Put Integra-S/Integra-GS on the antenna adapter flange by hooking a half-turn loosened clamp at the top and leaving the completely loosened clamp at the bottom. Make sure the O-ring is in place and the adapter flange fits into the Integra-S/Integra-GS transition flange socket.

Note! The protective sticker should be removed before attaching the Integra-S/Integra-GS FODU to the antenna.

3 Secure the interconnection by tightening the bottom clamp (not fully). Make sure rotation of the Integra-S/Integra-GS is still possible.

4 Rotate Integra-S/Integra-GS to match the required polarization.

5 The sticker on the back lid indicates the polarization of the Integra-S/Integra-GS. Adjust polarization so that the interface ports are located at the lower side of the Integra-S/Integra-GS.

6 Verify polarization accuracy with a level, by placing it on the top edge of the Integra-S/Integra-GS housing.

7 Secure the position of Integra-S/Integra-GS by fully tightening both fixation clamps.

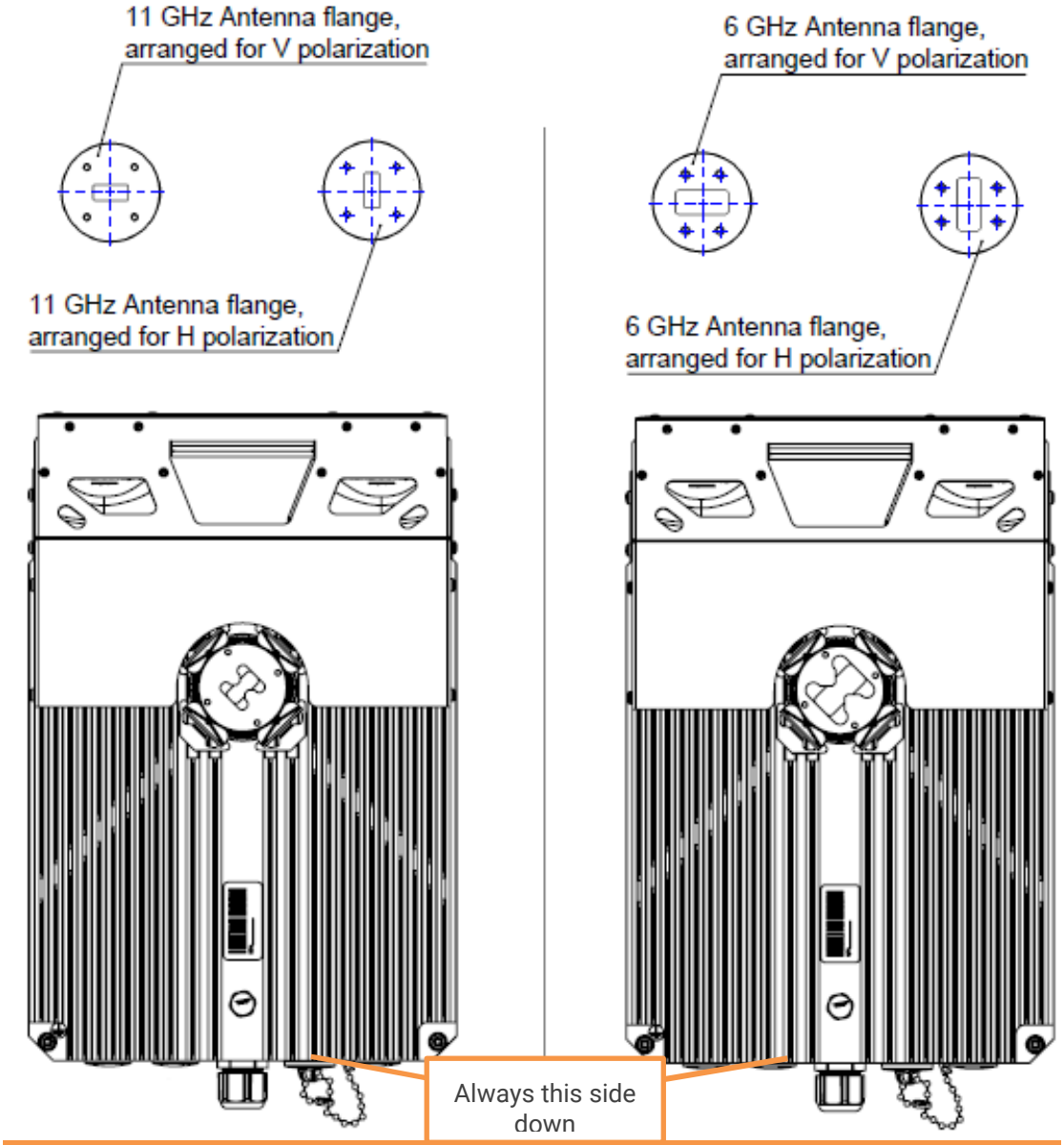
* Integra-S/Integra-GS 15/18/17/23/24/26/32/38/42GHz are separate FODU models

It is recommended to protect the installed radio from direct sunlight.

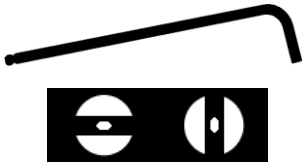
The default polarization for licensed frequency band radios is vertical.

Integra-S/Integra-GS 6-13GHz* FODU: attaching to the antenna

Integra-S/Integra-GS 6-13GHz* FODU features twisted polarization flange and the resulting signal polarization is determined by Interface on antenna/OMT. To change signal polarization, please rotate only the antenna interface, as the radio always remains in the vertical position.



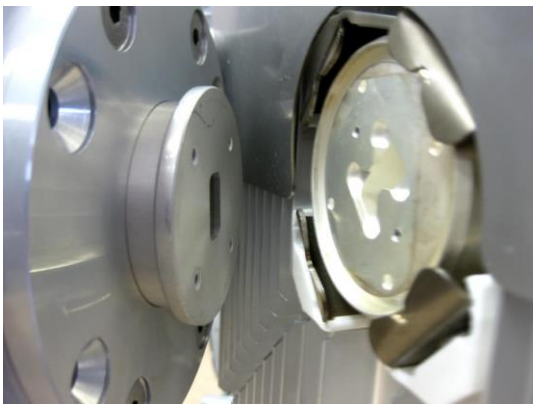
Tools required: Size 5 Allen wrench, 240mm



Level (not supplied)

1 Integra-S/Integra-GS 6-13GHz* FODU features a twisted polarization flange and the resulting signal polarization is determined by Interface on antenna/OMT. To change signal polarization, please rotate only the antenna interface, as the radio always remains in a vertical position.

Example of vertical polarization interconnection.

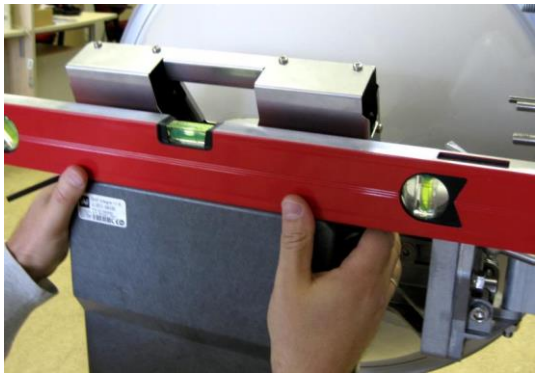


2 Example of horizontal polarization interconnection.

3 Put Integra-S/Integra-GS on the antenna adapter flange by hooking a half-turn loosened clamp at the top and leaving the completely loosened clamp at the bottom. Make sure the O-ring is in place and the adapter flange fits into the Integra-S/Integra-GS transition flange socket.

Note! The protective sticker should be removed before attaching the Integra-S/Integra-GS FODU to the antenna.

4 Tighten bottom fixation clamps.



5 Use the air level to verify that Integra-S/Integra-GS FODU is properly leveled. Tighten all four fixation clamps properly.

6 Final view of assembled Integra-S/Integra-GS 6-13GHz* 1+0 setup.

* Integra-S/Integra-GS 6U/6L/7/8/10/11/13 are separate FODU models

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

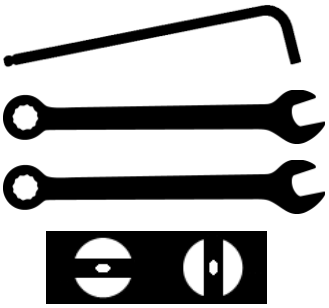
Integra-S/Integra-GS 6-13GHz* 2+0 & OMT interconnection

Tools required: Size 5 Allen wrench, 240mm

10mm (0.394”) wrench (not supplied)

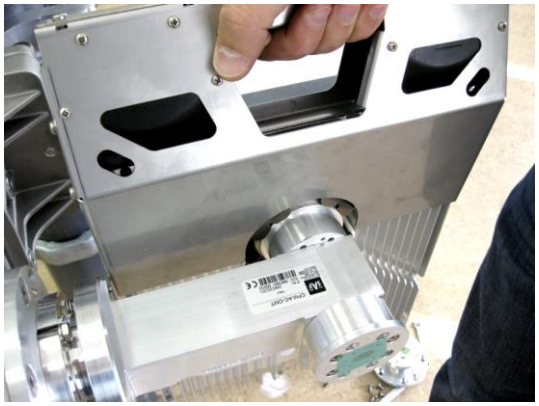
8mm (0.315”) wrench (not supplied)

Level (not supplied)



It is recommended to perform steps 1-2 on the ground.

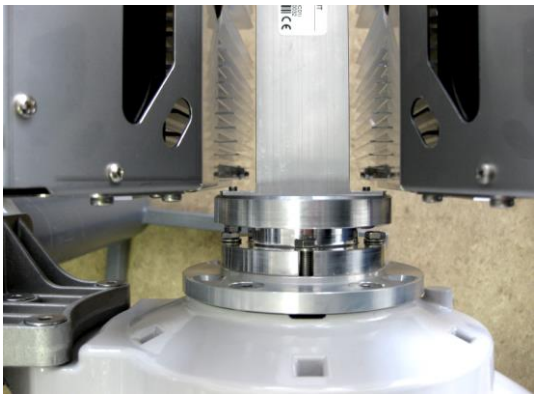
1 Prepare Integra-S/Integra-GS 6-13GHz* FODU by loosening both bottom clamps (should not overlap the flange plate) and tightening both upper clamps (will be used as a hook).



2 Attach Integra-S/Integra-GS 6-13GHz* FODU to the OMT using both upper clamps Integra-S/Integra-GS 6-13GHz* FODU features twisted polarization flange and resulting signal polarization is determined by Interface on antenna/OMT. To change signal polarization, please rotate only the antenna interface, as the radio always remains in a vertical position

3 Slightly tighten both bottom fixation clamps to secure FODU to the OMT.

4 Use the air level to verify that FODUs are properly leveled. Note that the radio position should be in parallel with the OMT. Thus, if the antenna is inclined or declined in elevation, the radio position should be kept at the same angle.



5 Tighten all 4 Integra-S/Integra-GS fixation clamps on both FODUs. When properly attached there's a gap between FODUs, OMT, and antenna.

6 Final view of assembled Integra-S/Integra-GS 6-13GHz* 2+0 setup.

* Integra-S/Integra-GS 6U/6L/7/8/10/11/13 are separate FODU models

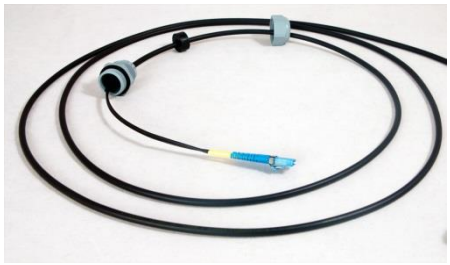
For connecting Integra-S/-GS 15-42GHz to an OMT, please follow the instructions in Chapter Integra-S/Integra-GS 15-42GHz* FODU: attaching to the antenna.

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

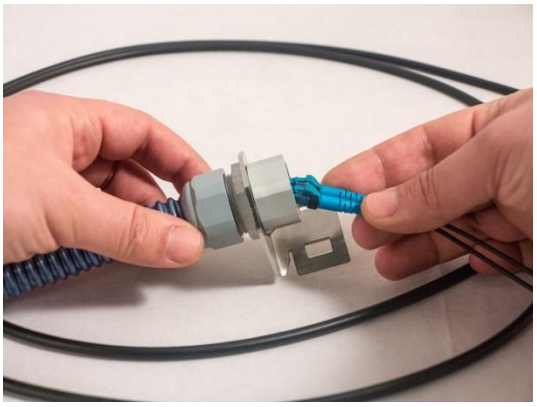
Connecting FO interface using fiber conduit kit

1 Fiber conduit kit.

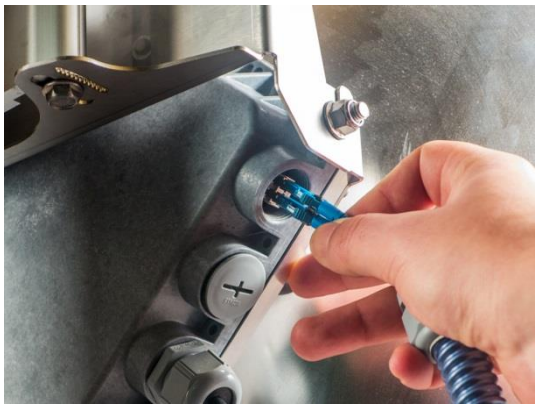
2 Unscrew the cap of the SFP port (LAN2 or LAN3) that will be used and install an SFP module.



3 Disassemble the conduit kit and put its parts in the following sequence (left – FODU direction, right – CPE direction).



4 Push the FO cable from the LC connector side through the conduit.



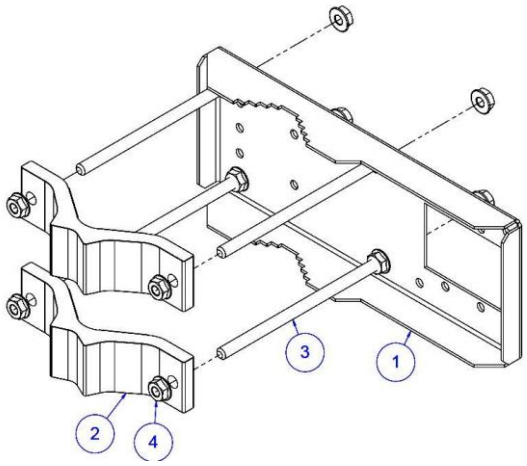
5 Connect LC connector to SFP module.

6 Tighten parts on both ends of the conduit. Fasten another end of the fiber conduit to the pole using included tie-wrap. Assembled view.

Integra-GS 6-13GHz* remote mount kit assembly

Tools required: Size 5 Allen wrench

13mm (0.512”) wrench (not supplied)

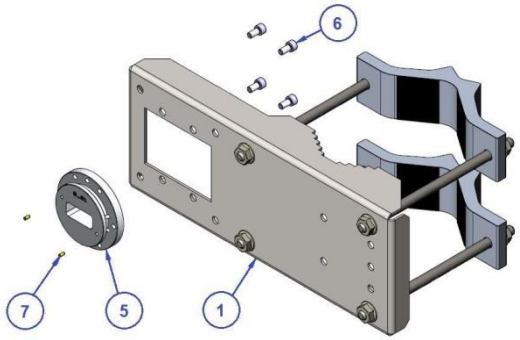


1

Assemble the mounting bracket using a 13mm wrench:

Screw one hex flange nut [4] on each of the four threaded rods [3]. Insert threaded rods into available holes of the mounting clamp [1]. Put hex nuts [4] on the other side of the clamp and screw on the threaded rods until these are visible from another side of the clamp, not more than 2mm. Tighten hex flange nuts with torsion 20...25 N·m.

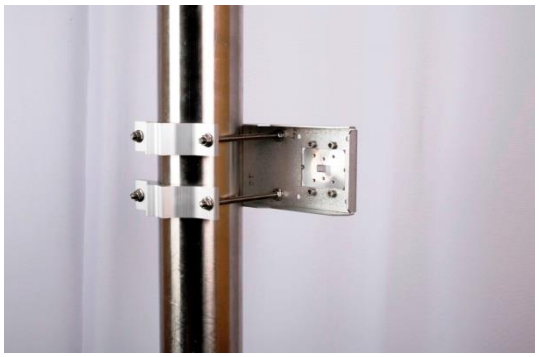
Attach two mounting bracket clamps [2] on threaded rods [3] as shown in the picture and afterward screw on the remaining four hex flange nuts [4] on all threaded rods.



2

Attach waveguide transition flange to the mounting bracket using size 5 Allen wrench:

Put the flat side of the transition flange [5] on the flat side of the mounting clamp [1] as shown in the picture and screw in four socket head screws [6] from another side of the clamp. Put two dowel pins [7] in the appropriate holes of the transition flange. Pins are sitting in holes very loose; therefore, perform the last action immediately before FODU installation.



3

View of the assembled mounting bracket on the thick pole mast:

Bracket clamps in the following position support mast diameters of 55..120 mm.

4

View of the assembled mounting bracket on the thin pole mast:

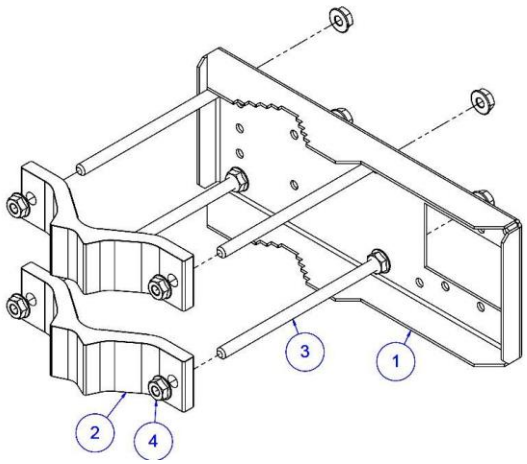
Bracket clamps in a reverse position support smaller mast diameters of 25...75mm.

*Integra-GS 6U/6L/7/8/10/11/13 are separate FODU models

Integra-GS 15-42GHz* remote mount kit assembly

Tools required: Size 5 Allen wrench

13mm (0.512”) wrench (not supplied)

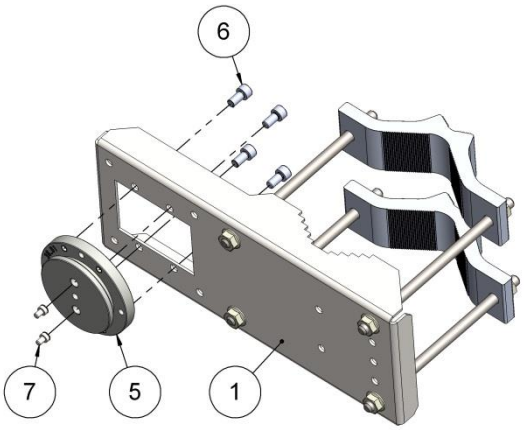


1

Assemble Mounting Bracket using a 13mm wrench:

Screw one hex flange nut [4] on each of the four threaded rods [3]. Insert threaded rods into available holes of the mounting clamp [1]. Put hex nuts [4] on the other side of the clamp and screw on the threaded rods until these are visible from another side of the clamp, not more than 2mm. Tighten hex flange nuts with torsion 20...25 N·m.

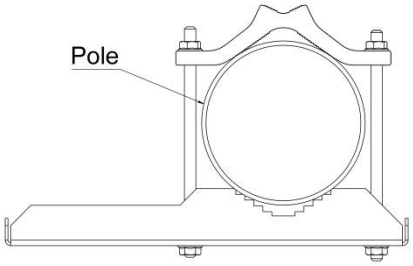
Attach two mounting bracket clamps [2] on threaded rods [3] as shown in the picture and afterward screw on the remaining four hex flange nuts [4] on all threaded rods.



2

Attach the waveguide transition flange to the mounting bracket using a size 5 Allen wrench:

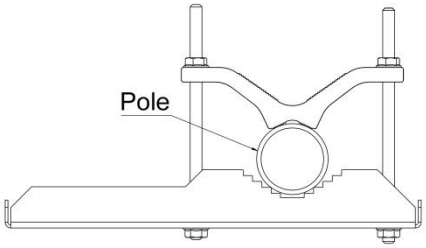
Put the flat side of the transition flange [5] on the flat side of the mounting clamp [1] as shown in the picture and screw in four socket head screws [6] from another side of the clamp. Two screws [7] have to be screwed into the antenna flange of ODU (not shown here). Screws' heads serve as guiding pins while the ODU is attached to the transition flange [5].



3

View of the assembled mounting bracket on the thick pole mast:

Bracket clamps in the following position support mast diameters of 55..120 mm.



4

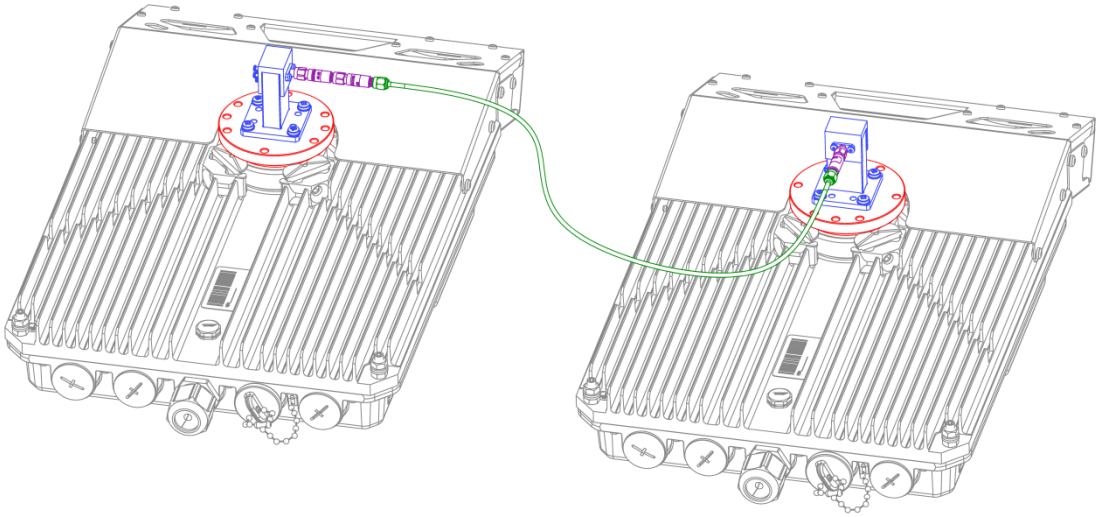
View of the assembled mounting bracket on the thin pole mast:

Bracket clamps in a reverse position support smaller mast diameters of 25...75mm.

*Integra-GS 15/18/17/23/24/26/32/38/42GHz are separate FODU models

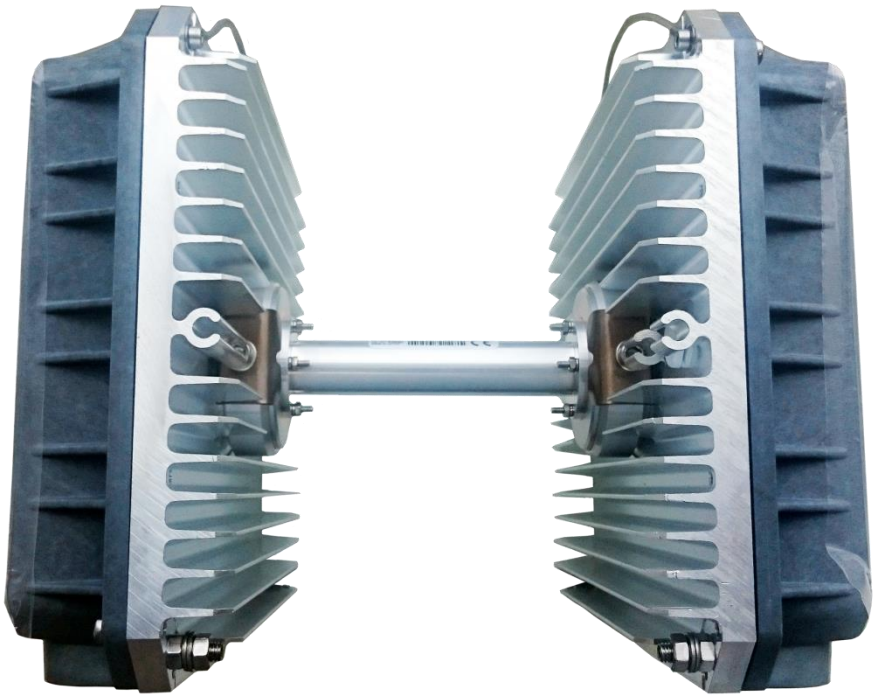
Initial setup in the indoor environment

Integra-S/Integra-GS FODUs can be interconnected using a test kit (available for purchase as an optional accessory). P/N is DxxTST01, where xx – frequency band, e.g., D11TST01 for 11GHz. The exception is 17 and 24GHz radios.



The test kit consists of an adapter flange, waveguide-to-coaxial adapter, attenuators, and coaxial cable.

In the case of 17 and 24 GHz radios a test tube (P/N D0S17TST01 or D0S24TST01) should be used:



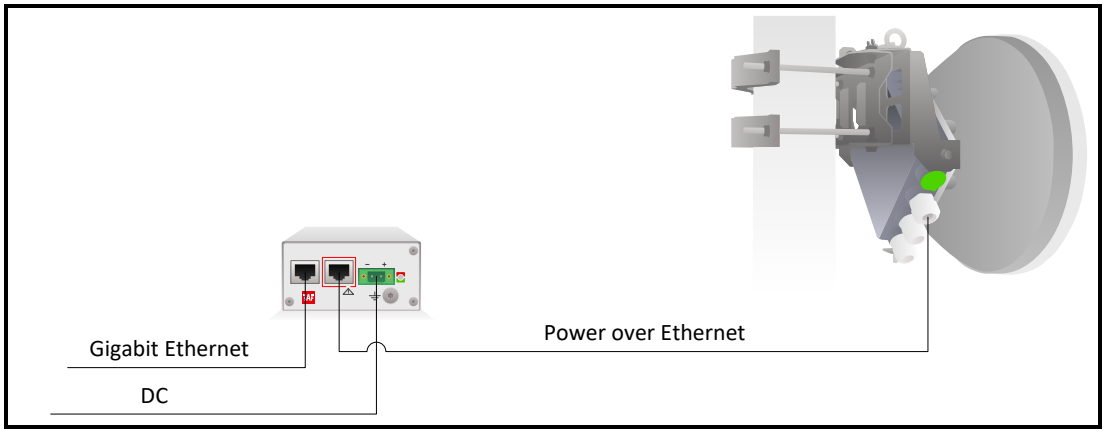
Chapter 3: WEB GUI

Initial configuration

Powering Integra/Integra-S/Integra-G/Integra-GS FODU and connecting to PC

Use Power over Ethernet (PoE) injector P/N I0ATPI43 with an appropriate power supply (10…57V DC). Please see the interconnection scheme below.

Use 5-10A 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.



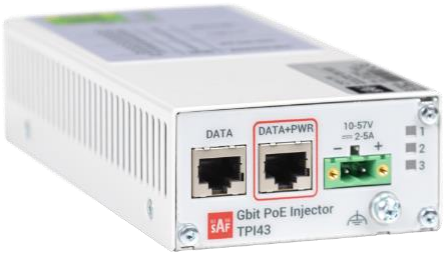
The Ethernet cable from the PoE injector should be connected to the RJ-45 port on Integra/Integra-S/Integra-G/Integra-GS FODU (LAN1). The total length of Ethernet cables from CPE to PoE injector (DATA port) and from Integra/Integra-S/Integra-G/Integra-GS to PoE injector (DATA+PWR port) combined should not exceed 100m. It is recommended to use outdoor-rated STP/FTP Ethernet cable Cat5e or better.

When powered, the RSSI LED will light up a solid green color for approx. 20s. Afterward, RSSI LED will go out for approx. 35s and eventually start blinking indicating the current Rx level. Please refer to the chapter RSSI LED for further details on blinking patterns and corresponding Rx levels.

Universal programmable PoE injector (P/N I0ATPI43)

The I0ATPI43 is an indoor Power over Ethernet injector which 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 selected operating mode.



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

1		PoE enabled and supplied to DATA+POWER port
2		Output voltage is equal to 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 the voltage loss in long cables or insufficient input voltage from power supply.

In turn, the mode with 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:

S1	S2	Mode	P(out) max	V(out)	Description
↑	↑	A	120W	57V	DC/DC converter switched on; UltraPWR
↓	↑	B[2]	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 PoE injector is turned off.

The PoE injector has a built-in lightning and surge protection preventing transient over-voltages from damaging radio and user's indoor equipment. Device also has an 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.

[2] Default recommended mode

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[3]	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	

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)

[3] 2ESDV-02P plug with screw locks is included.

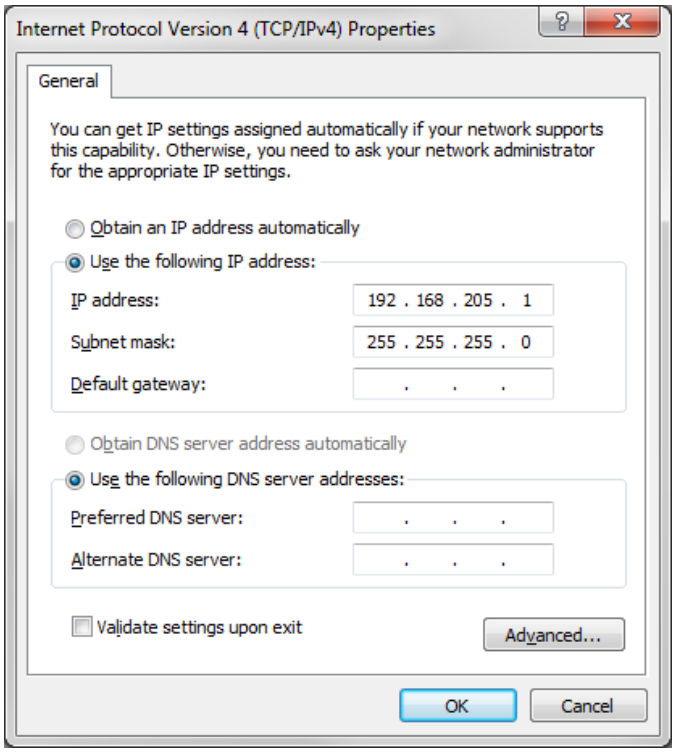
System requirements

To access the Integra/Integra-S/Integra-G/Integra-GS Web GUI you will need a PC with the following Web browser:

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

Ethernet management connection configuration

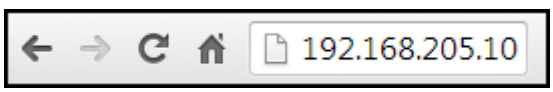
Before proceeding with the initial link setup in the Web GUI, you must adjust the IPv4 settings of your LAN adapter to 192.168.205.0 subnet. The IP address should be something other than the default low/high side IP addresses (192.168.205.10/192.168.205.11).



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

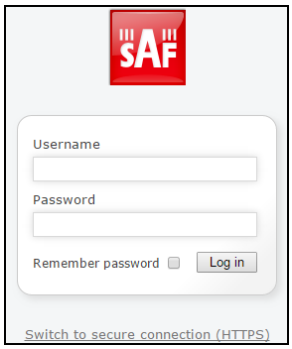
Accessing Web GUI

1) Launch your browser and in the address field enter the IP address of a FODU. Default IP addresses are as follows:
   - 192.168.205.10 for low side FODU (P/N D*******L*)
   - 192.168.205.11 for high side FODU (P/N D*******H*)



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

2) Press “Enter” key.
3) The login screen will appear.
4) Enter username and password. Default credentials are as follows:
   - Username: **admin**
   - Password: **changeme**



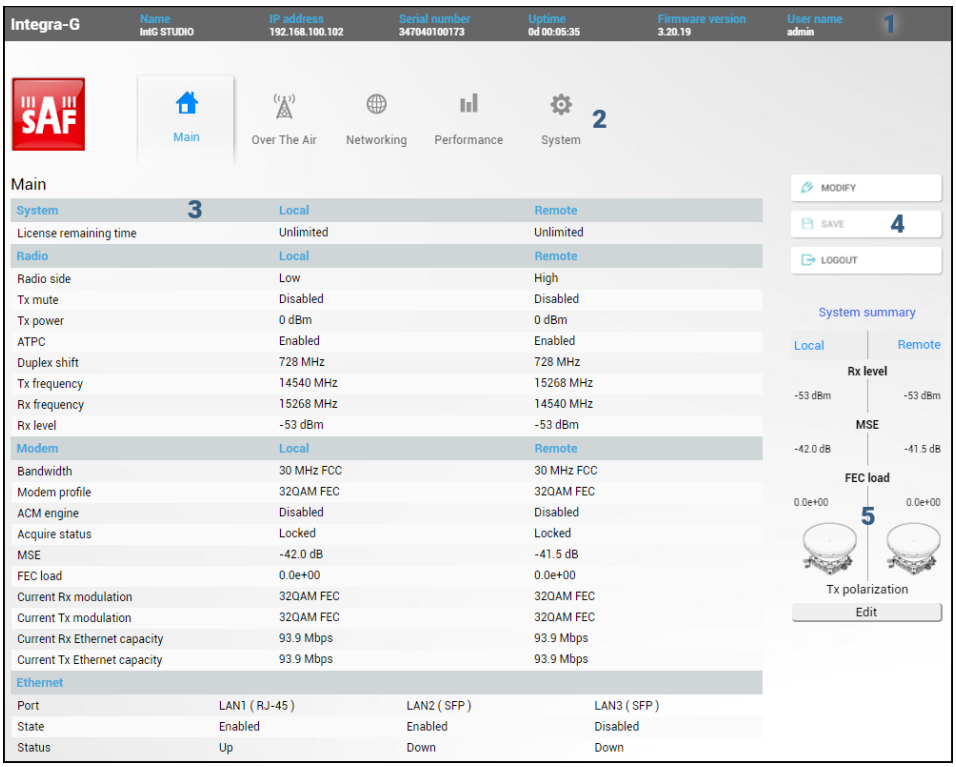
5) Select “Remember password” if you want the browser to remember entered login credentials.
6) Press “Log in” button.

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

Minimum supported horizontal resolution is 1024px.

Main page

After login you will be automatically redirected to the *Main* page of the Web GUI:



Web GUI is divided into 5 sections:

1 Top panel

Shows information about the Integra/Integra-S/Integra-G/Integra-GS FODU you are connected to including:

- 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:

- *Over the air* (Radio/modem (NP) 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.

4 MODIFY / SAVE / LOGOUT

Allows modifying parameters in the main window. If none can be modified, the MODIFY button appears inactive. After modification, the SAVE button becomes active and indicates a number of unsaved changes as well as their type (when moving the cursor over the button). The LOGOUT button will log out from the current session.

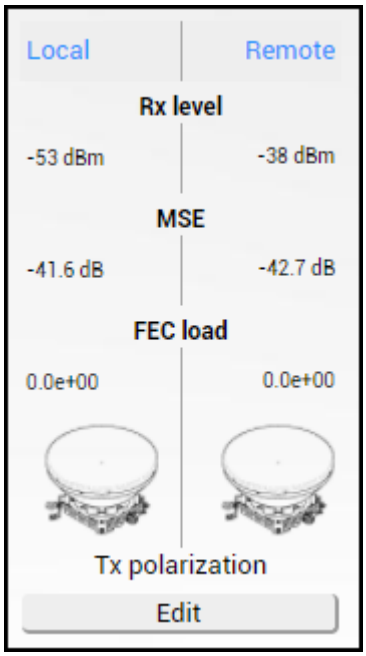
5 System summary

Shows one to four (default value – three) selected parameters of the local and remote systems, as well as Tx polarization (as read from the internal accelerometer).

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).

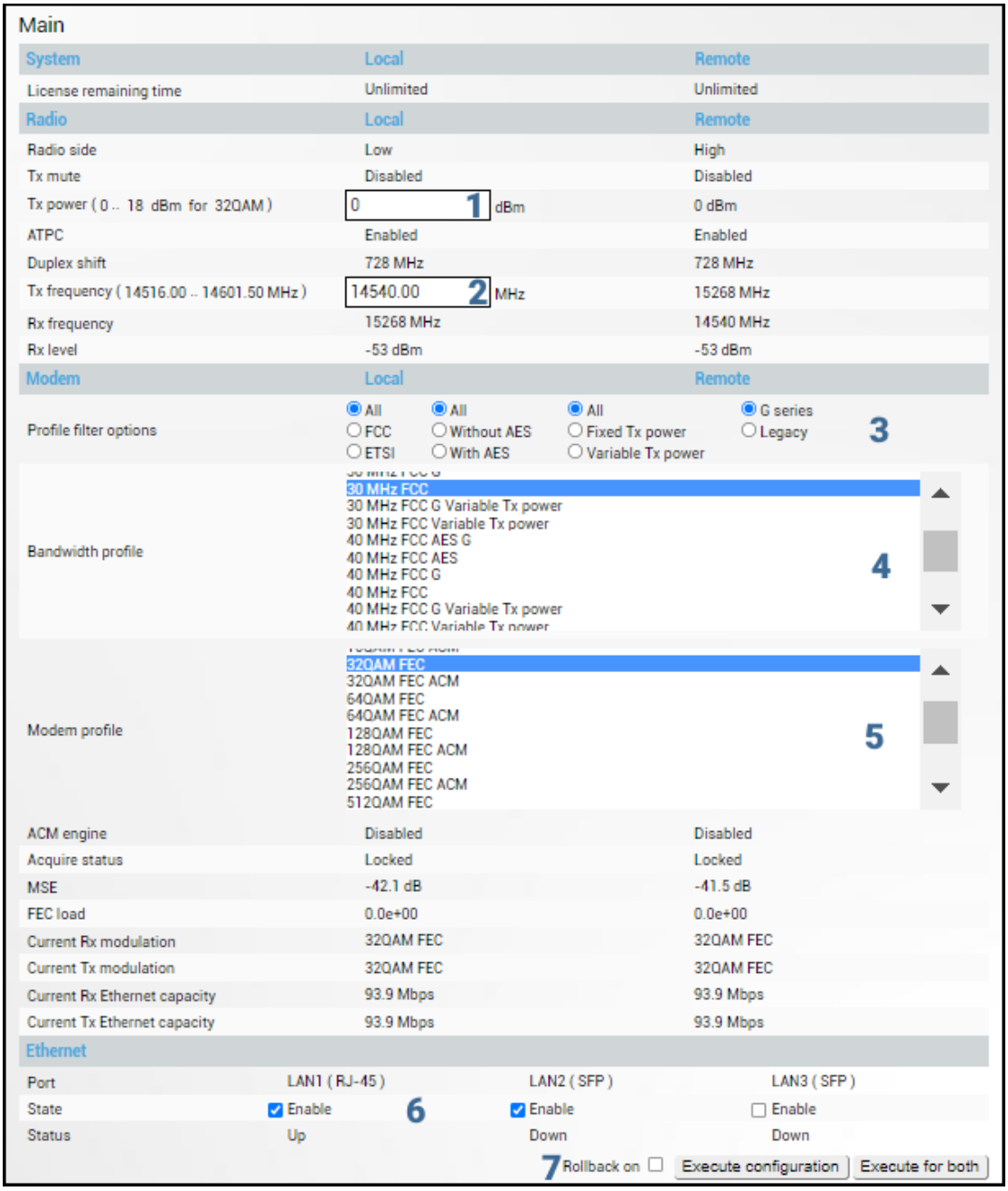
Values appear in orange color in case alarm threshold values were exceeded during the last 15 seconds.

The two square indicators show the number of active alarms on local and remote radios. The indicator is colored green if no alarms (“0”) are present, otherwise, it is colored red.



Modifying basic system parameters

To proceed with the initial configuration, press the MODIFY button and the entry fields will appear for adjustable values:



1 Tx power

The available range depends on the radio model and selected modulation. The actual range will be indicated in brackets. If a Variable Tx power bandwidth profile was selected, the available range is the maximum Tx power at 4QAM modulation when ACM downshift occurs.

2 Tx frequency

The available range depends on the frequency band, subband, radio side, and channel bandwidth selected. The actual range will be indicated in brackets.

Tx frequency range indicates the range of central frequencies for the configured channel bandwidth.

The default frequency range (indicated on the label) is defined for 3.5MHz channel bandwidth.

3 Profile filter options

Allows filtering the bandwidth selection list by FCC or ETSI standard and with or without AES encryption enabled, as well as selecting “All” to disable filtering.

If allowed by the license, AES-encrypted bandwidth options will be available. Please refer to the Over the Air→Security→AES encryption chapter for further details and activation steps of AES encryption.

4 Bandwidth profile

Allows choosing between available channel bandwidth options along with the indication of fixed modulation or maximum modulation for ACM, bandwidth standard ETSI or FCC, AES encryption functionality, and Tx power mode – fixed or variable – in case ACM profile is chosen.

Please refer to the Over the Air→Security→AES encryption chapter for further details and activation steps of AES encryption.

AES encryption is not supported for Variable Tx power bandwidth profiles.

5 Modem profile

Allows choosing between available modulations for the selected channel bandwidth.

The “FEC” suffix indicates a better sensitivity mode (longer FEC overhead), while “Weak FEC” indicates a higher capacity mode (shorter FEC overhead).

“Weak FEC” is available only for the highest modulation for the selected channel bandwidth.

ACM stands for Adaptive Coding and Modulation and enables the adaptive modulation change according to MSE value. Modulation indicates maximum modulation, while the minimum is 4QAM.

6 State

Allows enabling/disabling each of three available LAN ports.

In case 2+0 aggregation is enabled, the LAN2 state is “Restricted” as it can be used only for interconnection between two Integra/Integra-S/Integra-G/Integra-GS FODUs. Please refer to the Over The Air → Modem → Aggregation configuration chapter for further details.

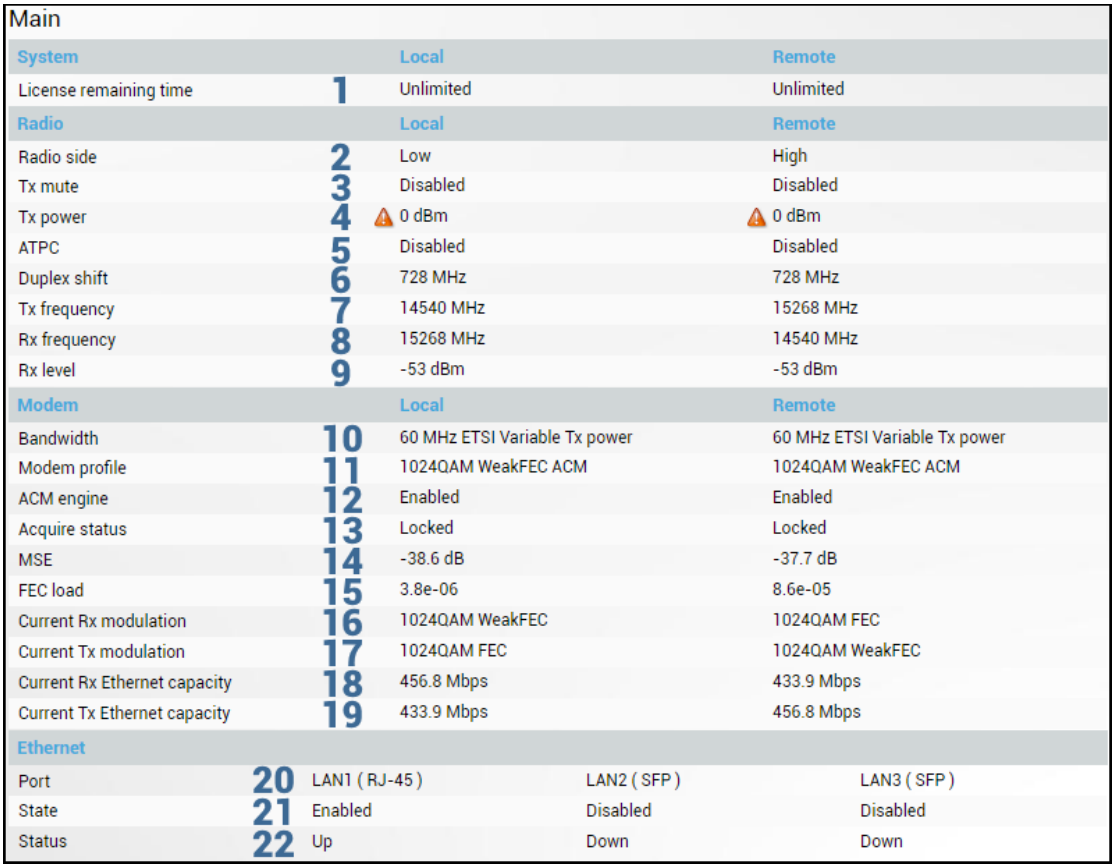
7 Execute

By pressing *„Execute configuration”,* changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on”* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

Rollback triggers when applied configuration changes interrupt management connectivity. For this reason, rollback will not work if the remote side of the link is not reachable.

Pressing *„Execute for both”* applies changes made to the corresponding section both for local and remote side Integra/Integra-S/Integra-G/Integra-GS FODUs.

Parameters on Main page



Main

System		Local	Remote
License remaining time	1	Unlimited	Unlimited
Radio		**Local**	**Remote**
Radio side	2	Low	High
Tx mute	3	Disabled	Disabled
Tx power	4	⚠ 0 dBm	⚠ 0 dBm
ATPC	5	Disabled	Disabled
Duplex shift	6	728 MHz	728 MHz
Tx frequency	7	14540 MHz	15268 MHz
Rx frequency	8	15268 MHz	14540 MHz
Rx level	9	-53 dBm	-53 dBm
Modem		**Local**	**Remote**
Bandwidth	10	60 MHz ETSI Variable Tx power	60 MHz ETSI Variable Tx power
Modem profile	11	1024QAM WeakFEC ACM	1024QAM WeakFEC ACM
ACM engine	12	Enabled	Enabled
Acquire status	13	Locked	Locked
MSE	14	-38.6 dB	-37.7 dB
FEC load	15	3.8e-06	8.6e-05
Current Rx modulation	16	1024QAM WeakFEC	1024QAM FEC
Current Tx modulation	17	1024QAM FEC	1024QAM WeakFEC
Current Rx Ethernet capacity	18	456.8 Mbps	433.9 Mbps
Current Tx Ethernet capacity	19	433.9 Mbps	456.8 Mbps

Ethernet				
Port	20	LAN1 (RJ-45)	LAN2 (SFP)	LAN3 (SFP)
State	21	Enabled	Disabled	Disabled
Status	22	Up	Down	Down

1) ***License remaining time*** – shows the amount of time remaining for an active time-limited license; in case of an unlimited time license, "Unlimited" is being shown.
   When the license expires, the modulation will drop to "4QAM FEC Limited", the link capacity will drop to 256Kbps and you will see a warning.
2) ***Radio side*** – shows the radio side of the local and remote Integra-G.
3) ***Tx mute*** – Tx shows if the transmitter is currently muted ("Enabled") or active ("Disabled").
4) ***Tx power*** – shows current transmitter power in dBm. ⚠ will appear if the value is dynamically changed according to the current ACM modulation. Move the mouse over for an explanation.
5) ***ATPC*** – shows if ATPC is enabled or disabled.
6) ***Duplex shift*** – shows the margin between the transmitting and receiving frequencies.
7) ***Tx frequency*** – shows the transmitting frequency.
8) ***Rx frequency*** – shows the receiving frequency.
9) ***Rx level*** – shows the current level of the received signal. It must not differ significantly from the previously calculated value.
10) ***Bandwidth*** – shows the width of currently utilized bandwidth in MHz.
11) ***Modem profile*** – Indicates currently configured modulation.
    The "FEC" suffix indicates a better sensitivity mode (longer FEC overhead), while "WeakFEC" indicates a higher capacity mode (shorter FEC overhead).
    "WeakFEC" is available only for the highest modulation in the selected channel bandwidth.
    An option with "ACM" (please refer to the chapter ACM (Adaptive Coding and Modulation) for further details) enables adaptive modulation change according to

Signal Quality value. Modulation indicates maximum modulation, while the minimum is 4QAM.

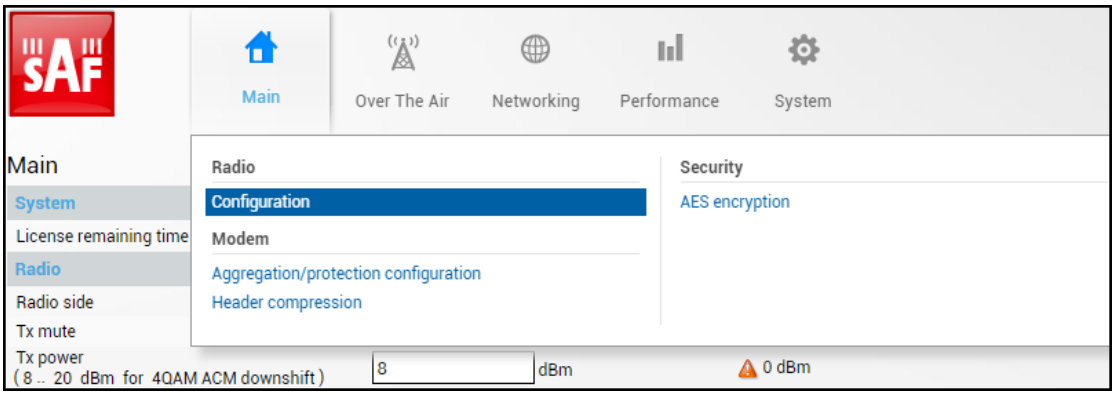
12) ***ACM engine*** – shows the status of the ACM engine.
13) ***Acquire status*** – indicates the acquired status of the modem. During normal operation, "Locked" will be shown.
14) ***MSE*** – shows Mean squared error value lower value means better signal quality.
15) ***FEC load*** – shows the load of Forward Error Correction.
16) ***Current Rx modulation*** – current received signal modulation.
17) ***Current Tx modulation*** – current transmitted signal modulation.
18) ***Current Rx Ethernet capacity*** – ingress capacity of the WAN port, depends on current Rx modulation and bandwidth.
19) ***Current Tx Ethernet capacity*** – egress capacity of the WAN port, depends on current Tx modulation and bandwidth.
20) ***Port*** – Name and interface type of the Ethernet port, RJ-45 or SFP/SFP+.
21) ***State*** – Ethernet port state – Enabled or Disabled. An exclamation mark designates the restricted state of the port. Move the mouse pointer over the icon to see the explanation.
22) ***Status*** – Ethernet port status, up or down (if the port is enabled).

Over The Air

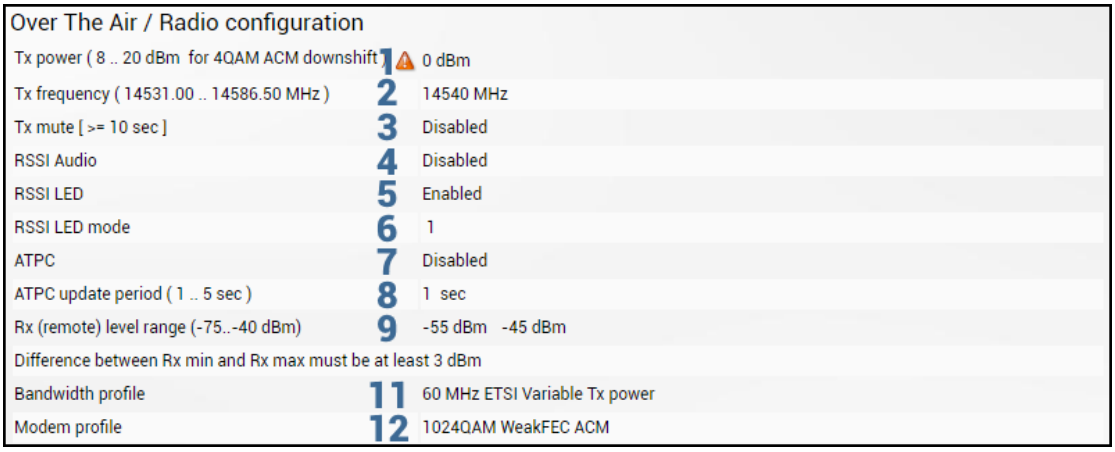
Over The Air → Radio → Configuration

The Radio configuration page is available in the menu (Over The Air→ Radio→Configuration).

Refer to the chapter Radio configuration – extra fields for a description of the extra fields of the 17/24 GHz Integra/Integra-S/Integra-G/Integra-GS FODUs.

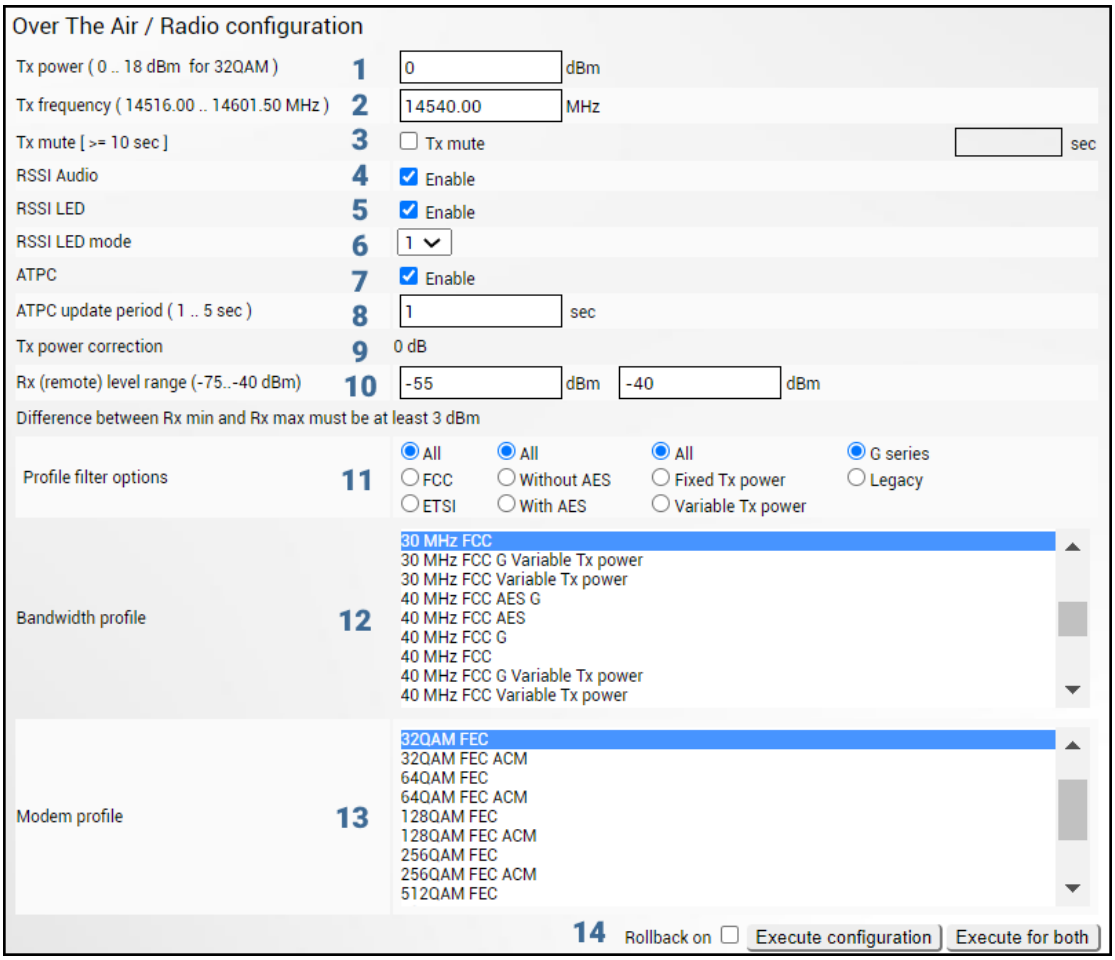


Status mode



Press MODIFY button.

Modify mode



1) ***Tx power*** – Indicates current Tx (transmit) power value (status mode); allows specifying Tx power value (modify mode). The available range depends on the radio model and selected modulation. The actual range will be indicated in brackets. ⚠ sign indicates that the Tx power value was adjusted by ATPC. Move the mouse over the sign for further details.
2) ***Tx frequency*** – Indicates current Tx (transmit) frequency (status mode); allows specifying Tx frequency (modify mode). The available range depends on the frequency band, subband, radio side, and channel bandwidth selected. The actual range will be indicated in brackets.
   Tx frequency range indicates the range of central frequencies for the configured channel bandwidth.
   The default frequency range (indicated on the label) is defined for 3.5MHz channel bandwidth.
3) ***Tx mute [>=10 sec]*** – Indicates whether Tx mute is enabled or disabled (status mode); allows muting the transmitter to a limited time interval in seconds (modify mode). The minimum value is 10 seconds. Note that the transmitter will be muted only if a valid value in seconds is entered.
4) ***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.

5) ***RSSI LED*** – Indicates whether the RSSI LED is enabled or disabled (status mode); allows disabling or enabling RSSI LED operation (modify mode). By default, the RSSI LED is enabled. Please refer to the RSSI LED section for further details.
6) ***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 RSSI LED section for further details.
7) ***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.
8) ***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.
9) ***Tx power correction*** – Indicates Tx power correction made by the ATPC function. Please refer to the ATPC (Automatic Transmit Power Control) description for further details.
10) ***Rx (remote) level range (-75..-40dBm)*** – Indicates minimum and maximum Rx level of the remote side Integra/Integra-S/Integra-G/Integra-GS for ATPC operation (status mode); allows defining the minimum and maximum Rx level of the remote side Integra/Integra-S/Integra-G/Integra-GS (modify mode). There should be at least a 3dB difference between min and max values. ATPC Tx power correction will be performed only in case of exceeding these thresholds. Values should be defined between -75 and -40 dBm. Please refer to the ATPC (Automatic Transmit Power Control) description for further details.

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

11) ***Profile filter options*** – Allows filtering the bandwidth selection list by standard (ETSI or FCC) or by AES encryption (with or without). "All" disables filtering.
12) ***Bandwidth profile*** – Indicates currently configured channel bandwidth (status mode); allows choosing between available profiles, as well as according to the standard of channel bandwidth – ETSI or FCC, with or without AES encryption (modify mode).
13) ***Modem profile*** – Indicates currently configured modulation (status mode); allows choosing between available modulations for selected channel bandwidth (modify mode).
    The "FEC" suffix indicates a better sensitivity mode (longer FEC overhead), while "WeakFEC" indicates a higher capacity mode (shorter FEC overhead).
    "WeakFEC" is available only for the highest modulation in the selected channel bandwidth.
    An option with "ACM" (please refer to the chapter ACM (Adaptive Coding and Modulation) for further details) enables adaptive modulation change according to MSE value. Modulation indicates maximum modulation, while the minimum is 4QAM.
    In case the current Tx power value is above the maximum value for any of the modulations, the maximum value will be indicated.
14) By pressing „*Execute configuration*", changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If „Rollback on" is selected, the configuration will be reverted in case erroneous configuration changes are applied.
    Pressing „*Execute for both*" applies changes made to the corresponding section both for local and remote side Integra/Integra-S/Integra-G/Integra-GS FODUs.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

radio [status]	Use to show radio status.
radio power <Tx power>	Use to set Tx power in dBm.
radio frequency <frequency>	Use to set Tx frequency in kHz.
radio rssi-led {disable | enable [mode {1|2|3}]}	Use to enable or disable RSSI LED operation.
radio rssi-led enable mode {1|2|3} **polarization** <seconds>	Use to enable the red RSSI LED's operation for n seconds. Its main purpose is an indication of polarization alignment accuracy +/- 3deg. Functionality may not be available in older HW revisions.
radio tx-mute {<time>|disable}	Use to mute the transmitter to a specific time in seconds or unmute.
radio factory	Use to reset radio settings to factory defaults – Tx power will be disabled and frequencies set to factory defaults.
radio upgrade <firmware>	Use to upgrade the radio firmware version. The firmware file must be located in the FTP directory.
radio version	Use to check the radio software version
radio atpc [status]	Use to check the status of ATPC (Automatic Transmit Power Control).
radio atpc state {enable|disable}	Use to enable/disable ATPC.
radio atpc delay <1..5>	Use to define the ATPC update period.
radio atpc rx_level <-75..-43> <-72..-40>	Use to define ATPC remote Rx level min and max thresholds.
modem configuration set <bandwidth> <min_mod> <max_mod>	Use to set modem configuration – bandwidth, minimum and maximum modulation. “e” suffix indicates “AES”. “s” suffix indicates “ETSI or “ETSI class 4L” (for 56 MHz). “_VP” suffix indicates "Variable Tx power”. “_W” suffix indicates “Weak FEC” modulation.
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.
modem allowed	Use to check the list of available modem configurations.

Over The Air → Modem → Aggregation/protection configuration

Integra/Integra-S/Integra-G/Integra-GS **2+0 aggregation** (link bonding) provides ACM-aware binding of user-available capacities of two parallel links each using an individual frequency pair. Traffic is split per-frame over two links on the modem level.

2+0 aggregation **is not** based on MAC-MAC connections. A single MAC address (e.g. router) can be used.

Integra/Integra-S/Integra-G/Integra-GS 2+0 aggregation features full link synchronization/power/cable redundancy by reconfiguring to 1+0 operation mode in case of failure.

Full 2+0 to 1+0 redundancy will operate only when an external switch is used. Please see below interconnection schemes **c** and **d**.

Integra/Integra-S/Integra-G/Integra-GS **1+1 protection** provides Hot Standby redundancy of user-available capacities of two parallel links each using the same frequency pair. Traffic is using only one link at a time. Transmitters of the second link will be automatically muted.

Full 1+1 redundancy (including cables, power, HW protection) will be available only when an external switch is used. Please see below interconnection schemes **c** and **d**.

Header compression cannot be used with 2+0 aggregation configured.

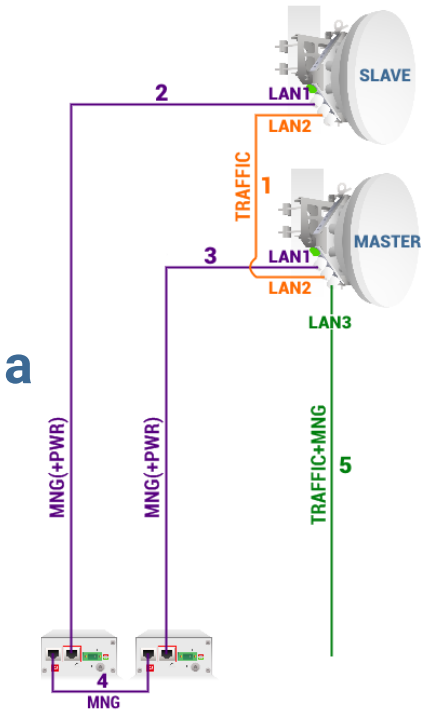
Two pairs of Integra/Integra-G or Integra-S/Integra-GS FODUs are required. In the case of 2+0 aggregation with Integra-S/Integra-GS OMT, a dual-polarized antenna, or a coupler can be used. In the case of 1+1 HSB with Integra-S/Integra-GS, only a coupler can be used (as only a single frequency pair in the same polarization is being utilized).

Necessary equipment for Integra/Integra-S/Integra-G/Integra-GS 2+0 or 1+1

1) 4 Integra/Integra-S/Integra-G/Integra-GS FODUs – 2 low side, 2 high side.
2) 2 or 4 SFP modules and appropriate FO cables (multi-mode or single-mode) for Integra/Integra-S/Integra-G/Integra-GS interconnection (depending on interconnection scheme **a**, **b**, **c** or **d**; see below).
3) Electrical or optical Ethernet cables (together with corresponding SFP modules) for user traffic (depending on chosen interconnection scheme).
4) In the case of Integra-S/Integra-GS – additionally, 4 antennas, or 2 antennas and OMT/couplers. Please refer to the chapter Integra-S/Integra-GS 6-13GHz* 2+0 & OMT interconnection for instructions on Integra/Integra-S/Integra-G/Integra-GS installation to an antenna or an OMT.

General configuration guide

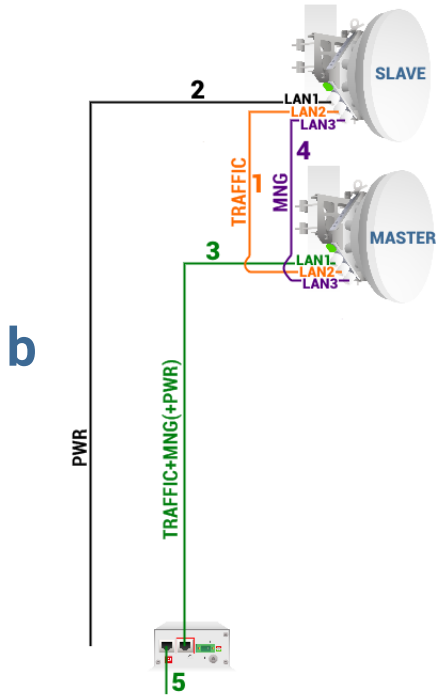
1) Do not interconnect Integra/Integra-S/Integra-G/Integra-GS with each other and do not plug Integra/Integra-S/Integra-G/Integra-GS into switches before you have finished the configuration of each node.
2) Choose one link (low/high side radio) which will operate as the “Master”. The second link will operate as the “Slave”.
3) Configure radio/modem parameters for each link. Channel bandwidths must be the same (e.g., 40MHz) for both links. All other parameters can differ but keep in mind that in the 2+0 configuration frequencies must differ, but in the 1+1 configuration frequencies must be the same.
4) Both links should be polarized according to ACAP (Adjacent Channel Alternate-Polarized) principle. In case the co-polarized channels are used, it is recommended to introduce a guard band equal to ¼ BW (e.g., 15MHz in the case of 60MHz channels). CCDP (Co-Channel Dual-Polarization) operation on the same frequency channel and opposite polarizations is not allowed.
5) Configure different IP addresses for all 4 Integra/Integra-S/Integra-G/Integra-GS FODUs.
6) The remote IP address for all units must be entered manually. To do that, remove the selection in the “Auto” checkbox and afterward enter the appropriate remote IP address in the menu ”IP configuration” (please refer to Chapter System → Configuration → IP configuration).



1. Mandatory fiber optic cable between LAN2 (optical) ports on both units.
2. Electrical Ethernet cable (1000Base-T) between PoE injector's (#1) DATA+PWR port and LAN1 (electrical) port of the Slave FODU. Both data and power are carried, therefore the total length of cables #2, #3, and #4 combined should not exceed 100m.
3. Electrical Ethernet cable (1000Base-T) between PoE injector's (#2) DATA+PWR port and LAN1 (electrical) port of Master FODU. Both data and power are carried, therefore the total length of cables #2, #3, and #4 combined should not exceed 100m.
4. Electrical Ethernet cable (1000Base-T) between PoE injectors' (#1 and #2) DATA ports. Provides management access to Slave FODU. The total length of cables #2, #3, and #4 combined should not exceed 100m.
5. Fiber optic cable between LAN3 (optical) port of the Master or Slave FODU and CPE for both traffic and management traffic.

Advantages: 1) external switch not required; 2) length of optical cable for traffic/management up to 10km.

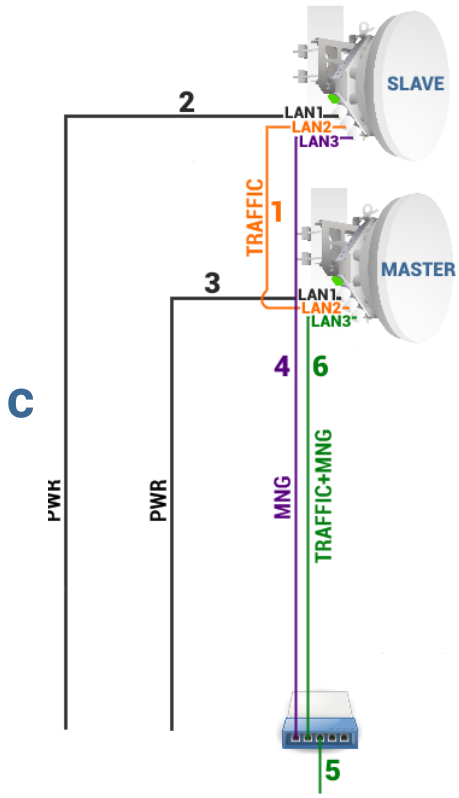
b



1. Mandatory fiber optic cable between LAN2 (optical) ports on both units.
2. Cable for powering Slave FODU. You can use a 2-wire power cable with DC power adapter (P/N D0ACPW01) or a standard Ethernet cable with the PoE injector. Depending on power consumption cable length can be extended up to 700m. Refer to chapter RJ-45 port for details.
3. Electrical Ethernet cable (1000Base-T) between PoE injector's (#2) DATA+PWR port and LAN1 (electrical) port of the Master FODU. Both data and power are carried, therefore the total length of cables #3 and #5 combined should not exceed 100m.
4. Fiber optic cable between LAN3 (optical) ports on both units. Provides management access to the Slave FODU.
5. Electrical Ethernet cable (1000Base-T) between PoE injector's (#1 or #2) DATA port and CPE or both traffic and management traffic. The total length of cables #3 and #5 combined should not exceed 100m.

Advantages: 1) external switch not required; 2) optical cable used only for interconnection between both FODUs; 3) only two cables are installed between FODUs and an indoor facility.

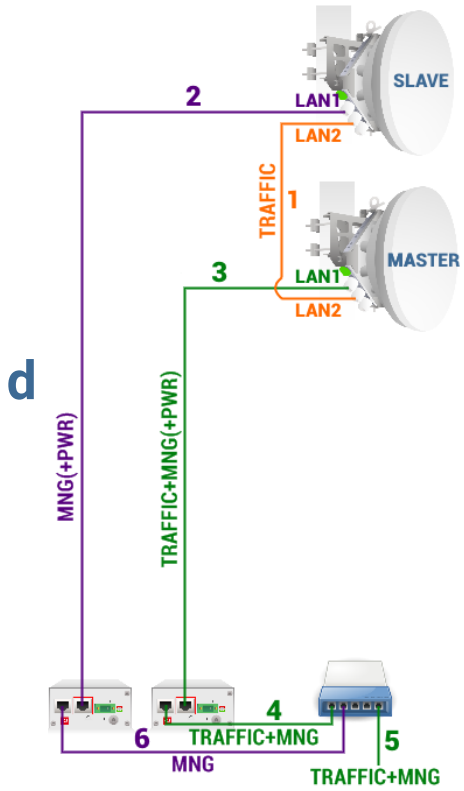
c



1. Mandatory fiber optic cable between LAN2 (optical) ports on both units.
2. Cable for powering the Slave FODU. You can use a 2-wire power cable with a DC power adapter (P/N D0ACPW01) or a standard Ethernet cable with the PoE injector. Depending on power consumption cable length can be extended up to 700m. Refer to chapter RJ-45 port for details.
3. Cable for powering the Master FODU. You can use a 2-wire power cable with a DC power adapter (P/N D0ACPW01) or a standard Ethernet cable with the PoE injector. Depending on power consumption cable length can be extended up to 700m. Refer to chapter RJ-45 port for details.
4. Fiber optic cable between LAN3 (optical) port of the Slave FODU and external switch. Provides management access to the Slave FODU. If the Master link is down, traffic will be redirected through this cable.
5. Electrical Ethernet cable (1000Base-T) between the external switch and CPE for both traffic and management traffic.
6. Fiber optic cable between LAN3 (optical) port of the Master FODU and an external switch for both traffic and management traffic.

Advantages: 1) solution provides the greatest cable length for powering Integra/Integra-S/Integra-G/Integra-GS and the length of optical cable for traffic/management can be up to

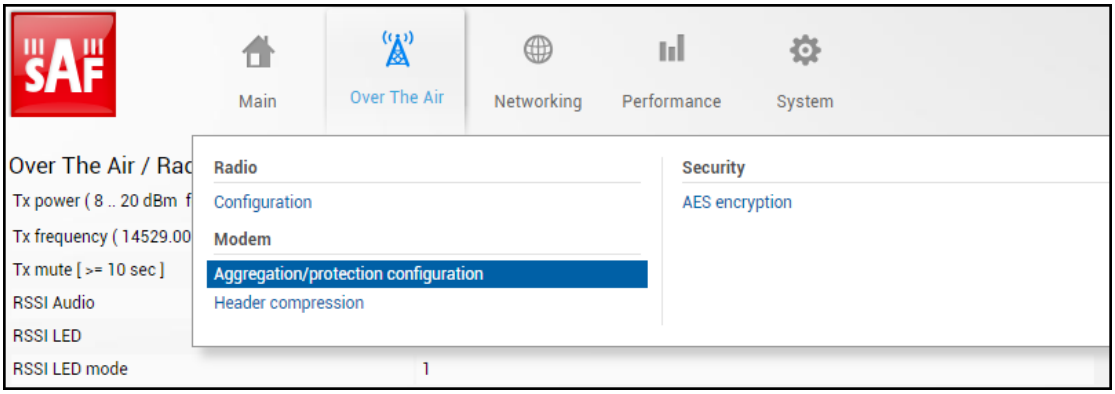
10km. For details on the length of the power cable refer to chapter RJ-45 port; 2) Slave link will be able to reconfigure to 1+0 in case the Master unit goes down (2+0 redundancy).



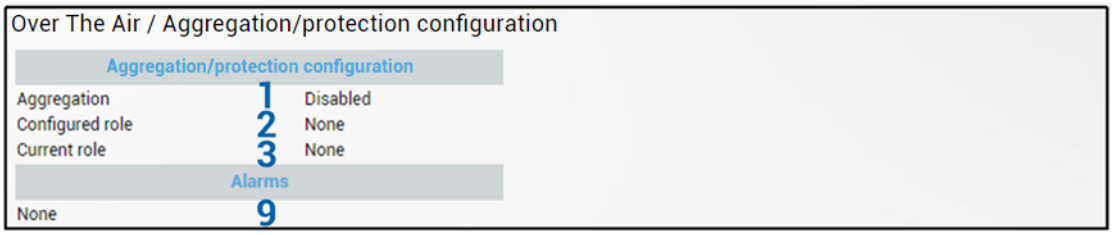
1. Mandatory fiber optic cable between LAN2 (optical) ports on both units.
2. Electrical Ethernet cable (1000Base-T) between PoE injector's (#1) DATA+PWR port and LAN1 (electrical) port of the Slave FODU. Both data and power are carried, therefore the total length of cables #2 and #6 combined should not exceed 100m. If the Master link is down, traffic will be redirected to this cable.
3. Electrical Ethernet cable (1000Base-T) between PoE injector's (#2) DATA+PWR port and LAN1 (electrical) port of the Master FODU. Both data and power are carried, therefore the total length of cables #3 and #4 combined should not exceed 100m.
4. Electrical Ethernet cable (1000Base-T) between PoE injector's (#2) DATA port and external switch. The total length of cables #3 and #4 combined should not exceed 100m.
5. Electrical Ethernet cable (1000Base-T) between the external switch and CPE for both traffic and management traffic.
6. Electrical Ethernet cable (1000Base-T) between PoE injector's (#1) DATA port and external switch. The total length of cables #2 and #6 combined should not exceed 100m.

Advantages: 1) only a single fiber optic cable is required; 2) only two cables are installed between FODUs and indoor facility; 3) Slave link will be able to reconfigure to 1+0 in case the Master unit goes down (2+0 redundancy).

Configuration in Web GUI

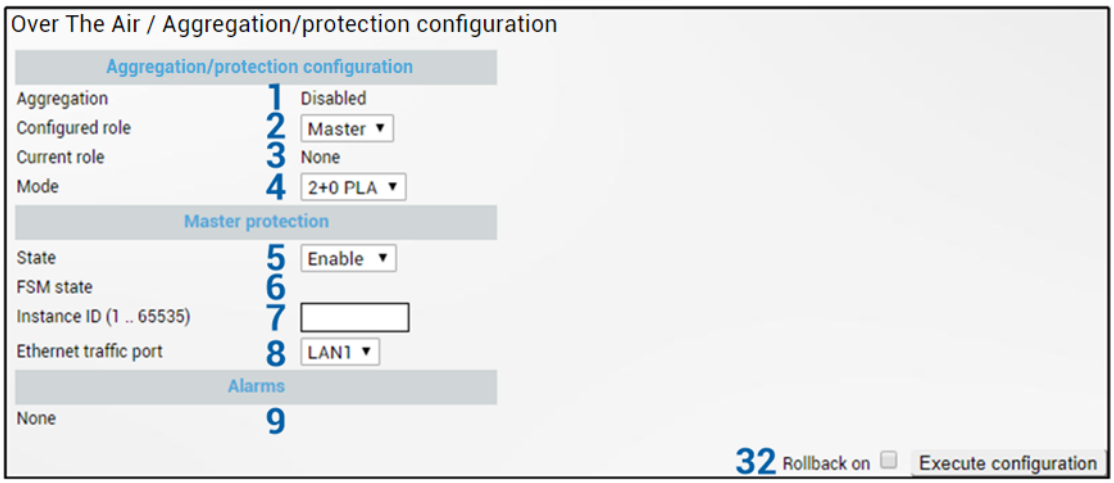


Status mode

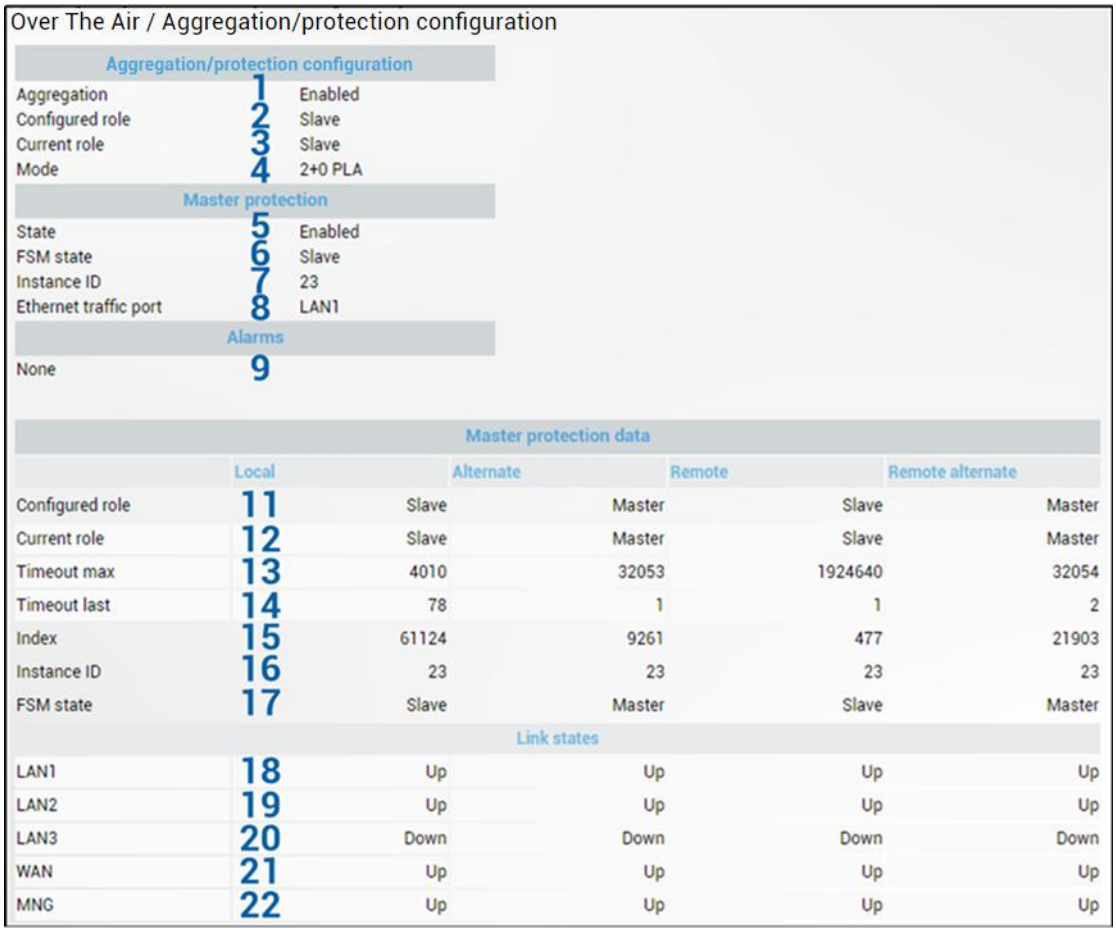


Press MODIFY button.

Modify mode



Slave status after enabling aggregation

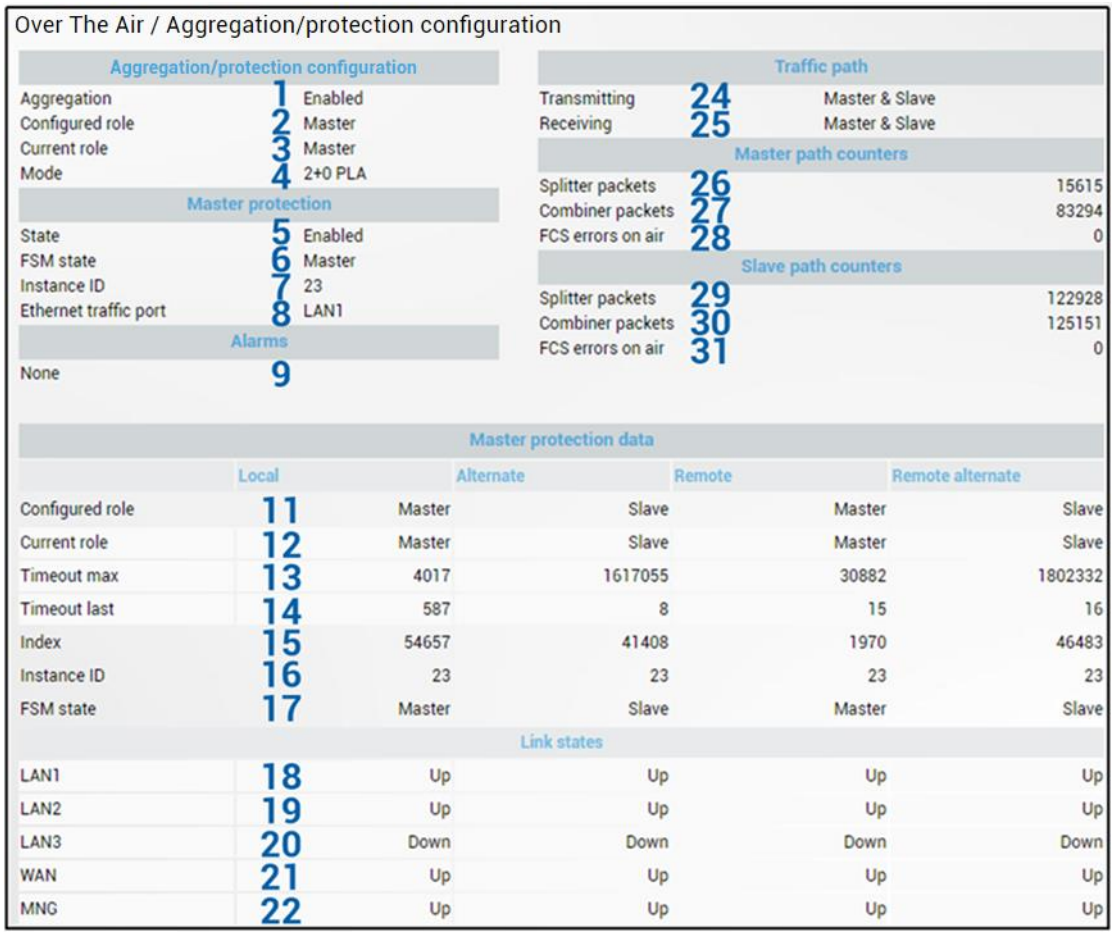


Over The Air / Aggregation/protection configuration

Aggregation/protection configuration		
Aggregation	1	Enabled
Configured role	2	Slave
Current role	3	Slave
Mode	4	2+0 PLA
Master protection		
State	5	Enabled
FSM state	6	Slave
Instance ID	7	23
Ethernet traffic port	8	LAN1
Alarms		
None	9	

Master protection data					
	Local		Alternate	Remote	Remote alternate
Configured role	11	Slave	Master	Slave	Master
Current role	12	Slave	Master	Slave	Master
Timeout max	13	4010	32053	1924640	32054
Timeout last	14	78	1	1	2
Index	15	61124	9261	477	21903
Instance ID	16	23	23	23	23
FSM state	17	Slave	Master	Slave	Master
Link states					
LAN1	18	Up	Up	Up	Up
LAN2	19	Up	Up	Up	Up
LAN3	20	Down	Down	Down	Down
WAN	21	Up	Up	Up	Up
MNG	22	Up	Up	Up	Up

Master status after enabling aggregation



Over The Air / Aggregation/protection configuration

Aggregation/protection configuration		
Aggregation	1	Enabled
Configured role	2	Master
Current role	3	Master
Mode	4	2+0 PLA

Master protection		
State	5	Enabled
FSM state	6	Master
Instance ID	7	23
Ethernet traffic port	8	LAN1

Alarms	
None	9

Traffic path		
Transmitting	24	Master & Slave
Receiving	25	Master & Slave

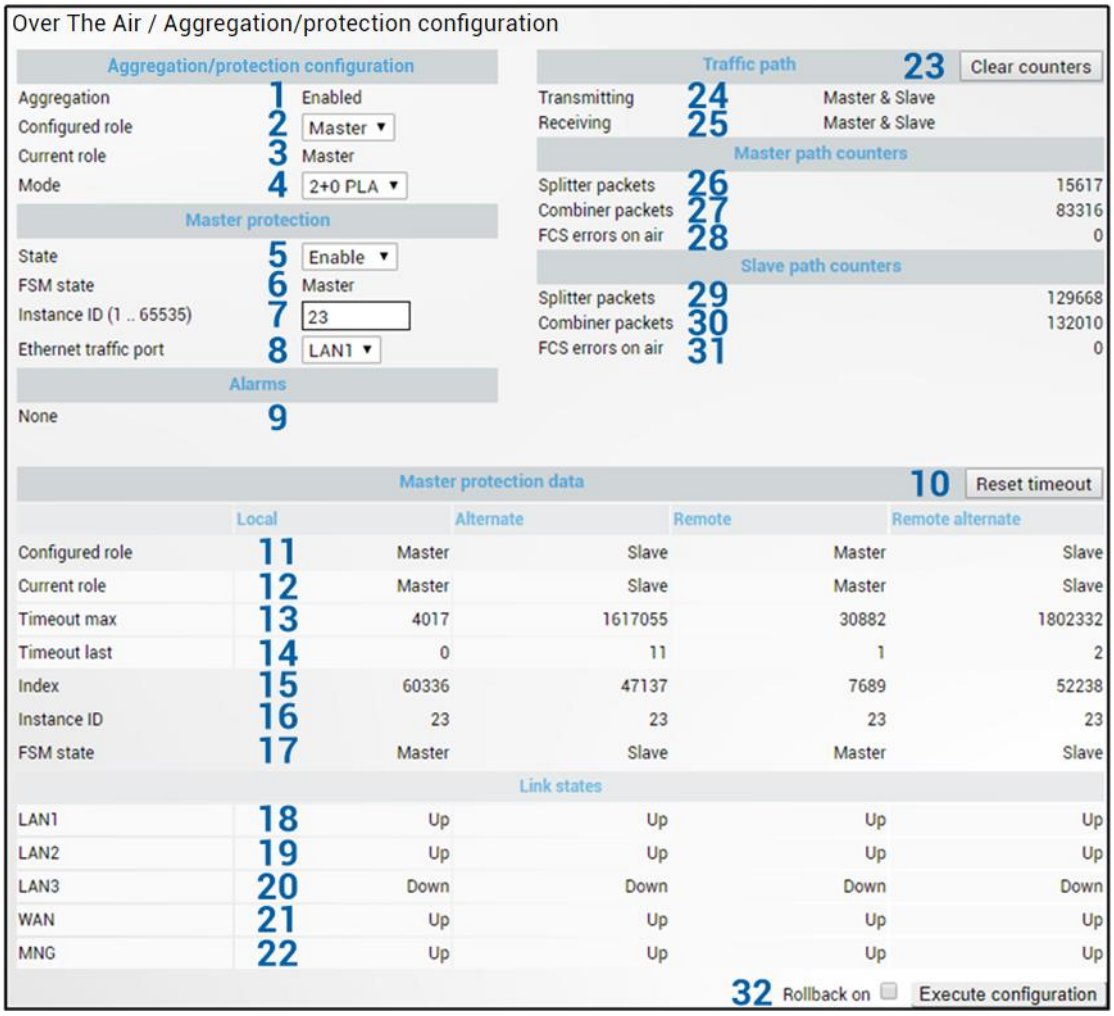
Master path counters		
Splitter packets	26	15615
Combiner packets	27	83294
FCS errors on air	28	0

Slave path counters		
Splitter packets	29	122928
Combiner packets	30	125151
FCS errors on air	31	0

Master protection data		Local	Alternate	Remote	Remote alternate
Configured role	11	Master	Slave	Master	Slave
Current role	12	Master	Slave	Master	Slave
Timeout max	13	4017	1617055	30882	1802332
Timeout last	14	587	8	15	16
Index	15	54657	41408	1970	46483
Instance ID	16	23	23	23	23
FSM state	17	Master	Slave	Master	Slave
Link states					
LAN1	18	Up	Up	Up	Up
LAN2	19	Up	Up	Up	Up
LAN3	20	Down	Down	Down	Down
WAN	21	Up	Up	Up	Up
MNG	22	Up	Up	Up	Up

Press MODIFY button.

Master modify mode after enabling aggregation



When all four Integra/Integra-S/Integra-G/Integra-GS FODUs are successfully configured and interconnected, the status of the Master unit should look as shown above.

Explanation of status/configuration fields

Aggregation configuration

1) ***Aggregation*** - Indicates whether aggregation is enabled or disabled.
2) ***Configured role*** – Indicates the configured role (status mode); allows specifying aggregation role (modify mode).
3) ***Current role*** – Indicates the current role. It may differ from the configured role in case Master protection is enabled, the alternate device is or was not available and reconfiguration to 1+0 configuration took place.
4) ***Mode –*** "2+0 PLA" for 2+0 Physical Layer Aggregation. "1+1 HSB" for 1+1 Hot StandBy protection.

Master protection

5) ***State*** – Indicates whether Master protection is enabled or disabled (status mode); allows enabling or disabling Master protection (modify mode). (For 1+1 configuration always in Enable state)

6) ***FSM state*** – Indicates current Finite State Machine's state. Will be visible only when Master protection is enabled.
   8 states are possible – Master, Slave, Active (transition to Passive, Slave, or Active Try), Passive (transition to Slave), Active Try (1+1 transition to Active Tx), Active Tx (1+1 transmitting), Standby (ready for 1+1 protection), and TpDown (Slave state when Traffic port is down). In the case of TpDown aggregation port (LAN2) is shut down as well.
7) ***Instance ID (0…65535)*** – Indicates configured instance ID (status mode); allows entering instance ID (modify mode). Will be available only when Master protection is enabled.

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

Instance ID should differ for other 2+0 links in the network.

8) ***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).

Alarms

9) 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.

AIS condition – synchronization loss of Master or Slave device or link status of aggregation port (LAN2) of the remote device is down.

Master protection data

The status of all four units is shown. Local – the unit you are currently connected to; alternative – 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 timeout*** – Allows resetting protection data refresh time counters. The button is available only in modify mode.
11) ***Configured role*** – Indicates configured role.
12) ***Current role*** – Indicates current role. May differ from the configured role in case Master protection is enabled, the alternate device is or was not available and reconfiguration to 1+0 configuration took place.
13) ***Timeout max*** – Maximum refresh time of protection data in milliseconds.
14) ***Timeout last*** – Most recent refresh time of protection data in milliseconds.
15) ***Index*** – Aggregation data identifier. Value sequentially increments to 65535 and resets to 0.
16) ***Instance ID*** – Indicates configured instance ID.
17) ***FSM state*** – Indicates current Finite State Machine's state. Will be visible only when Master protection is enabled.
18) ***LAN1*** – Indicates link status of LAN1 port – up or down.
19) ***LAN2*** – Indicates link status of LAN2 port – up or down.
20) ***LAN3*** – Indicates link status of LAN3 port – up or down.
21) ***WAN*** – Indicates link status of WAN port – up or down.
22) ***MNG*** – Indicates link status of MNG port – up or down.

Traffic path

23) ***Clear counters*** - Allows resetting master and slave path counters. The button is available only in modify mode.
24) ***Transmitting*** – For 2+0 configuration: Indicates whether Master, Slave, or both are transmitting traffic. For 1+1 configuration: Indicates whether the current role Master (Local master) or Slave (Alternate Slave) is transmitting.
25) ***Receiving*** – For 2+0 configuration: Indicates whether Master, Slave, or both are receiving traffic. For 1+1 configuration: Indicates whether the current role Master (Local master) or Slave (Alternate Slave) is receiving.

Master path counters

26) ***Splitter packets*** – Indicates the number of packets transmitted by Master FODU.
27) ***Combiner packets*** – Indicates the number of packets received by Master FODU.
28) ***FCS errors on air*** – Indicates the number of FCS errors received by Master FODU.

Slave path counters

29) ***Splitter packets*** – Indicates the number of packets transmitted by Slave FODU.
30) ***Combiner packets*** – Indicates the number of packets received by Slave FODU.
31) ***FCS errors on air*** – Indicates the number of FCS errors received by Slave FODU.

Slave path counters

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

Configuration example:

Configuration for both Slave FODUs

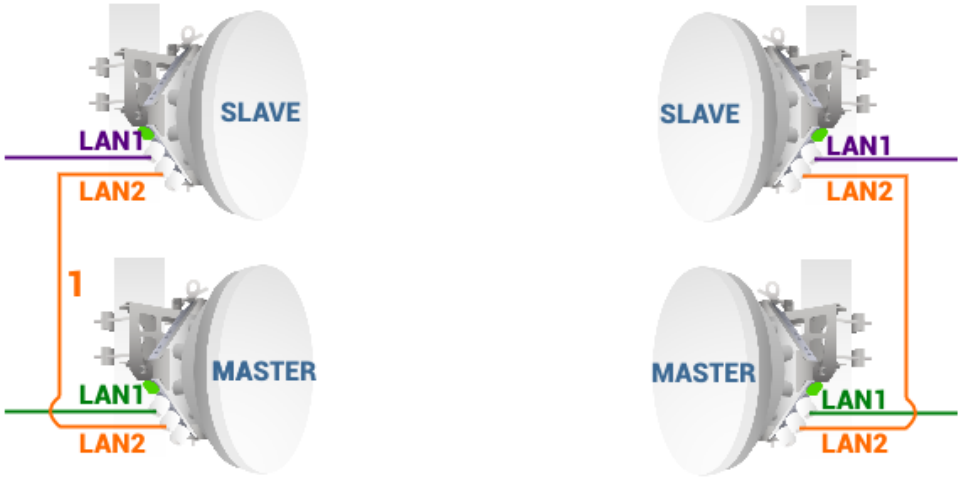
For 2+0:

Aggregation/protection configuration	
Aggregation	Enabled
Configured role	Slave
Current role	Slave
Mode	2+0 PLA
Master protection	
State	Enabled
FSM state	Slave
Instance ID	23
Ethernet traffic port	LAN1

For 1+1:

Aggregation/protection configuration	
Aggregation	Enabled
Configured role	Slave
Current role	Slave
Mode	1+1 HSB
Master protection	
State	Enabled
FSM state	Standby
Instance ID	11
Ethernet traffic port	LAN1

192.168.205.100 192.168.205.200



192.168.205.10 192.168.205.20

Configuration for both Master FODUs

For 2+0:

Aggregation/protection configuration	
Aggregation	Enabled
Configured role	Master
Current role	Master
Mode	2+0 PLA
Master protection	
State	Enabled
FSM state	Master
Instance ID	23
Ethernet traffic port	LAN1

For 1+1:

Aggregation/protection configuration	
Aggregation	Enabled
Configured role	Master
Current role	Master
Mode	1+1 HSB
Master protection	
State	Enabled
FSM state	Active Tx
Instance ID	11
Ethernet traffic port	LAN1

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

aggr status	Use to show aggregation status, statistics, and alarms.
aggr status clear	Use to clear the aggregation statistics.
Aggr role {none|master|slave}	Use to specify 2+0 aggregation role – Master or Slave. “none” disables aggregation.
Aggr role {none|master 1+1| slave 1+1}	Use to specify 1+1 Hot StandBy role – Master or Slave. “none” disables aggregation.
Aggr force {none|master|slave}	Use to force traffic to transmit solely via Master or Slave FODU.
Aggr mprot enable <id> {LAN1|LAN3}	Use to enable master protection by specifying instance ID and traffic port – LAN1 or LAN3.
Aggr mprot disable	Use to disable master protection.
aggr mprot data	Use to show master protection refresh data.
aggr mprot data reset	Use to reset master protection refresh data counters.
aggr mprot smpdata	Use to show the status of all 2+0 devices.
aggr mprot state <state>	Use to change FSM state. For testing purposes only!

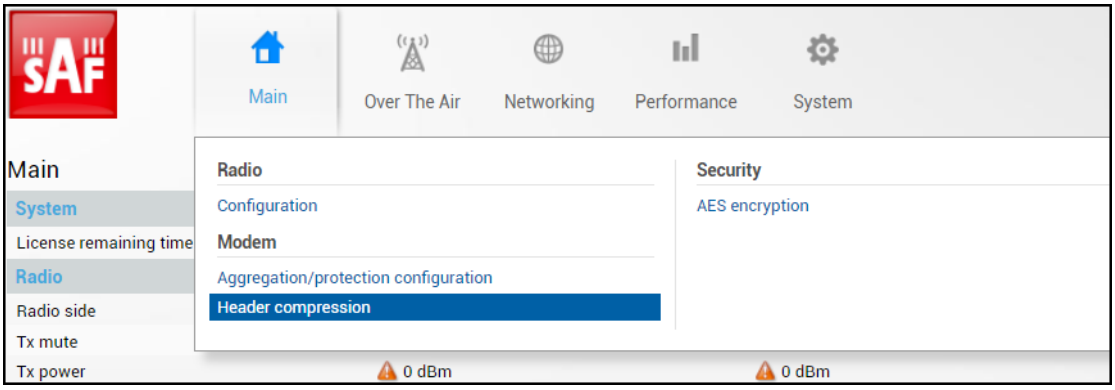
Over The Air → Modem → Header compression

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. 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 header compression.

In summary, header compression is the process of compressing excess protocol headers before transmitting them on a link and uncompressing them to their original state on reception at the other end of the link.

For more details see Header Compression section in Chapter 6: FUNCTIONAL DESCRIPTION.

Header compression cannot be used with 2+0 aggregation configured.

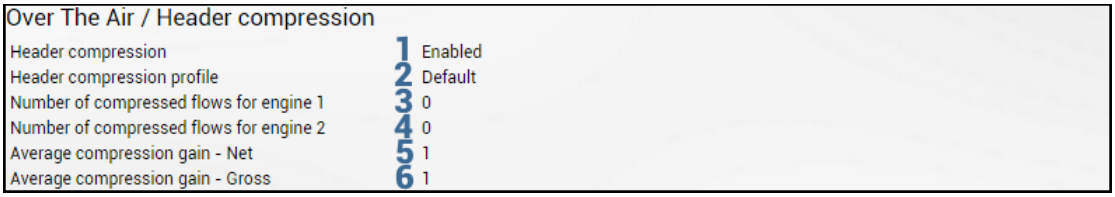


Status mode

Press MODIFY button.

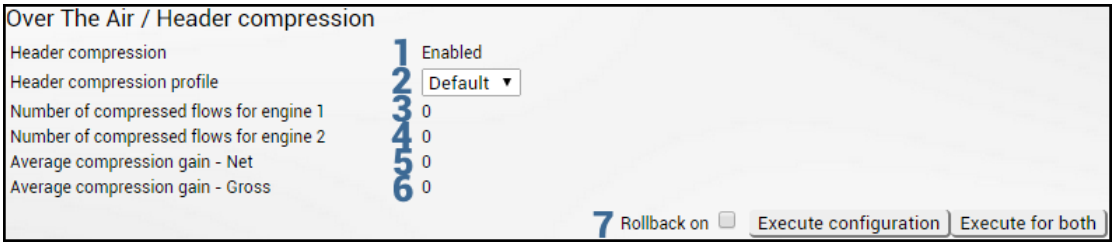
Modify mode

Status mode after enabling header compression



Press MODIFY button.

Modify mode after enabling header compression



Explanation of status/configuration fields:

1) ***Header compression*** – Indicates whether header compression is enabled or disabled.
2) ***Header compression profile*** – Indicates which header compression profile is selected (status mode); allows choosing compression profile and thus enabling header compression or disabling it using the "None" profile (modify mode).
3) ***Number of compressed flows for engine 1*** – Indicates the number of compressed entries for engine #1. The maximum is 2048.
4) ***Number of compressed flows for engine 2*** – Indicates the number of compressed entries for engine #2. The maximum is 2048.
5) ***Average compression gain - Net*** – Indicates compression percentage between ingress and egress data.
6) ***Average compression gain - Gross*** – Indicates compression percentage between ingress and egress data including GFP (Generic Framing Procedure) overhead.
7) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.
   Pressing *„Execute for both"* applies changes made to the corresponding section both for local and remote side Integra/Integra-S/Integra-G/Integra-GS FODUs.

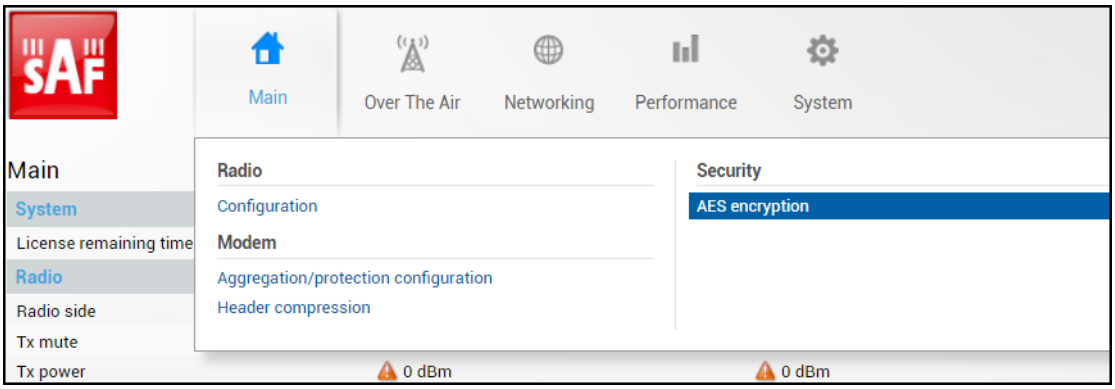
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

modem hc preset {none|default}	Use to enable (preset "default") or disable (preset "none") header compression.
modem hc statistics	Use to show head compression statistics.

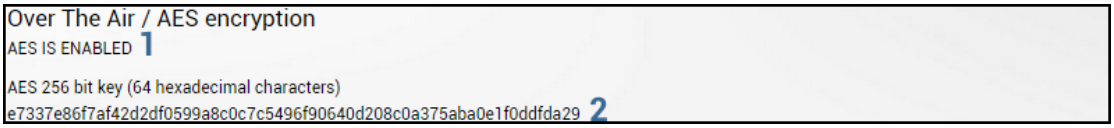
Over The Air → Security → AES encryption

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 6: FUNCTIONAL DESCRIPTION.



Status mode



Press MODIFY button.

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/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

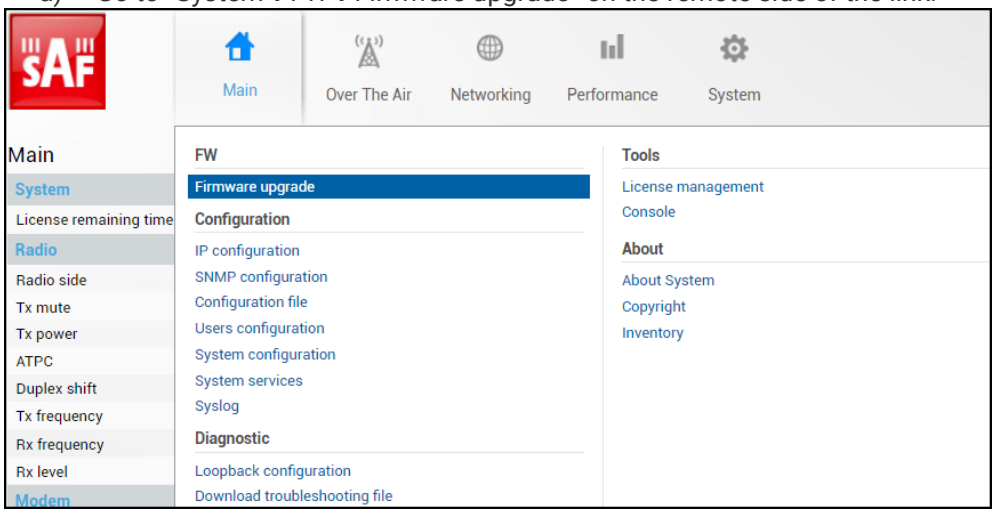
modem aes	Use to show AES state and key.
modem aes key <64hexkey>	Use to set AES 256-bit key.

Activation of AES for Integra/Integra-S/Integra-G/Integra-GS FODU

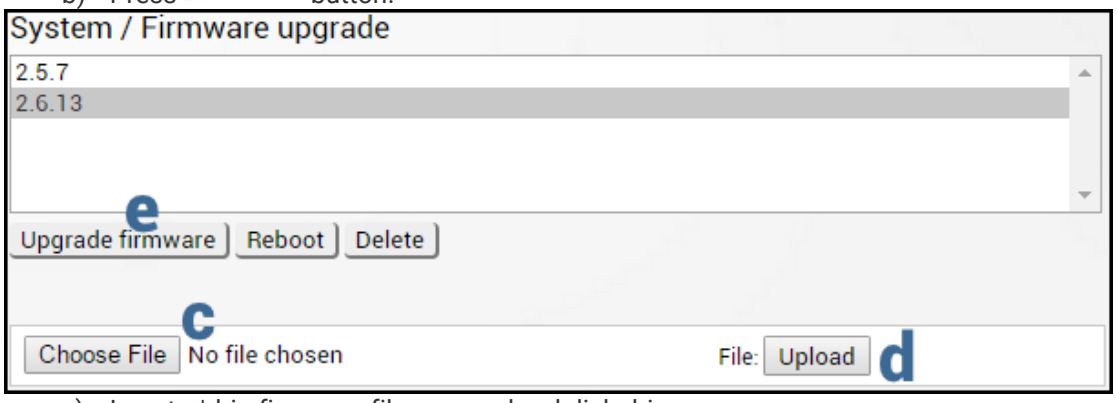
1) Make sure the firmware version is V2.5.13 or later.
   0) If required perform the firmware upgrade.

⚠ Skip this step if the firmware version is V2.5.13 or later.

   a) Go to "System→FW→Firmware upgrade" on the remote side of the link.



b) Press MODIFY button.



c) Locate *.bin firmware file on your hard disk drive.
d) Upload selected *.bin firmware file.
e) Select the uploaded *.bin firmware file from the list and press “Upgrade firmware”.

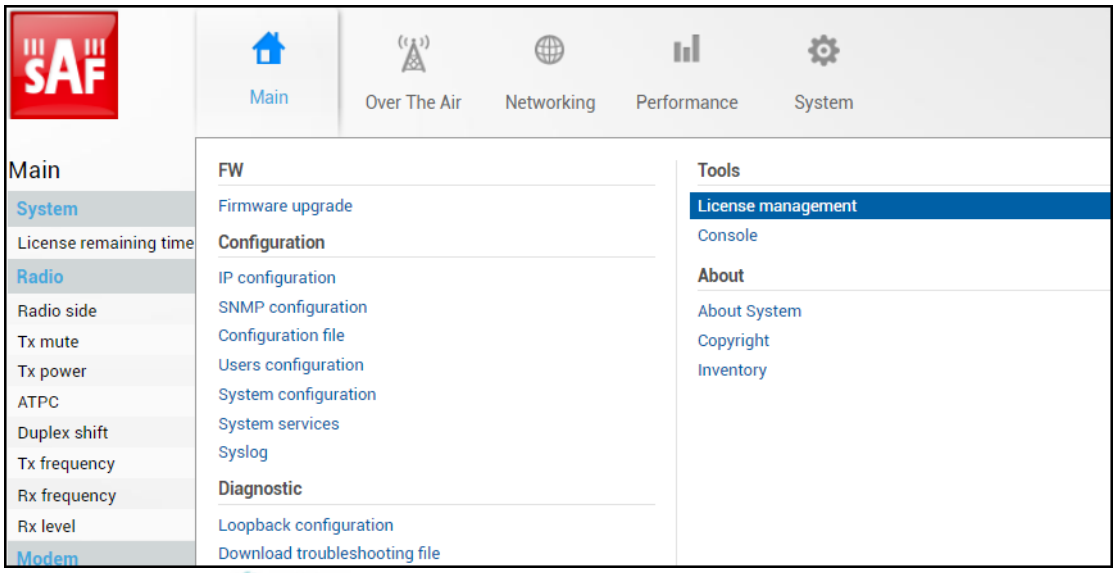
⚠ The remote side should be upgraded first.

f) Repeat steps a)-e) for the local side of the link.

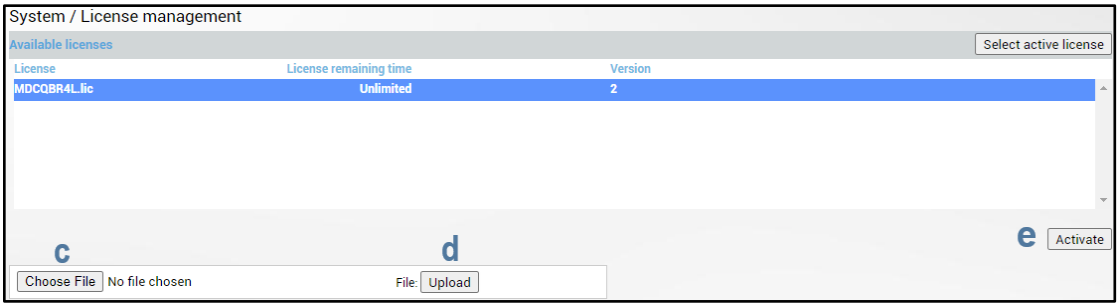
2) Upload and activate license key enabling AES functionality:

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

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



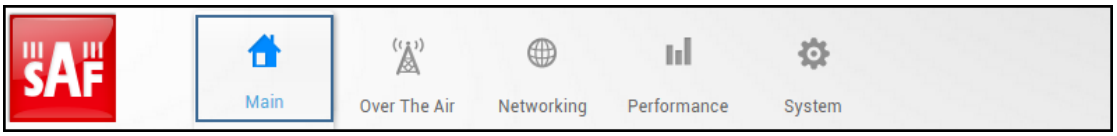
b) Press MODIFY button.



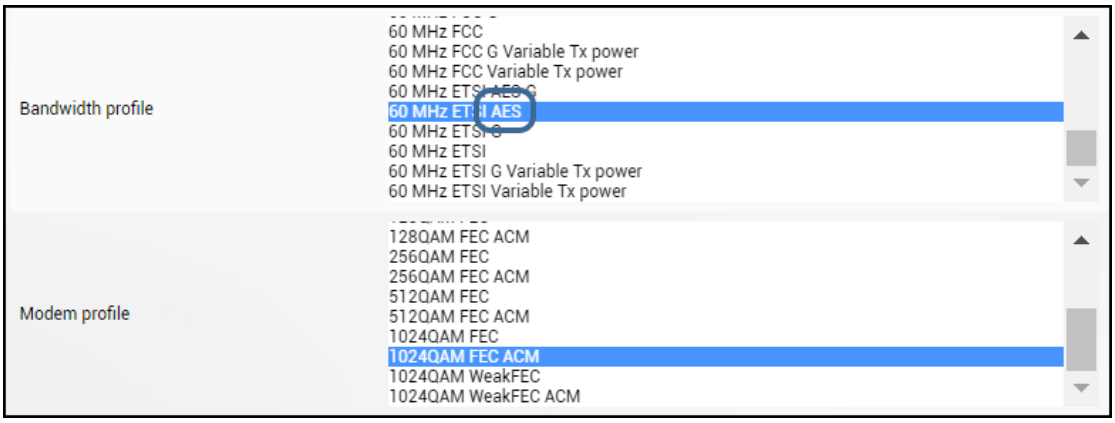
c) Locate *.lic license file on your hard disk drive.
d) Upload selected *.lic license file.

e) Select the uploaded *.lic license file from the list and press “Activate”.
f) Repeat a)-e) for the local side of the link.

3) Set bandwidth with AES:
a) Go to “Main” page.

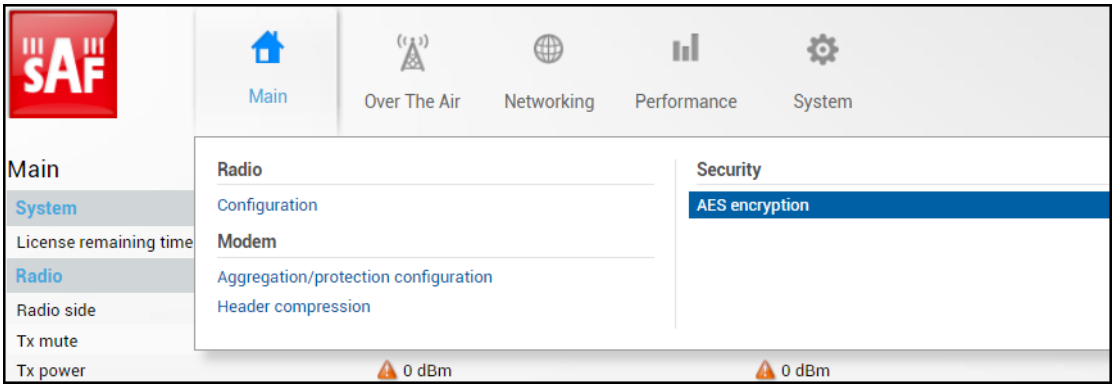


b) Press MODIFY button.
c) Select the required bandwidth with AES and required modulation.



d) Press “Execute for both” button.

4) Apply AES 256-bit key:
a) Go to “Over The Air→Security→AES encryption” on the remote side of the link.



b) Press MODIFY button.

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.

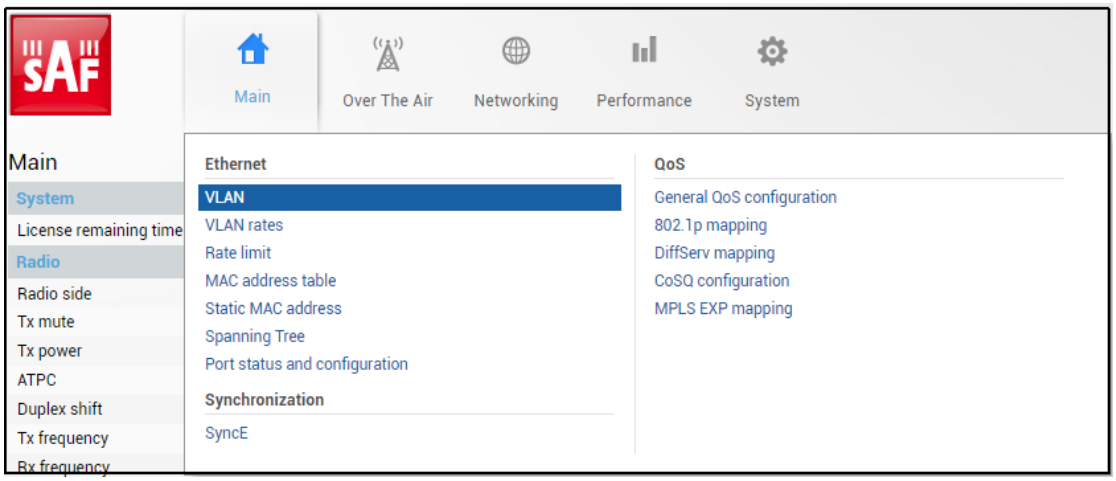
Networking

Networking → Ethernet → VLAN

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.

An example below shows a sample configuration with VLAN IDs 100-300 configured as tagged members on LAN2 and WAN ports (user traffic) and VLAN ID 500 as a tagged member on LAN2 and WAN ports and untagged member on MNG port (management traffic).



Status mode

Networking / VLAN

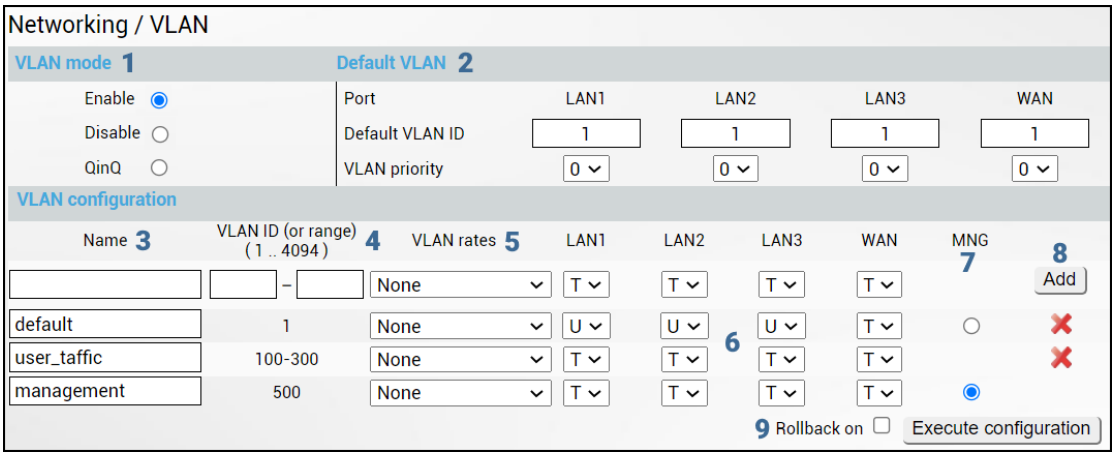
VLAN mode 1	Default VLAN 2				
Disabled	Port	LAN1	LAN2	LAN3	WAN
	Default VLAN ID	1	1	1	1
	VLAN priority	0	0	0	0

VLAN configuration

Name 3	VLAN ID (or range) (1 .. 4094) 4	VLAN rates 5	LAN1	LAN2	LAN3	WAN	MNG 7
default	1	None	U	U	U	T	
user_taffic	100-300	None	T	T 6	T	T	
management	500	None	T	T	T	T	●

Press MODIFY button.

Modify mode



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 VLAN support.

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

⚠ While in "QinQ" mode, the radio switch will only work with an outer VLAN tag (S-tag) in accordance with the configuration in the "Default VLAN" and "VLAN configuration" sections. A custom user configured Ethernet type ID is used instead of 0x8100 (default for IEEE 802.1Q). All packets tagged by 802.1Q header are considered as untagged and additional tag is added.

2) ***Default VLAN*** – Indicates Default VLAN IDs and VLAN priorities on LAN and WAN ports (status mode); allows specifying the default VLAN ID and priorities on each of LAN and WAN ports (modify mode). Specified VLAN ID and priority will be added to untagged ingress packets. VLAN priority will be removed from tagged egress packets on particular ports as well, but the VLAN ID will be removed according to the tagged/untagged configuration (see below) of that particular port.
3) ***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).
4) ***VLAN ID (or range) (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).
5) ***VLAN rates*** – Indicates configured VLAN rate (status mode); allows selecting a defined VLAN rate (modify mode). Please refer to the chapter Networking → Ethernet → VLAN rates.
6) ***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). On the LAN ports 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 WAN port.
7) ***MNG*** – indicates management VLAN ID (status mode); allows specifying which individual VLAN ID will be used for management access (modify mode).
8) ***Add*** – Press "Add" to add entered individual VLAN ID or VLAN ID range or press red cross (✖) to delete VLAN entry.

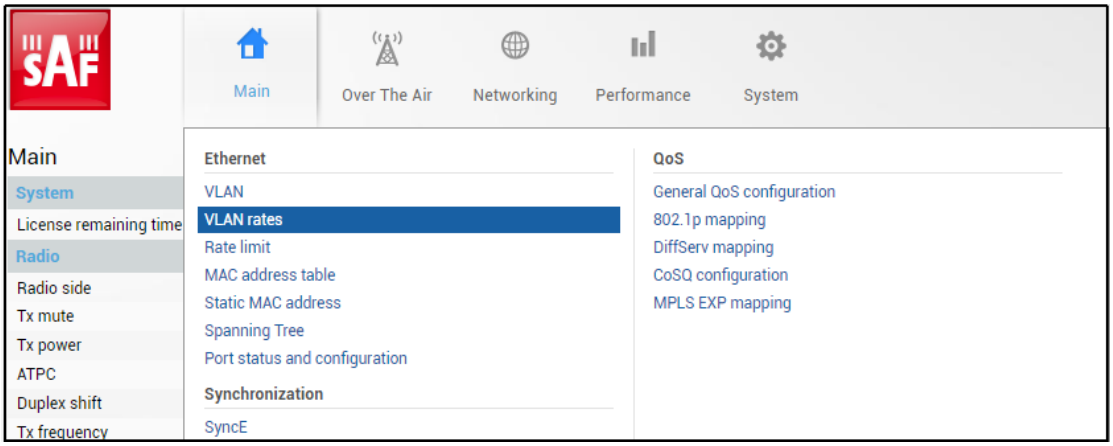
9) By pressing *„Execute configuration”,* changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on”* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

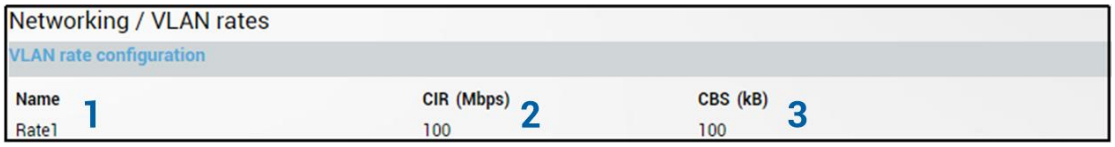
network vlan set mng <1…4094>	Use to set Management (MNG) VLAN ID.
network vlan set mode {disable|enable|qinq}	Use to set VLAN operation mode. “disable” – packets ingress/egress unmodified; “enable” – packets are handled according to VLAN configuration; “qinq” - packets are handled according to VLAN configuration for QinQ.
network vlan set mode qinq tpid <0x0001...0xFFFF>	Use to set tag protocol identifier (TPID) for S-TAG.
network vlan set vid <1…4094> **add** {tagged|untagged} {LAN1|LAN2|LAN3}	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 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 for multiple VLAN IDs.
network vlan set vid <1…4094> **rate** <name>	Use to apply existing rate profile to a VLAN ID.
network vlan set vid <1…4094> **remove**	Use to remove the defined rate profile from a VLAN ID.
network vlan set default priority <0…7>	Use to set default VLAN priority value for untagged packets.
network vlan set default vid <1…4094>	Use to set default VLAN ID for untagged packets.
network vlan show summary	Use to show 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 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.

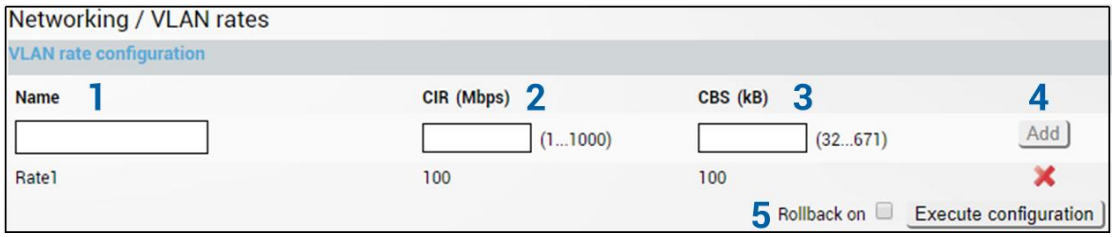


Status mode



Press MODIFY button.

Modify mode



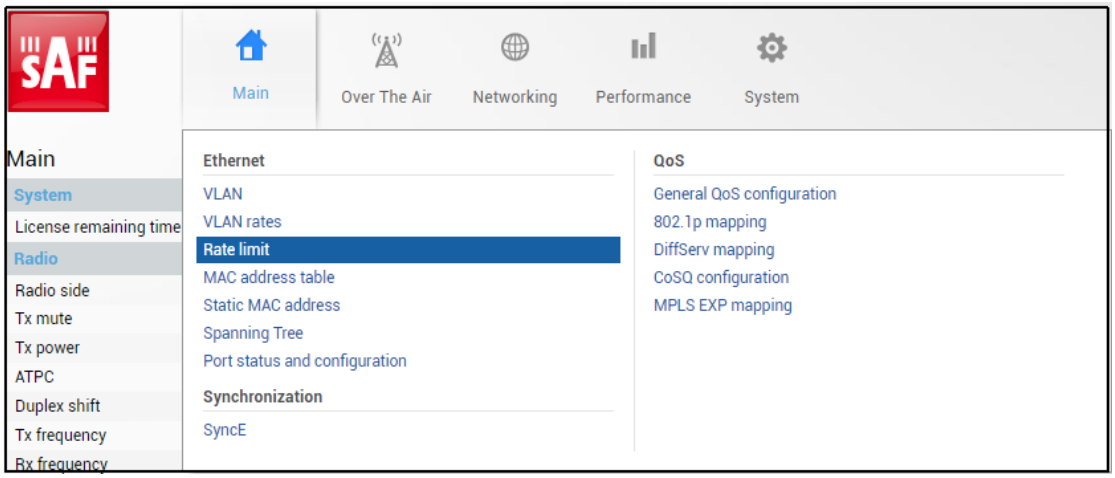
1) ***Name*** – Indicates whether the egress rate is enabled or disabled on a particular port (status mode); allows enabling/disabling egress rate on a particular port (modify mode).
2) ***CIR (Mbps)*** – Indicates configured rate CIR (Committed Information Rate) on a particular VLAN rate item in Mbps (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 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/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

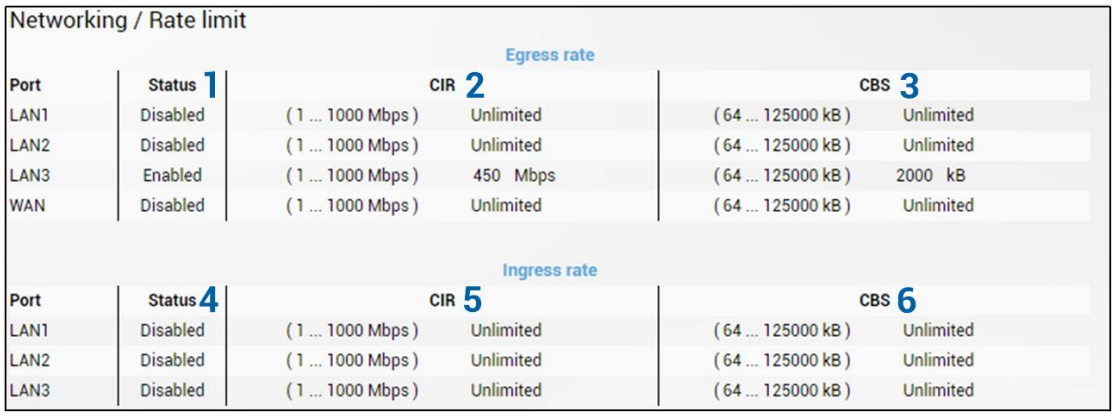
network vlan show rates	Use to show created rate profiles.
network vlan set rate {add|delete} <name> **cir** <1000…1000000kbps> **cbs** <32…671kB>	Use to create new or delete existing rate configuration profiles. Please refer to Chapter Networking → Ethernet → VLAN to apply the created rate profile to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

Networking → Ethernet → Rate limit

The rate limit page 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.

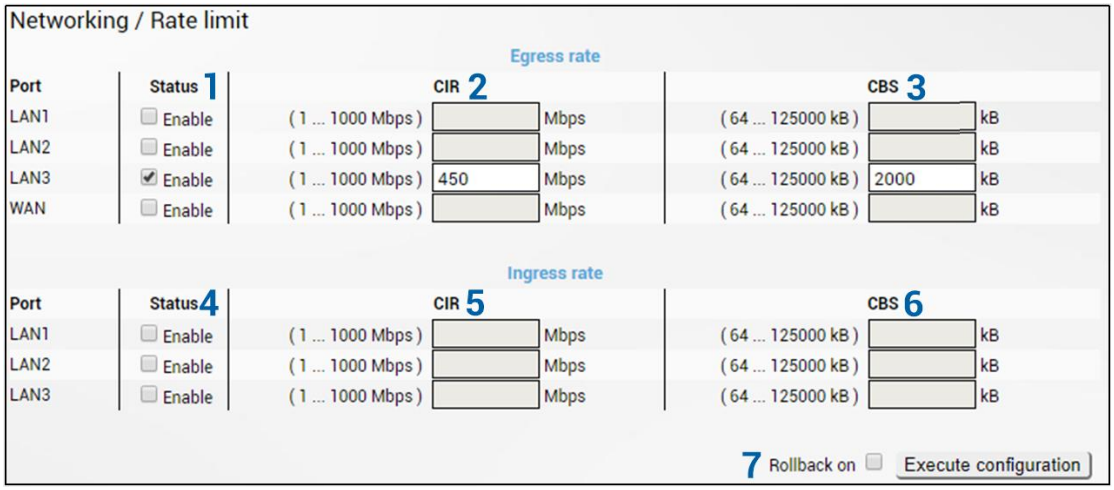


Status mode



Press MODIFY button.

Modify mode



1) ***Egress rate / Status*** – Indicates whether 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 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 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 ingress rate is enabled or disabled on a particular port (status mode); allows enabling/disabling 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/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

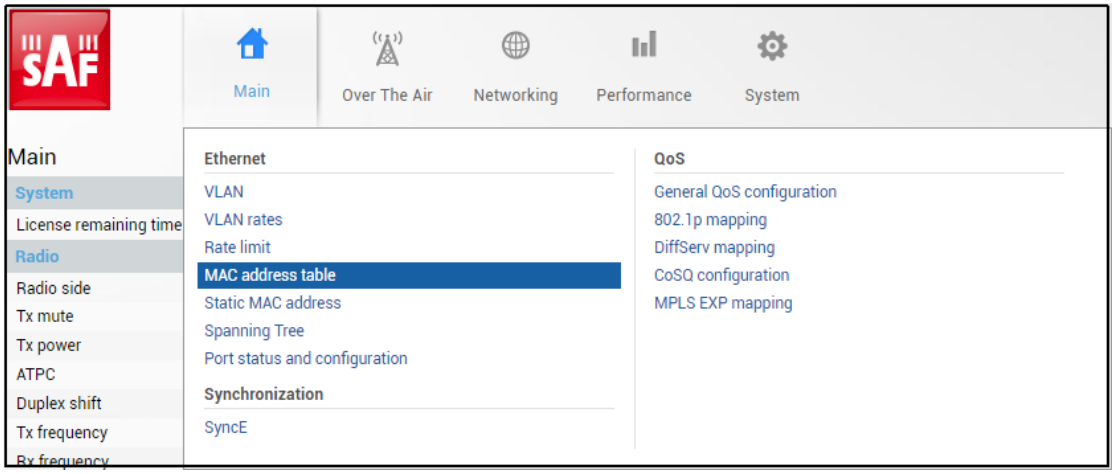
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

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 <port> **egress-rate cir** <96…1000000kbps> **cbs** <64…125000kB>	Use to set Committed Information Rate (CIR) and Committed Burst Size (CBS) setting for egress rate limit on a particular port.
network port set <port> **ingress-rate cir** <96…1000000> **cbs** <64…125000>	Use to set Committed Information Rate (CIR) and Committed Burst Size (CBS) setting for ingress rate limit on a particular 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.

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).



Status mode

Networking / MAC address table

MAC address table

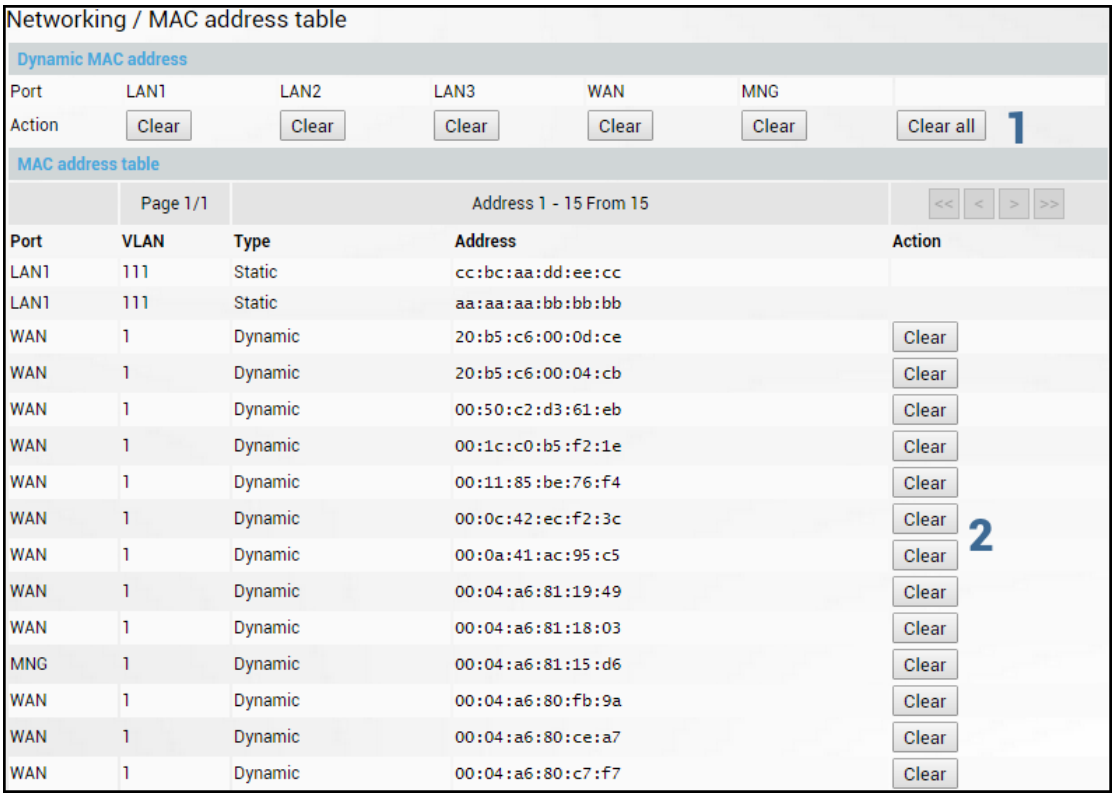
Page 1/1 Address 1 - 17 From 17 << < > >>

Port	VLAN	Type	Address
LAN1	111	Static	cc:bc:aa:dd:ee:cc
LAN1	111	Static	aa:aa:aa:bb:bb:bb
WAN	1	Dynamic	20:b5:c6:00:0d:ce
WAN	1	Dynamic	20:b5:c6:00:04:cb
WAN	1	Dynamic	00:50:c2:d3:61:eb
WAN	1	Dynamic	00:1c:c0:b5:f2:1e
WAN	1	Dynamic	00:11:85:be:76:f4
WAN	1	Dynamic	00:0c:42:ec:f2:3c
WAN	1	Dynamic	00:0a:41:ac:95:c5
WAN	1	Dynamic	00:04:a6:81:19:ea
WAN	1	Dynamic	00:04:a6:81:19:49
WAN	1	Dynamic	00:04:a6:81:18:03
MNG	1	Dynamic	00:04:a6:81:15:d6
WAN	1	Dynamic	00:04:a6:80:fb:9a
WAN	1	Dynamic	00:04:a6:80:ce:a7
WAN	1	Dynamic	00:04:a6:80:c7:f8
WAN	1	Dynamic	00:04:a6:80:c7:f7

2

Press MODIFY button.

Modify mode



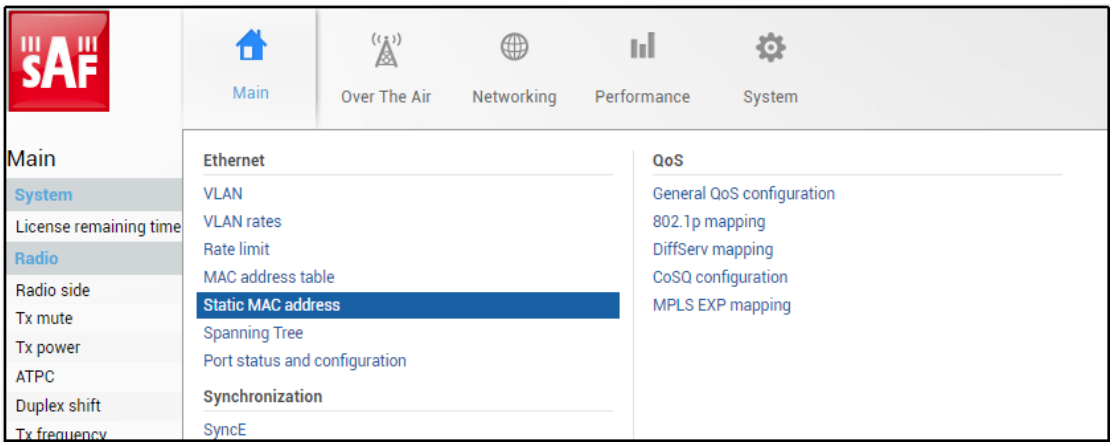
1) Use to clear the dynamic MAC address table on a particular port (“Clear”) or all ports simultaneously (“Clear all”).
2) Shows list of MAC address entries (status mode); allows clearing specific MAC address entries (modify mode).

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

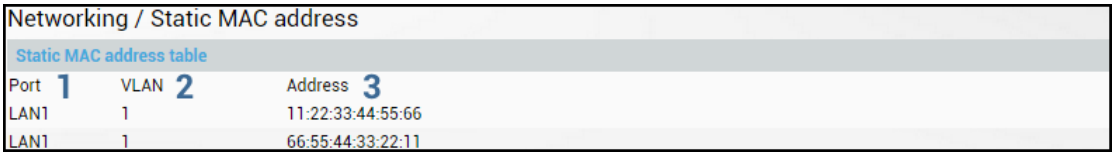
network mac table show	Use to show MAC table entries.
network mac table info	Use to show MAC table statistics.
network mac table clear vlan <vid>	Use to clear MAC table entries for a specific VLAN ID.
network mac table clear port <port>	Use to clear MAC table entries for a specific port.
network mac table clear mac-address <MAC>	Use to clear a dynamic MAC address for all VLAN IDs and ports.
network mac table clear all	Use to clear the whole dynamic MAC address table.

Networking → Ethernet → Static MAC Address

Allows adding and editing static MAC address entries.

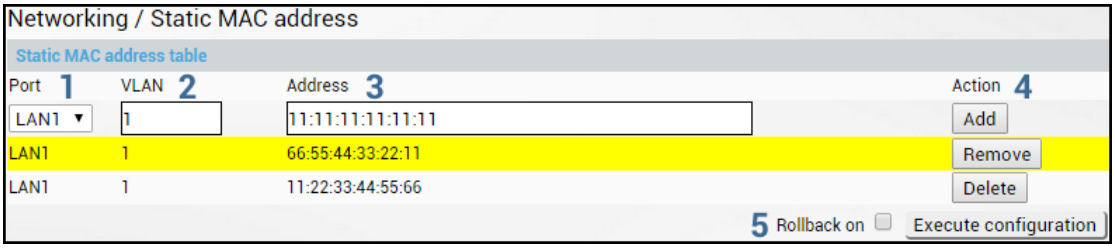


Status mode



Press MODIFY button.

Modify mode



1) ***Port*** – Indicates ports of configured static MAC addresses (status mode); allows specifying the port for static MAC address (modify mode).
2) ***VLAN*** – Indicates VLAN IDs of configured static MAC addresses (status mode); allows specifying VLAN for static MAC address (modify mode).
3) ***Address*** – Indicates configured static MAC addresses (status mode); allows specifying static MAC addresses (modify mode).
4) ***Action*** – Allows adding a new static MAC address ("Add"), removing temporarily entered static MAC address ("Remove"), or deleting permanently entered static MAC address ("Add").
5) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

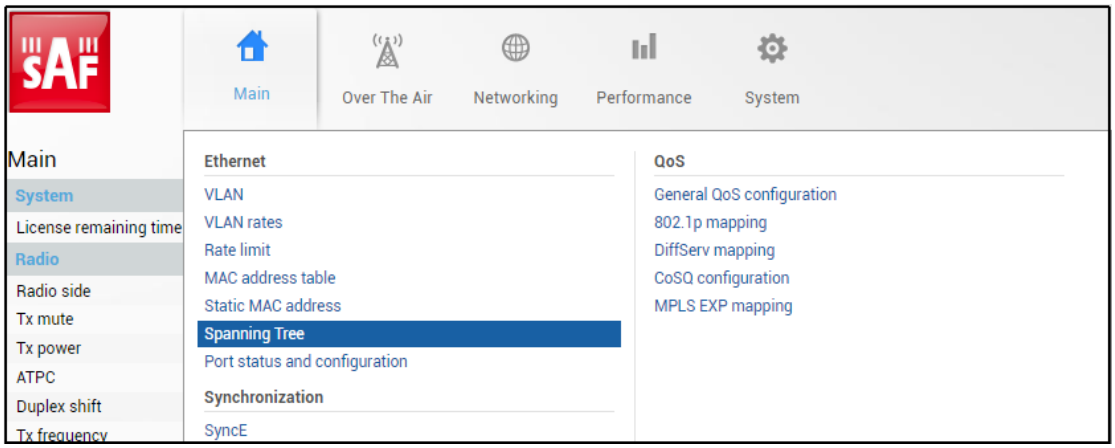
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

network mac static show	Use to show static MAC address table.
network mac static add mac-address <MAC> **vlan** <vlan> **port** <port>	Use to add static MAC address for selected VLAN ID and port.

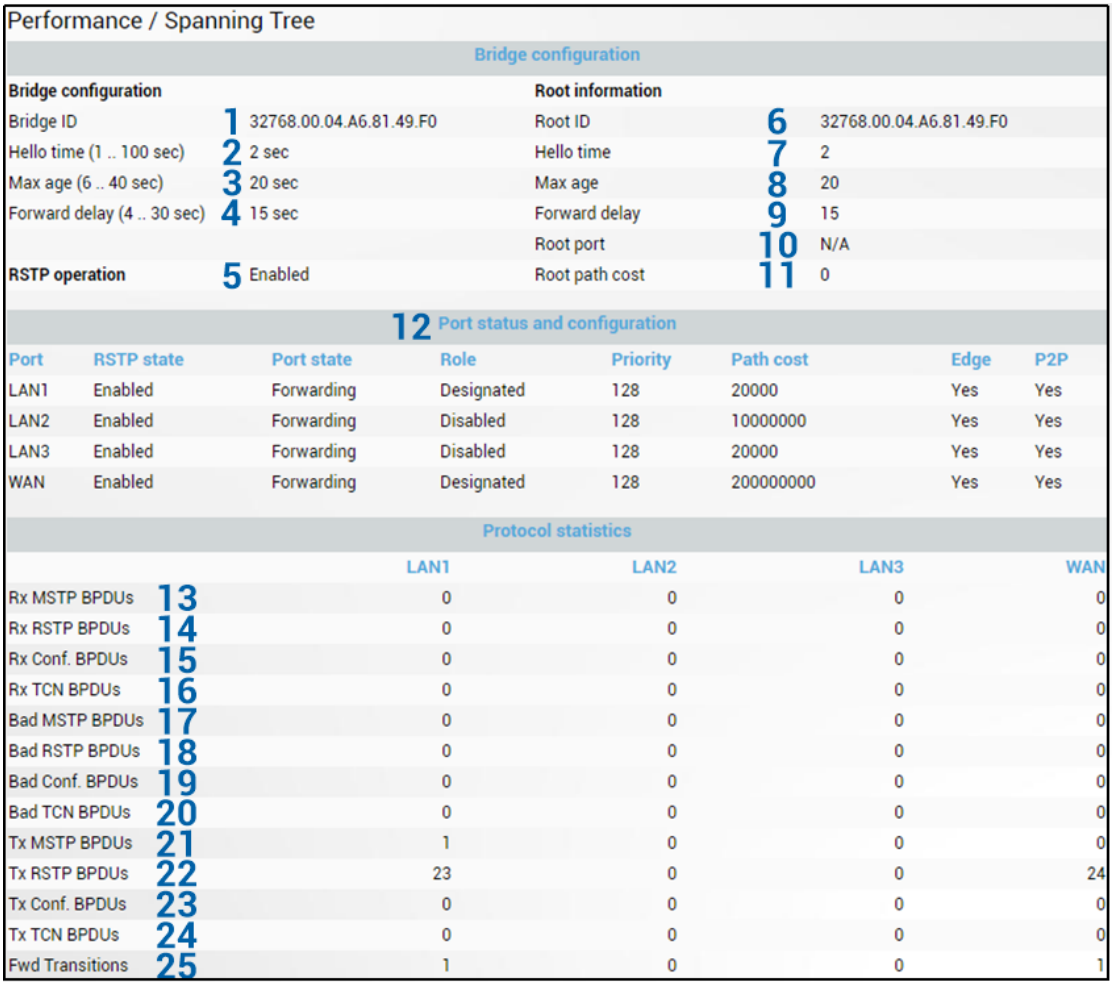
network mac static delete mac-address <MAC> **vlan** <vlan> **port** <port>	Use to remove static MAC address from selected VLAN ID and port.

Networking → Ethernet → Spanning Tree

The Spanning Tree page provides the configuration of Rapid Spanning Tree Protocol (Rapid STP).

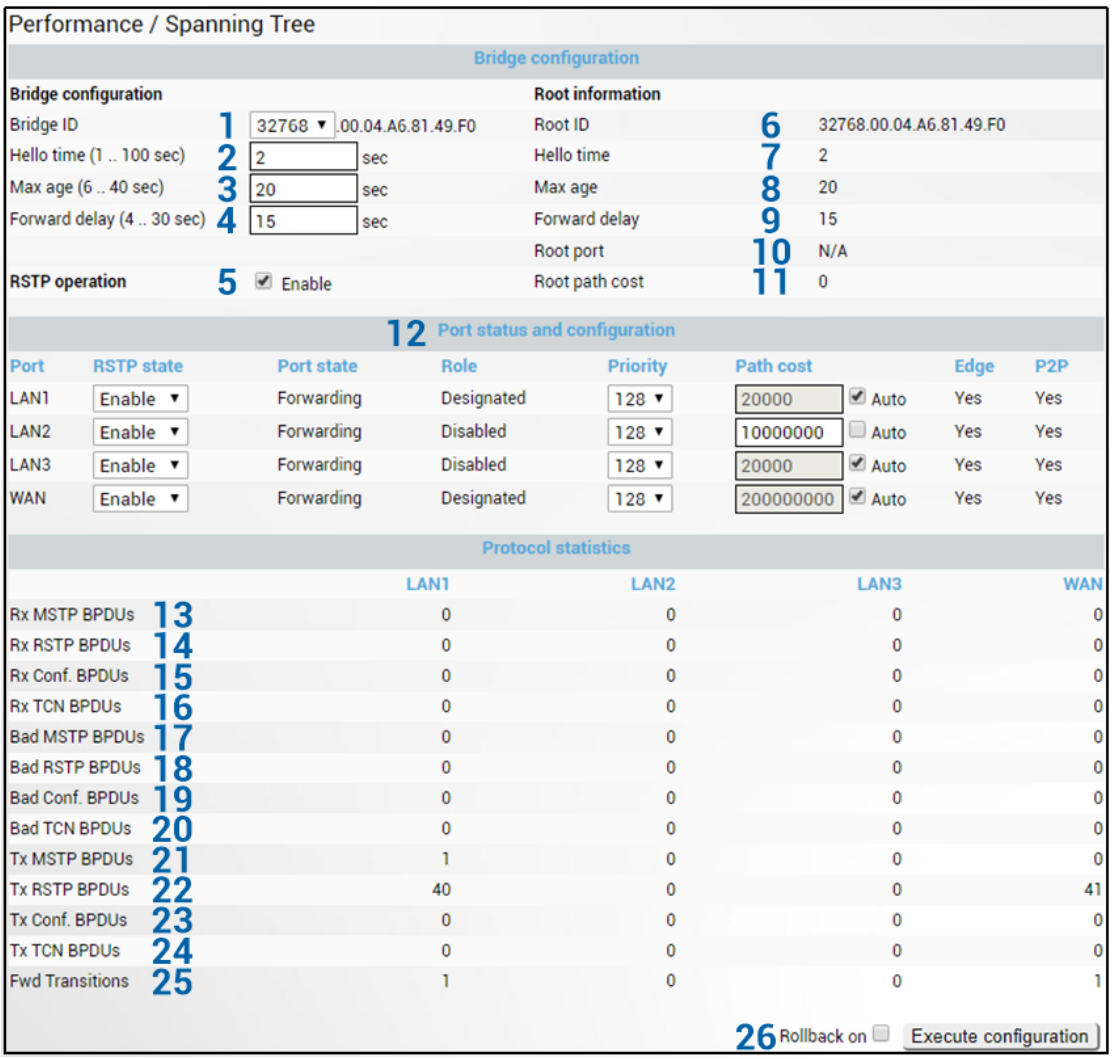


Status mode



Press MODIFY button.

Modify mode



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 configured time 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 configured time 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) ***RSTP operation –*** Indicates configured status of RSTP (status mode); allows enable or disable RSTP operation (modify mode).

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

6) ***Root ID –*** Indicates the Bridge ID of the current Root bridge.
7) ***Hello Time –*** Indicates the current hello time.

8) ***Max Age –*** Indicates the current max age.
9) ***Forward Delay –*** Indicates the current forward delay.
10) ***Root Port –*** Indicates elected root port is being shown.
11) ***Root Path Cost –*** Indicates the path cost from the current bridge to the root bridge.
12) ***Port status and configuration –*** STP parameters of every port:
    - ***RSTP state –*** Indicates RSTP state of the particular port (status mode); allows enable or disable 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 on the occasion 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 *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.
13) ***Rx MSTP BPDUs –*** Indicates how many MSTP BPDUs packets were received.
14) ***Rx RSTP BPDUs –*** Indicates how many RSTP BPDUs packets were received.
15) ***RX Conf BPDUs –*** Indicates how many STP BPDUs packets were received.
16) ***RX TCN BPDUs –*** Indicates how many topology changing notification BPDUs packets were received.
17) ***Bad MSTP BPDUs –*** Indicates how many bad MSTP BPDUs packets were received.
18) ***Bad RSTP BPDUs –*** Indicates how many bad RSTP BPDUs packets were received.
19) ***Bad Conf BPDUs –*** Indicates how many bad STP BPDUs packets were received.
20) ***Bad TCN BPDUs –*** Indicates how many bad topology changing notifications BPDUs packets received.
21) ***Tx MSTP BPDUs –*** Indicates how many MSTP BPDUs packets were sent.
22) ***Tx RSTP BPDUs –*** Indicates how many RSTP BPDUs packets were sent.
23) ***Tx Conf BPDUs –*** Indicates how many STP BPDUs packets were sent;
24) ***Tx TCN BPDUs –*** Indicates how many topology changing notification BPDUs packets were sent.
25) ***Fwd Transitions –*** Indicates how many times the port has been changed to forward status.
26) By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

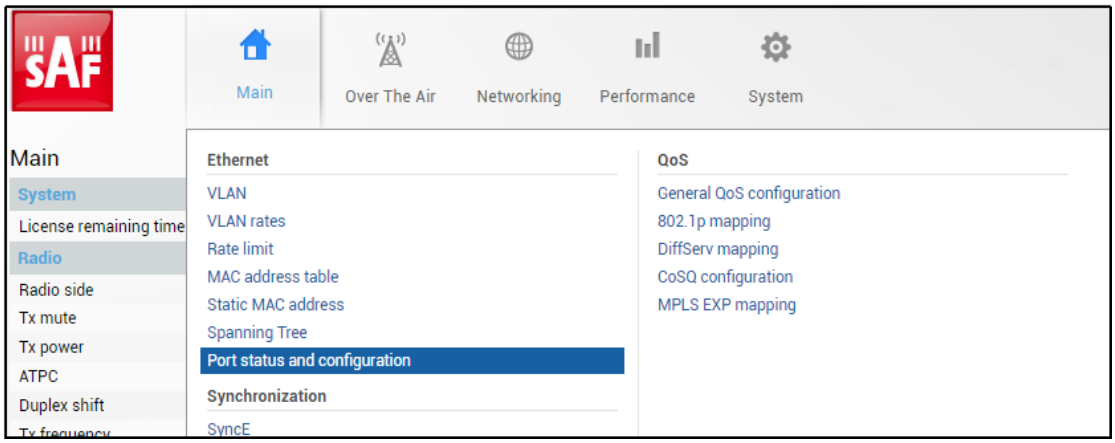
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

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.

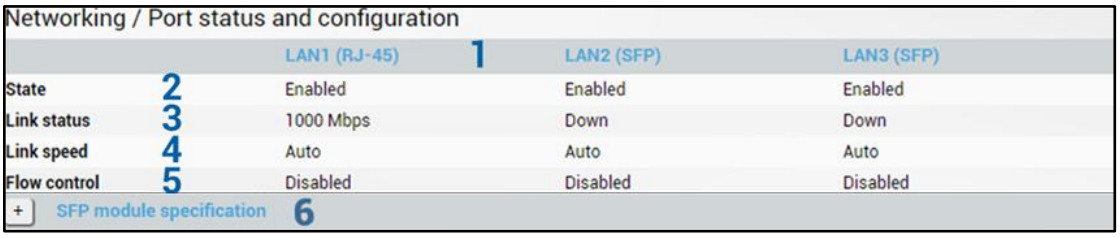
stp forwardDelay <4..30>	Use to set the time period that determines the time in seconds a separate port stays in Listening and Learning conditions.
stp helloTime <1..100>	Use to set the value of the time gap in seconds between which the BPDU packets are being sent.
stp log {enable | disable}	Use to enable or disable STP log.
stp maxAge <6..40>	Use to set the time period in seconds, during which the received BPDU packets' information is stored for a separate port.
stp state {enable | disable}	Use to enable or disable RSTP operation.
stp status	Use to show the status of STP configuration.

Networking → Ethernet → Port status and configuration

Shows the status of Ethernet switch ports, allows enabling and disabling the ports, Flow control, and modifying link speed/duplex.

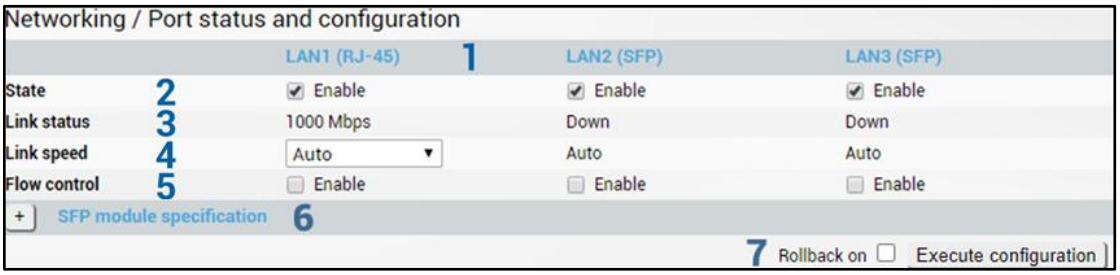


Status mode



Press MODIFY button.

Modify mode



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). "(Restricted)" will be indicated on the LAN2 port if 2+0 aggregation or 1+1 protection is enabled.
3) ***Link status*** – Indicates whether a link with the appropriate port is established as well as its link speed.
4) ***Link speed*** – Indicates whether link speed is configured to automatic speed setting or manual (status mode); allows changing link speed to the manual setting (modify mode).

LAN2 and LAN3 (SFP ports) support Auto Gigabit (1000FDX) only and cannot be modified.

Maximum L2 frame size supported in 1000FDX mode is 9600B, while in 100FDX mode (LAN1) – 9070B.

5) ***Flow control*** – Indicates whether flow control is enabled or disabled on a particular port (status mode); allows enabling/disabling flow control on each available port (modify mode). The default setting is disabled.
6) ***SFP module specification*** – if SFP module is present, you can expand this section to see information on SFP module used.
7) By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

SFP module specification will be shown at the bottom of the page if the SFP module is present and if the SFP module supports DOM.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

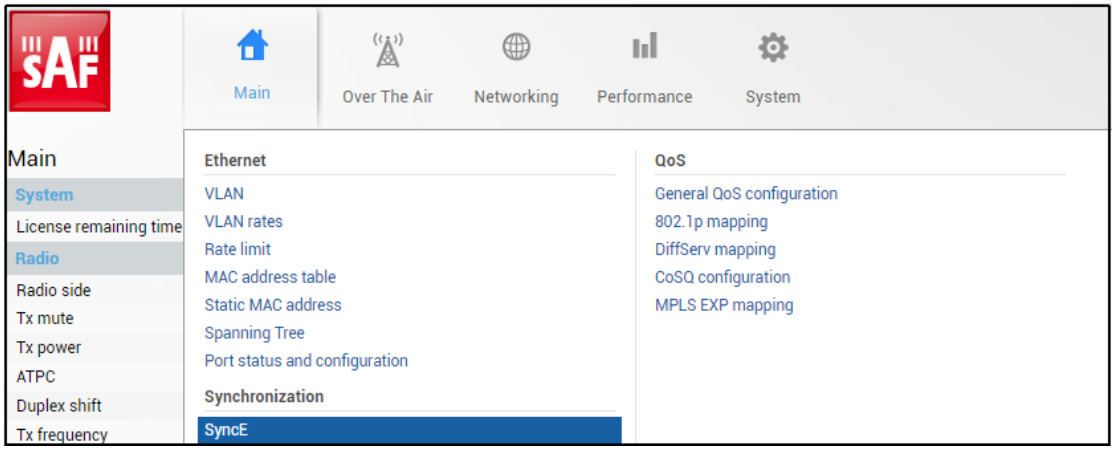
network port show info	Use to show the status of all ports.
network port show config	Use to show the configuration of all ports.
network port set <port> **admin-state** {enable|disable}	Use to enable or disable a particular port.
network port set LAN1 speed {auto|100fdx|100hdx|10fdx|10hdx}	Use to change speed and duplex setting on LAN1 port. The default value is "auto" (auto-negotiation).
network port set <port> **flow-control** {enable|disable}	Use to enable or disable flow control on a particular port.

Networking → Synchronization → SyncE

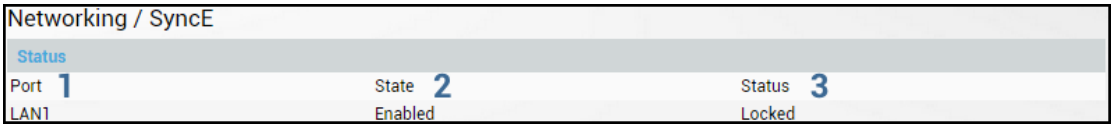
Synchronous Ethernet (SyncE) allows synchronizing the Ethernet switch clock to an external source clock by specifying an ingress port.

Incorrect SyncE configuration may result in a loss of connectivity.

Auto-negotiation ***will not*** function properly when the clock source ports on both Integra/Integra-S/Integra-G/Integra-G FODUs are pointing at each other (e.g. WAN-WAN in a link or LAN-LAN in a back-to-back connection).

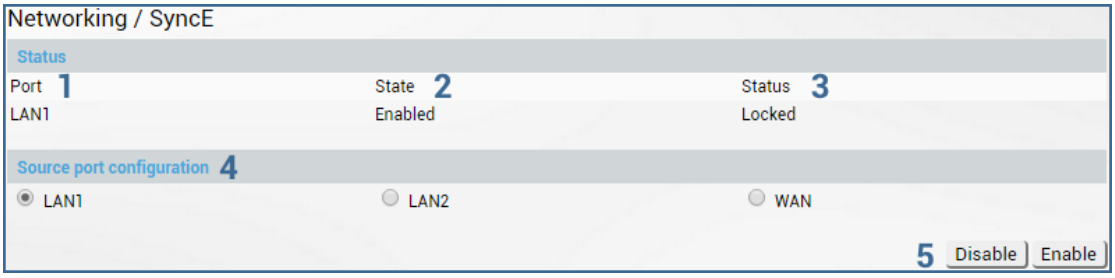


Status mode



Press MODIFY button.

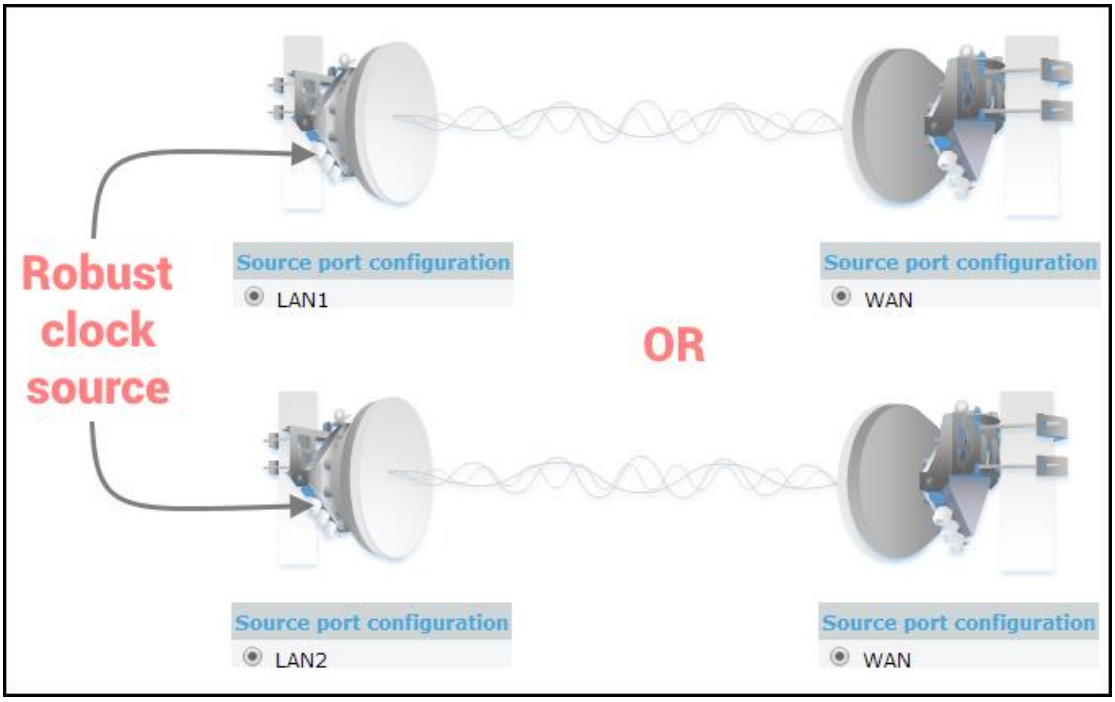
Modify mode



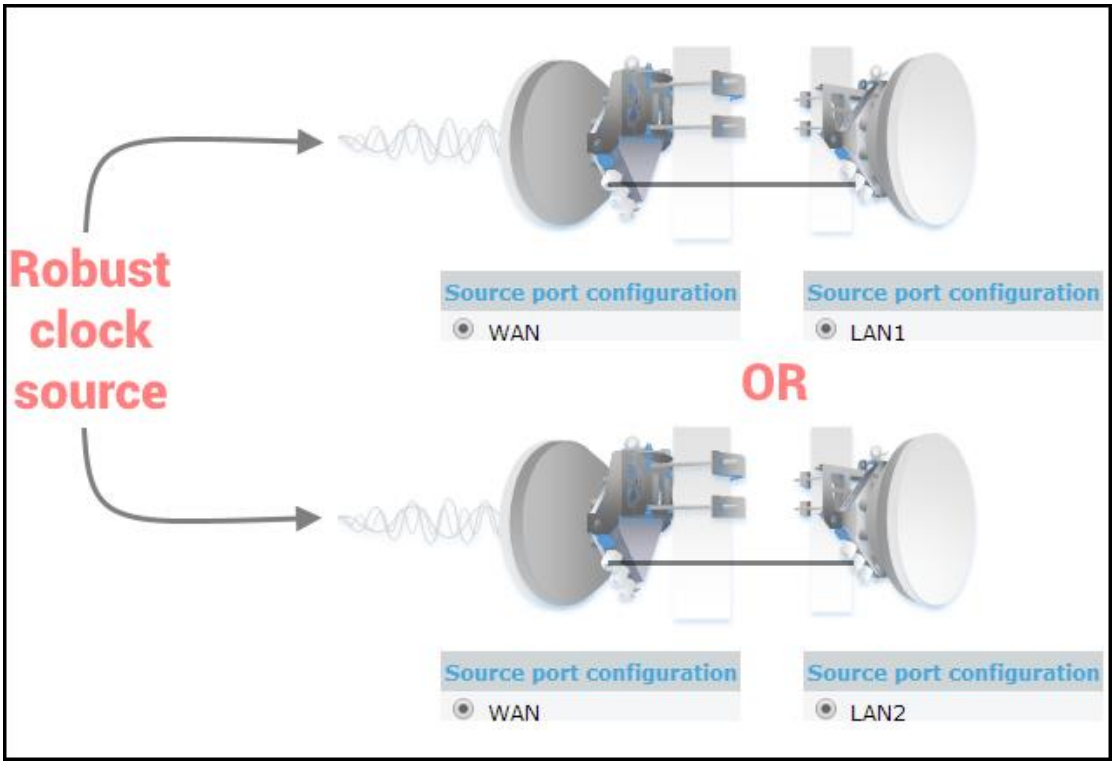
1) ***Port*** - Indicates SyncE source port (if enabled);
2) ***State*** – Indicates if SyncE is enabled.
3) ***Status*** – Indicates "Locked" if SyncE is operating normally.
4) ***Source port configuration*** – Allows specifying SyncE source port.
5) ***Disable/Enable*** – Allows enabling or disabling SyncE operation.

Configuration examples

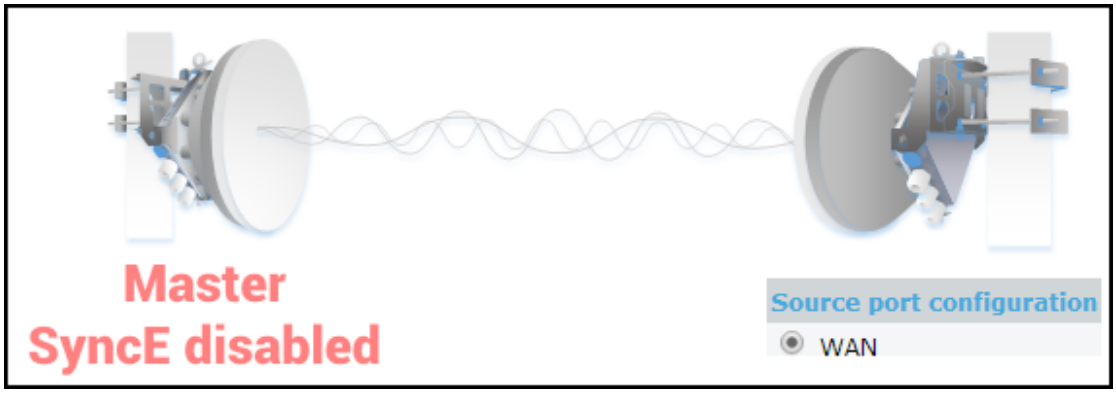
1) Integra/Integra-S/Integra-G/Integra-GS link with an external clock source.



2) Integra/Integra-S/Integra-G/Integra-GS back-to-back interconnection with an external clock source.



3) Integra/Integra-S/Integra-G/Integra-GS as a master clock source.



Auto-negotiation will not function properly when the clock source ports on both Integra/Integra-S/Integra-G/Integra-GS FODUs are pointing at each other (e.g. WAN-WAN in a link or LAN-LAN in a back-to-back connection).

SyncE will function properly on LAN2 and LAN3 ports only with appropriate SFP modules.

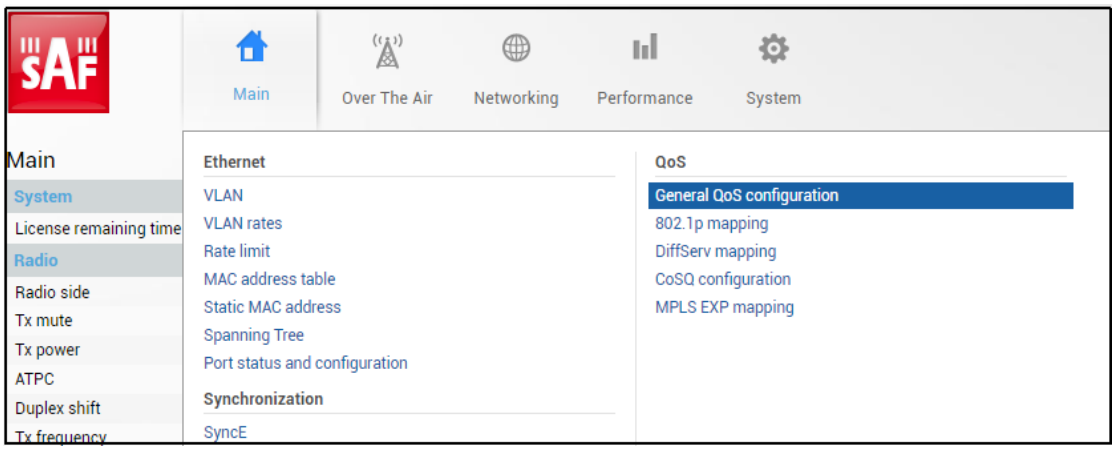
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

network sync enable {LAN1|LAN2|WAN}	Use to enable SyncE on a port connected to a clock source. The selected port will become “slave”, while other ports – “master”. Auto-negotiation will not function properly between two “slave” ports.
network sync disable	Use to disable SyncE on all ports.
network port show info	'SyncE_Act' and 'SyncE_Prio' field nonzero values indicate synchronous Ethernet activity.
network sync status	*Enabled* – shows if SyncE is enabled; *Polling failed* – indicates last data polling failure; *Speed Grade* – shows Ethernet speed on LAN1 port - 1000BASE-T(1G) or 100BASE-T(100M); *Port* – current port used as a clock source; *State* – clock status, "Locked" if SyncE operates normally; *State info* – additional information

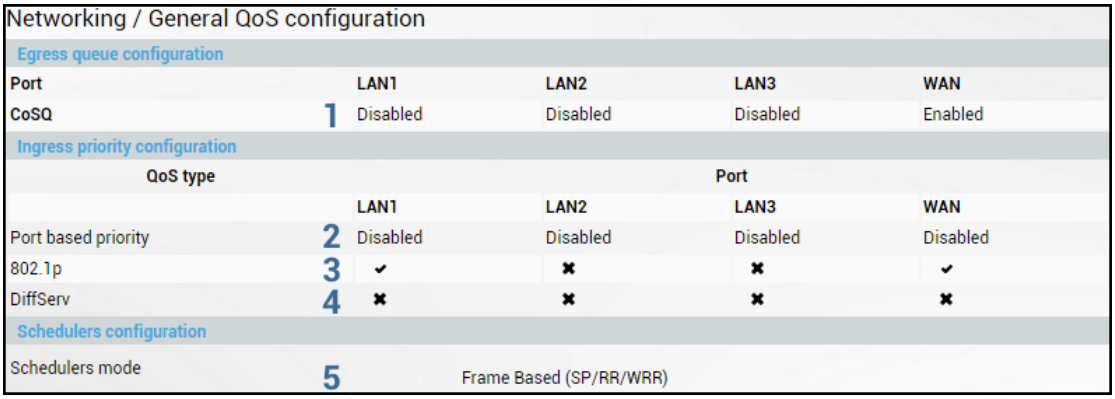
Networking → QoS → General QoS configuration

The General QoS configuration page allows defining QoS queueing rules.

Only one priority classification method (port/802.1p/DiffServ) can be enabled on a single port.

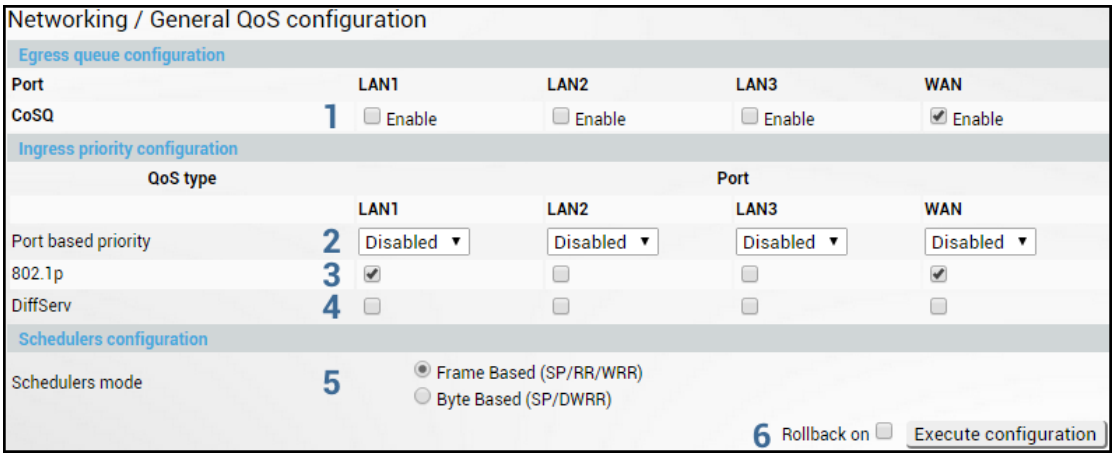


Status mode



Press MODIFY button.

Modify mode



1) ***CoSQ*** – Indicates whether CoSQ (Class of Service Queue) is enabled on the egress direction of a particular port (status mode); allows enabling or disabling CoSQ on available ports (modify mode). CoSQ is enabled by default on the WAN port.

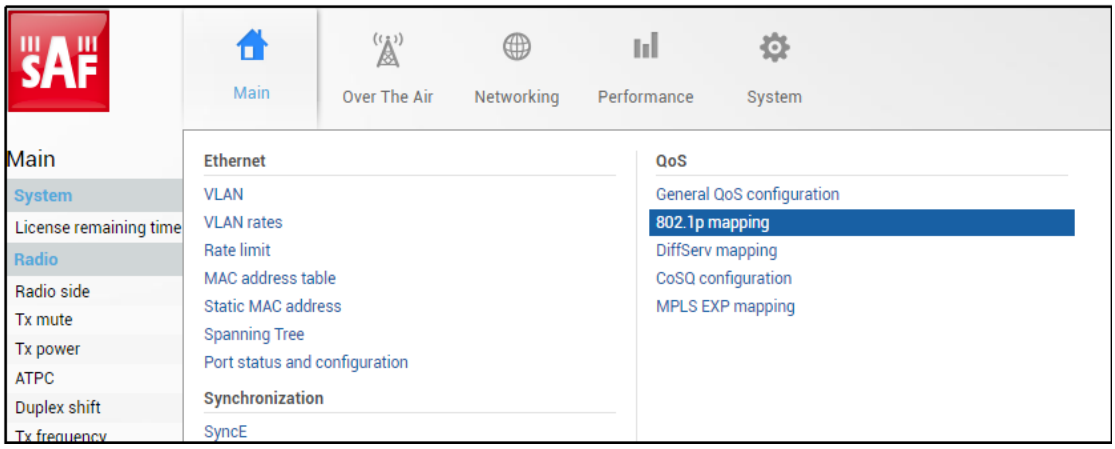
2) ***Port based priority*** – Indicates whether port-based prioritization is enabled (status mode); allows enabling or disabling port-based prioritization on available ports (modify mode). If enabled all packets on the egress of a port are put in a specified queue. 802.1p (PCP) and DiffServ (DSCP) values 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 mapping is enabled (status mode); allows enabling or disabling 802.1p mapping on available ports (modify mode). If enabled configured mapping (Networking → QoS → 802.1p mapping) is taken into account.
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 (Networking → QoS → DiffServ mapping).
5) ***Schedulers mode*** – Indicates whether frame-based (SP/RR/WRR – Strict Priority/Round Robin/Weighted Round Robin) or byte-based scheduling schemes (SP/DWRR – Strict Priority/Deficit Weighted Round Robin) are available (status mode); allows switching between frame-based to byte-based scheduling schemes (modify mode). A specific scheduling scheme can be set in Networking → QoS → CoSQ configuration. The scheduler's mode specifies how frames are handled at egress flow. DWRR compared to WRR is configured in kilobytes (KB), rather than the number of frames passed. The default setting is the frame-based mode.
6) By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

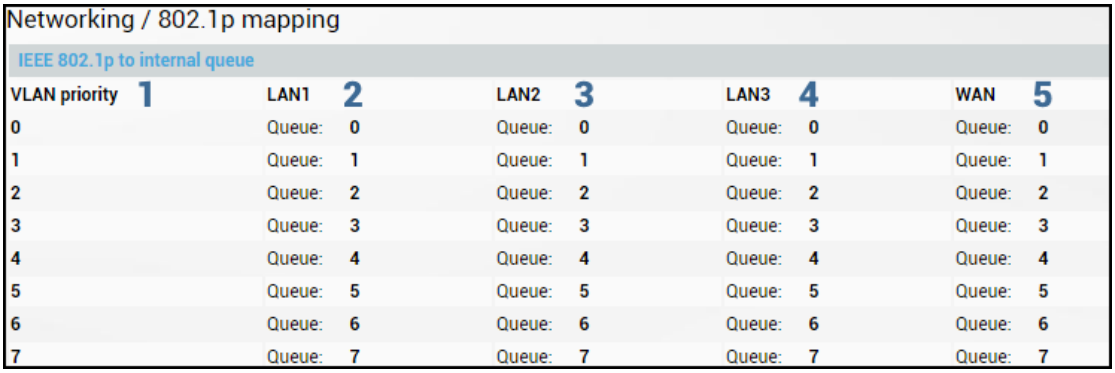
network qos set <port> **cosq state** {enable|disable}	Use to enable or disable CoSQ priority queues on a particular port.
network qos set <port> **vlan state** {enable|disable}	Use to enable or disable ingress 802.1p mapping on a particular port.
network qos set <port> **diffserv state** {enable|disable}	Use to enable or disable ingress DiffServ mapping (DSCP) on a particular port.
network qos reset config {LAN1|LAN2|LAN3|WAN|all}	Use to reset QoS configuration on a particular port or all ports simultaneously.
network qos set <port> **base state** {enable|disable}	Use to enable or disable port-based priorities.
network qos set <port> **base priority** <0…7>	Use to specify the queue of port-based priority.
network qos set sched_mode {frame|byte}	Use to select the scheduler's mode – frame (SP/RR/WRR) or byte (SP/DWRR).
network qos show config {LAN1|LAN2|LAN3|WAN|all}	Use to show QoS user configuration.
network qos show info {LAN1|LAN2|LAN3|WAN|all}	Use to show the actual status of QoS configuration.
network qos show sched_mode	Use to show CoSQ Scheduling Mode.

Networking → QoS → 802.1p mapping

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

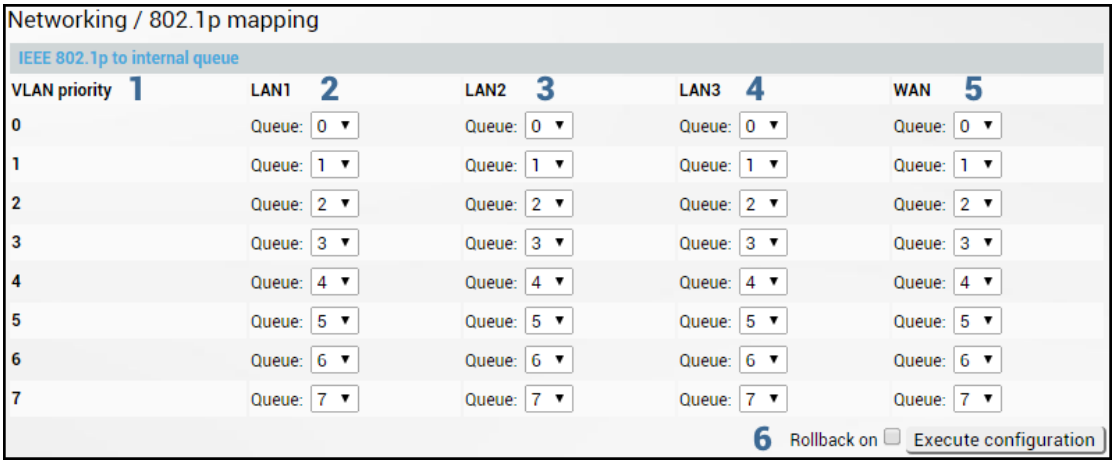


Status mode



Press MODIFY button.

Modify mode



1) ***VLAN priority*** – Indicates PCP (Priority Code Point) values 0 – 7.
2) ***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).

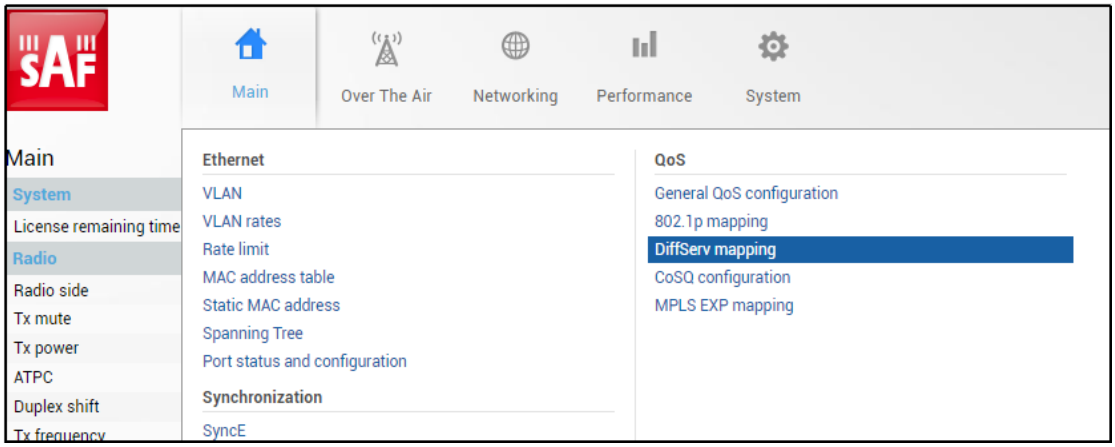
3) ***LAN2*** – Indicates to which egress queue packets will, according to 802.1p priority, be put in if 802.1p QoS prioritization is enabled on LAN2 port (status mode); allows modifying default mapping of priority values and queues (modify mode).
4) ***LAN3*** – Indicates to which egress queue packets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

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

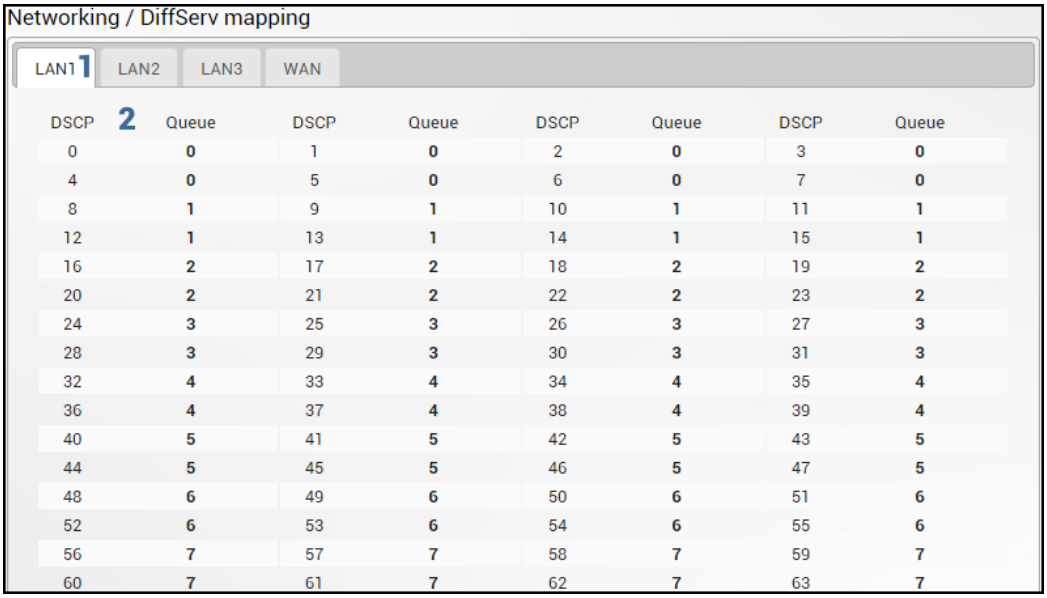
network qos set <port> **vlan priority** <0..7> **priority** <0..7>	Use to change default 802.1p priority mapping.

Networking → QoS → DiffServ mapping

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

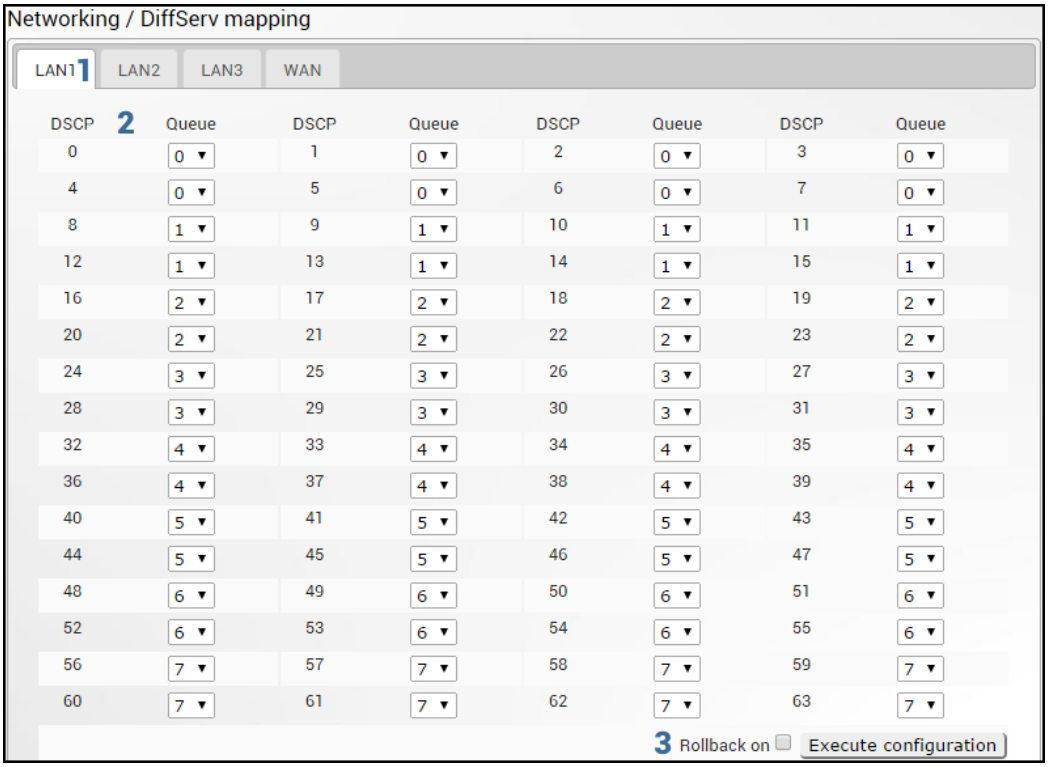


Status mode



Press MODIFY button.

Modify mode



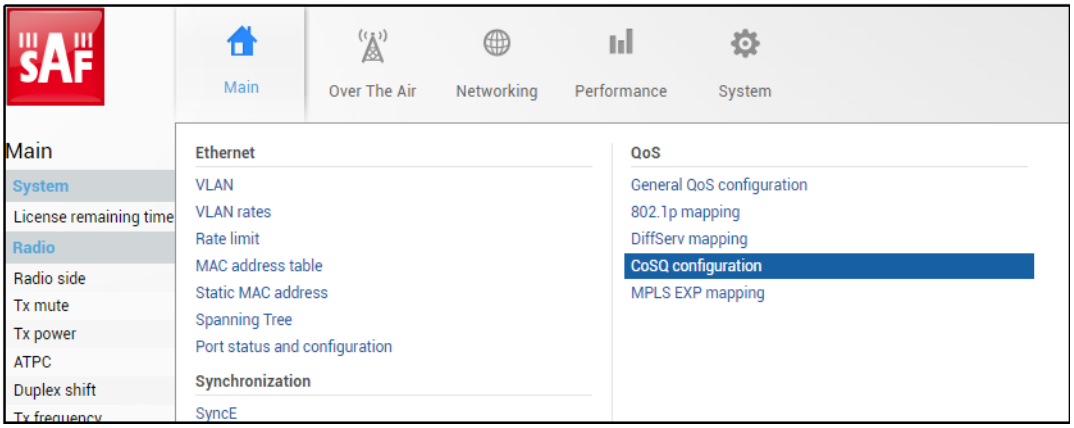
1) ***LAN1/LAN2/LAN3/WAN*** – Tabs allow selecting a particular port.
2) The table shows the mapping between DSCP values and CoS queues (status mode); allows modifying the default mapping of DSCP priority values and queues (modify mode).
3) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

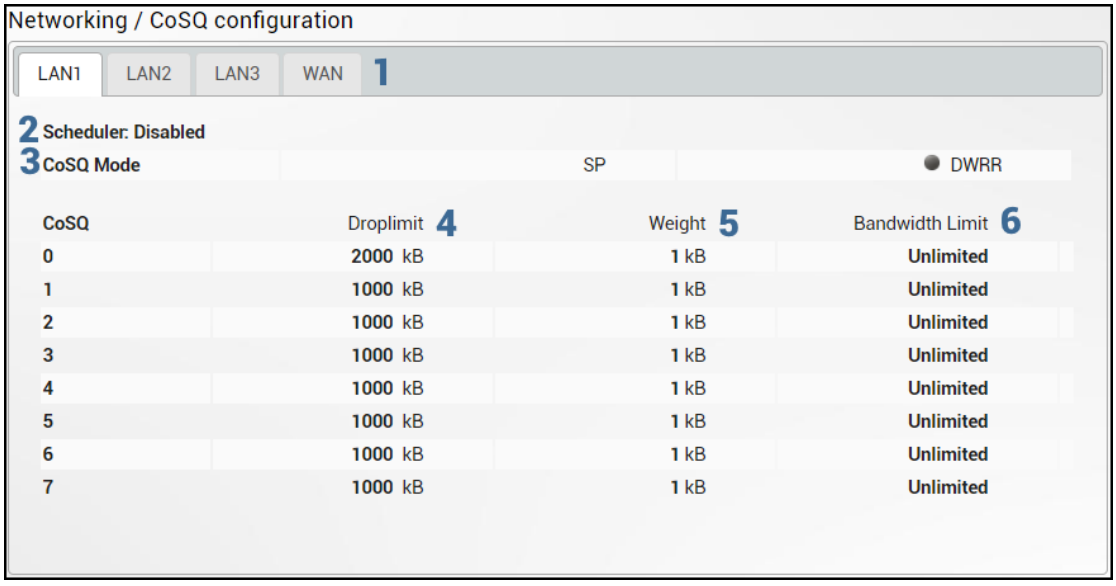
network qos set <port> **diffserv dscp** <0..63> **priority** <0..7>	Use to change default DiffServ priority (DSCP) mapping.

Networking → QoS → CoSQ configuration

The CoSQ configuration page allows modifying droplimit (buffer) size, queue weights or sizes (depending on queueing), and queueing scheduler. On the WAN port, it is possible to enable packet fragmentation and interleaving (by disabling low latency queues).

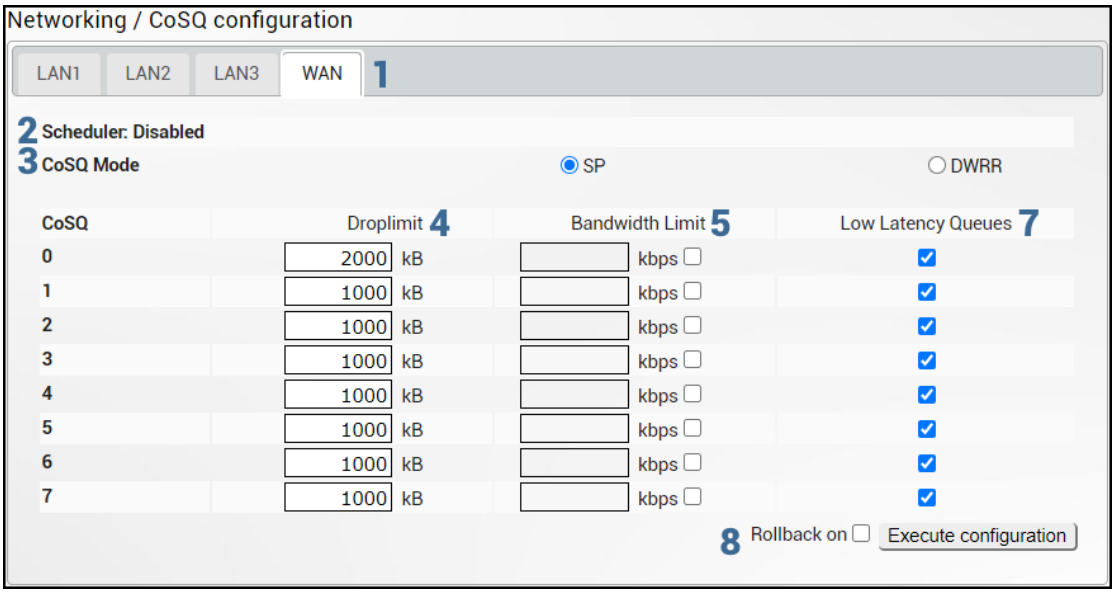


Status mode



Press MODIFY button.

Modify mode



1) ***LAN1/LAN2/LAN3/WAN*** – Tabs allow selecting a particular port.
2) ***Scheduler*** – Indicates whether CoSQ scheduler is enabled on the particular port. Corresponds to the "CoSQ" setting in the Networking → QoS → General QoS configuration page.
3) ***CoSQ Mode*** – Indicates which CoSQ scheduler mode is set on a particular port (status mode); allows setting Strict Priority (SP); Round Robin (RR) or Weighted Round Robin (WRR) if "Frame Based (SP/RR/WRR)" schedulers mode is set or Strict Priority (SP) or Deficit Weighted Round Robin (DWRR) if "Byte Based (SP/DWRR)" is set in Networking → QoS → General QoS configuration (modify mode).
   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 droplimit buffers of all available queues.
   WRR – scheduler drains all queues consecutively according to the specified ratio (queue weights) specified in a number of packets. The 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 (queue weights) 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. Default ratio is equal for all queues (1:1:1:1:1:1:1:1).
4) ***Droplimit*** – Indicates droplimit buffer size assigned for each queue (status mode); allows modifying droplimit buffer size for each queue (modify mode). By default, a 2000KB droplimit buffer size is assigned for queue #0 (lowest priority) and 1000KB for all other queues. Maximum size 4000KB.

⚠ Increasing buffer size increases data transmission latency.

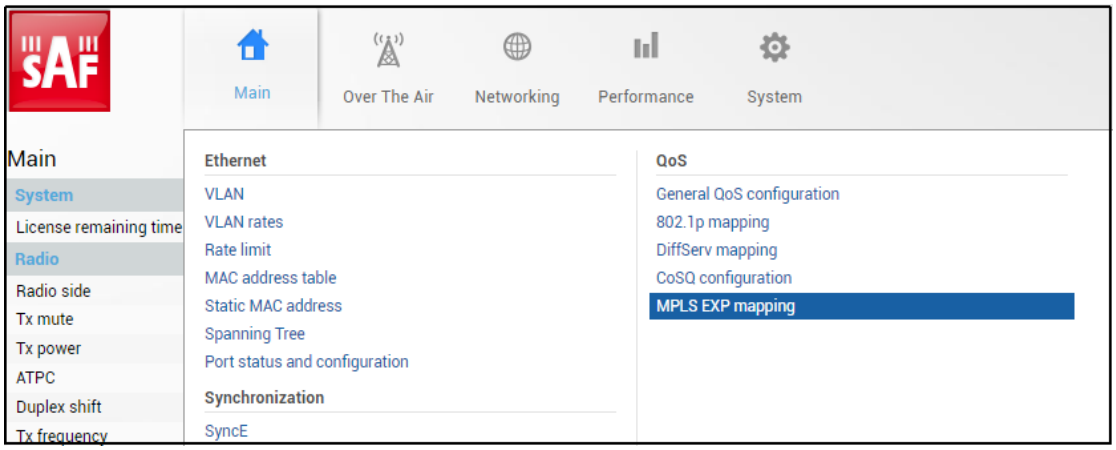
5) ***Weight*** – Indicates weights in packets or kilobytes configured for WRR or DWRR respectively (status mode); allows configuring weights in packets or kilobytes for WRR or DWRR respectively (modify mode). The default weight is set to "1" for each queue. The value range is 1..255.
6) ***Bandwidth limit*** – Indicates whether the rate limit is enabled on any of the available queues (status mode); allows specifying rate limit value on any of the available queues (modify mode). The bandwidth limit is available only on LAN ports.
7) ***Low latency queues*** – Indicates whether modem low latency queue is enabled for the priority queues (status mode); allows disabling low latency queues, thus enabling packet fragmentation and interleaving (modify mode). Please refer to Chapter Fragmentation and interleaving for further details. Low latency queues are available only on the WAN port.
8) By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

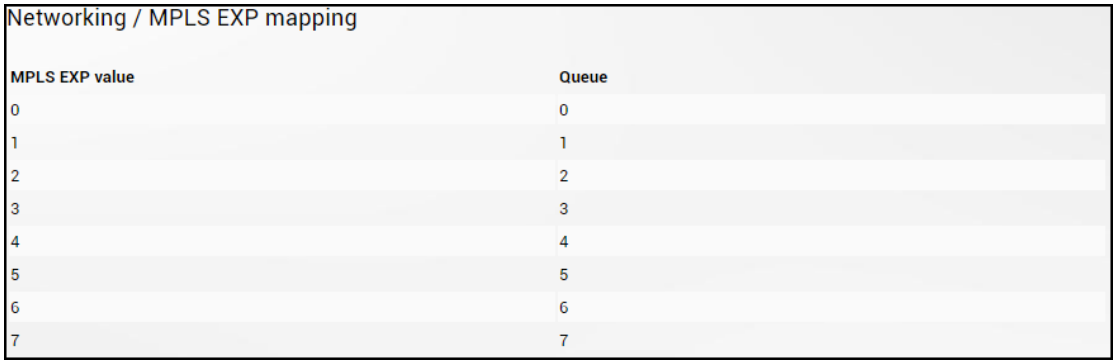
network qos set <port> **cosq scheduler mode** {sp|{{rr|wrr}|dwrr}}	Use to set CoSQ scheduler mode on a particular port.
network qos set <port> **cosq scheduler weight** <1..255> **queue** <0..7>	Use to assign a weight for a particular queue #. CoSQ scheduler should be enabled for that particular port and CoSQ scheduler mode should be set to WRR or DWRR.
network qos set <port> **cosq droplimit** <0..4000KB>	Use to set droplimit buffer size for a particular port.
network qos set WAN cosq lowlatency {enable|disable} **queue** <0..7>	Use to enable or disable low latency queue, thus disabling or enabling packet fragmentation. This functionality is available for WAN port only and by default low latency queues are enabled therefore packet fragmentation is disabled.
network qos show info {LAN1|LAN2|LAN3|WAN|all}	Use to show the actual status of QoS configuration.

Networking → QoS → MPLS EXP mapping

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

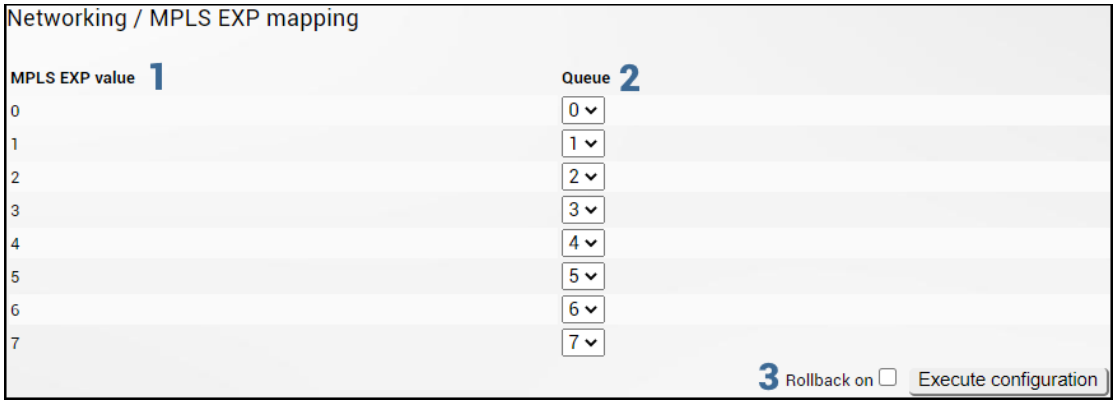


Status mode



Press MODIFY button.

Modify mode

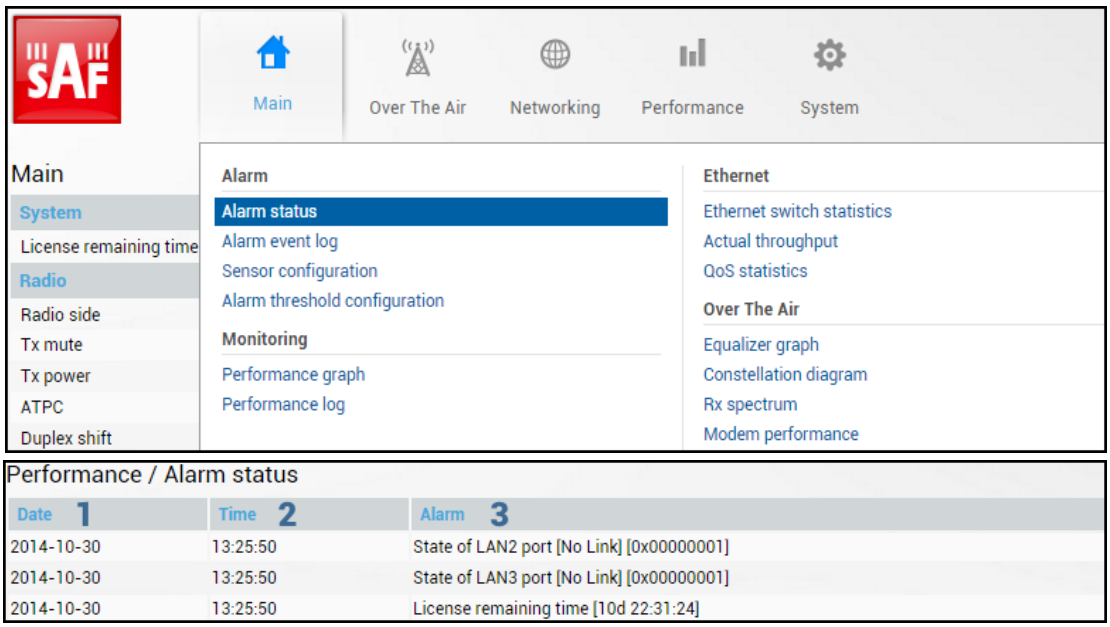


1) ***MPLS EXP value*** – Indicates MPLS EXP values 0 – 7;
2) ***Queue*** – Indicates to which egress queue will packets with according MPLS EXP value be put (status mode); allows modifying default mapping of MPLS EXP values and queues (modify mode).
3) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS. If *„Rollback on"* is selected, the configuration will be reverted in case erroneous configuration changes are applied.

Performance

Performance → Alarm → Alarm status

Alarm status 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)

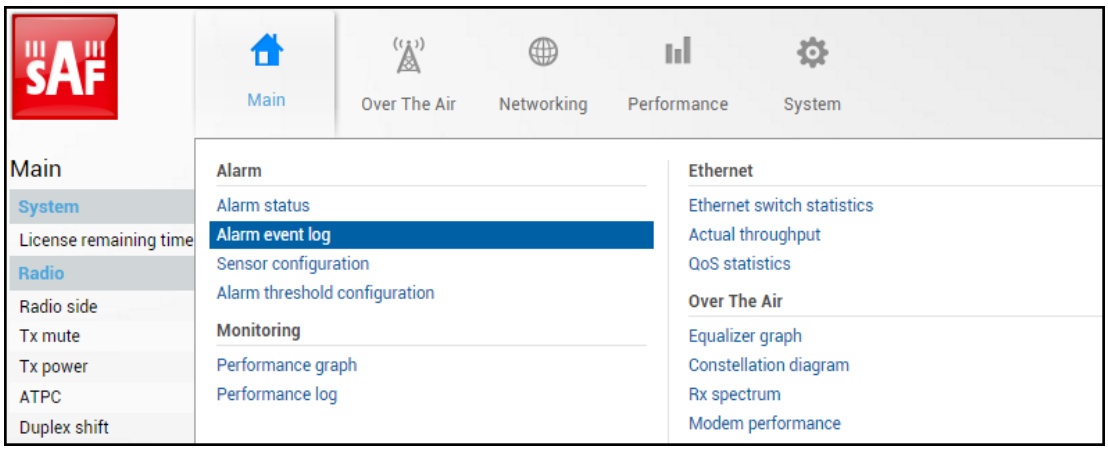
log sensor setlist	Use to show alarm status.

Performance → Alarm → Alarm event log

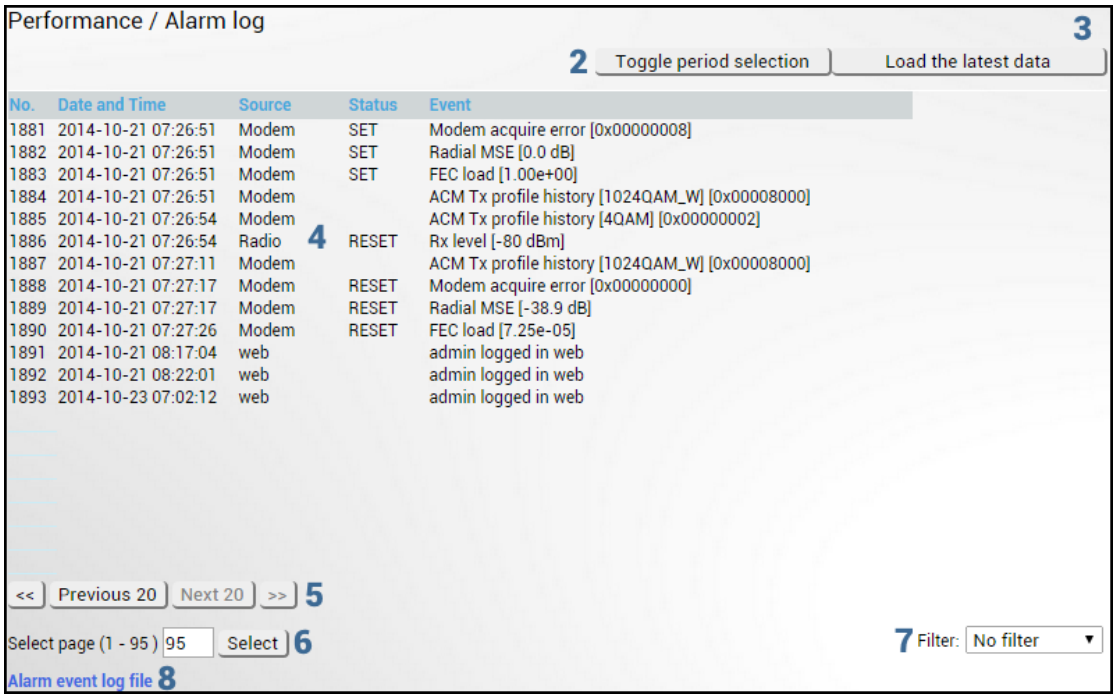
Alarm event log shows 20 alarm entries per page and about 5000 alarm entries in total. The full alarm log can be downloaded by pressing on "*Alarm event log file*". The last page of log entries is shown by default.

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.

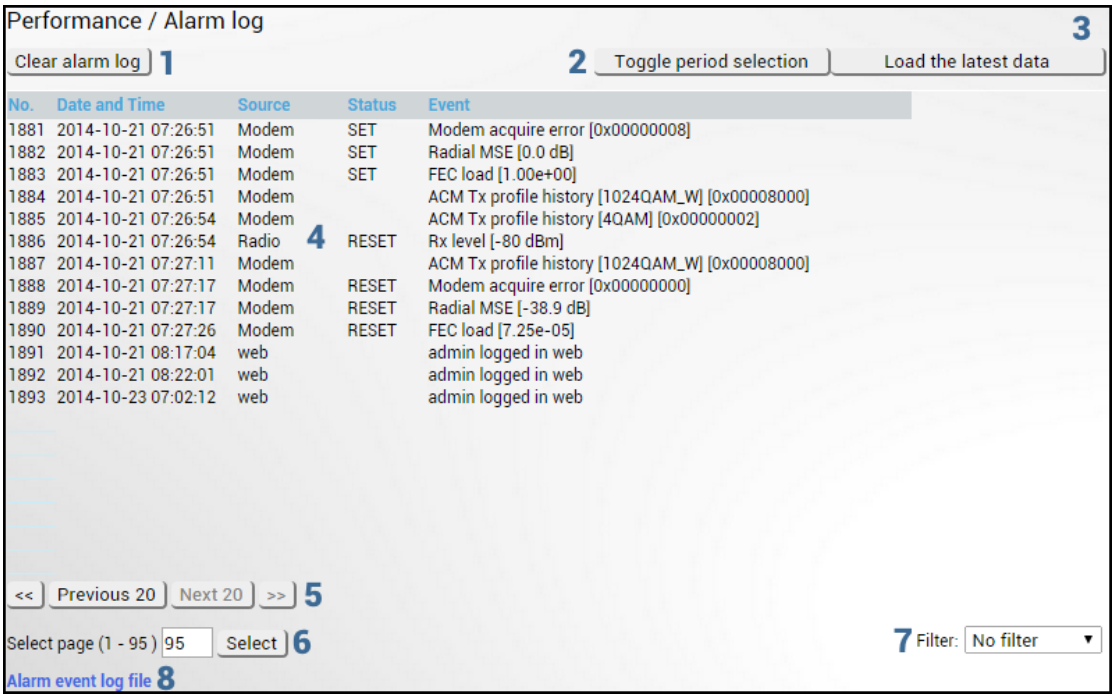

Main
Over The Air
Networking
Performance
System
Main
System
License remaining time
Radio
Radio side
Tx mute
Tx power
ATPC
Duplex shift
Alarm
Alarm status
Alarm event log
Sensor configuration
Alarm threshold configuration
Monitoring
Performance graph
Performance log
Ethernet
Ethernet switch statistics
Actual throughput
QoS statistics
Over The Air
Equalizer graph
Constellation diagram
Rx spectrum
Modem performance

Status mode

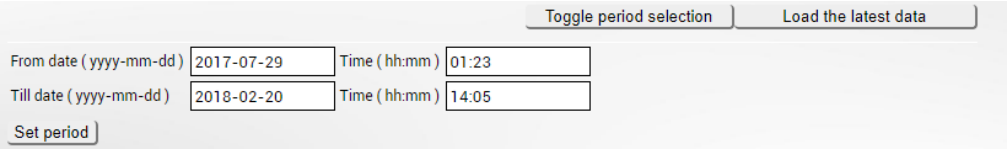

Performance / Alarm log
3
2
Toggle period selection
Load the latest data
No. Date and Time Source Status Event
1881 2014-10-21 07:26:51 Modem SET Modem acquire error [0x00000008]
1882 2014-10-21 07:26:51 Modem SET Radial MSE [0.0 dB]
1883 2014-10-21 07:26:51 Modem SET FEC load [1.00e+00]
1884 2014-10-21 07:26:51 Modem ACM Tx profile history [1024QAM_W] [0x00008000]
1885 2014-10-21 07:26:54 Modem ACM Tx profile history [4QAM] [0x00000002]
1886 2014-10-21 07:26:54 Radio 4 RESET Rx level [-80 dBm]
1887 2014-10-21 07:27:11 Modem ACM Tx profile history [1024QAM_W] [0x00008000]
1888 2014-10-21 07:27:17 Modem RESET Modem acquire error [0x00000000]
1889 2014-10-21 07:27:17 Modem RESET Radial MSE [-38.9 dB]
1890 2014-10-21 07:27:26 Modem RESET FEC load [7.25e-05]
1891 2014-10-21 08:17:04 web admin logged in web
1892 2014-10-21 08:22:01 web admin logged in web
1893 2014-10-23 07:02:12 web admin logged in web
<< Previous 20 Next 20 >> 5
Select page (1 - 95) 95 Select 6
7 Filter: No filter
Alarm event log file 8

Press MODIFY button.

Modify mode



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



3) ***Load the latest data*** – refreshes alarm log and shows last 20 log entries.
4) List of alarm log entries – entry number, date and time, source node, 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 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" refer to the commands above

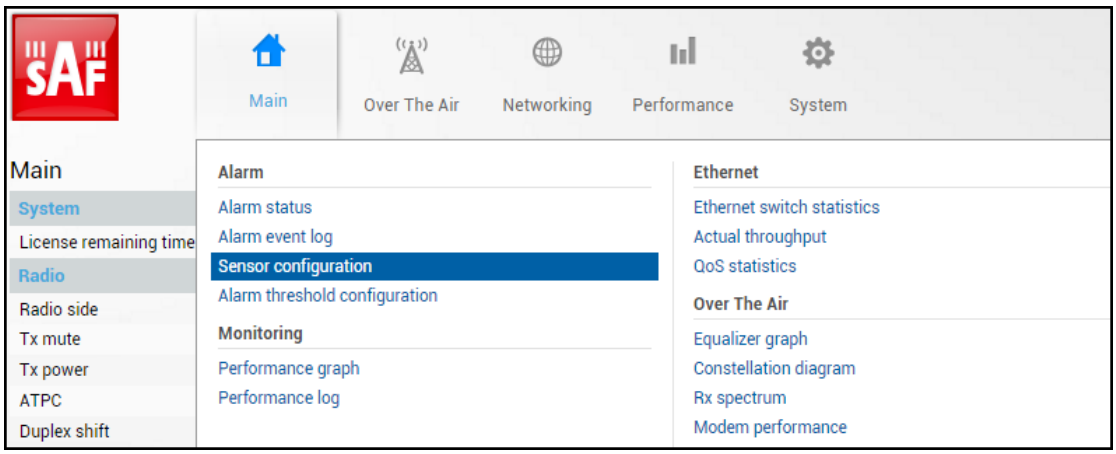
log event show module {modem| psu | radio | system | alarm_only | iman} [last <#_of_entries>] [time <starttime> [<endtime]]	Use to show entries for a specific module. Regarding subcommands "last" and "time" refer to the commands above
log event clear	Use to clear alarm log
log event configure {enable|disable}	Use to enable or disable the event log filter
log event configure dump <1…60>	Use to configure duration in minutes during which filter is monitoring 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)

Performance → Alarm → Sensor configuration

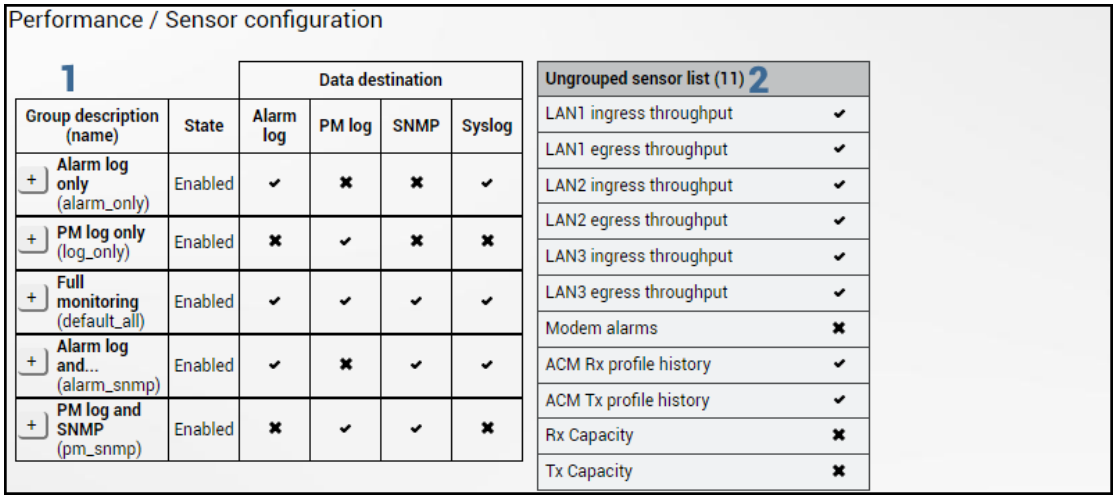
The following section allows for specifying the behavior of available sensor parameters.

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

It is not recommended to add "License remaining time" sensor parameter to performance ("perfd") type parameters.

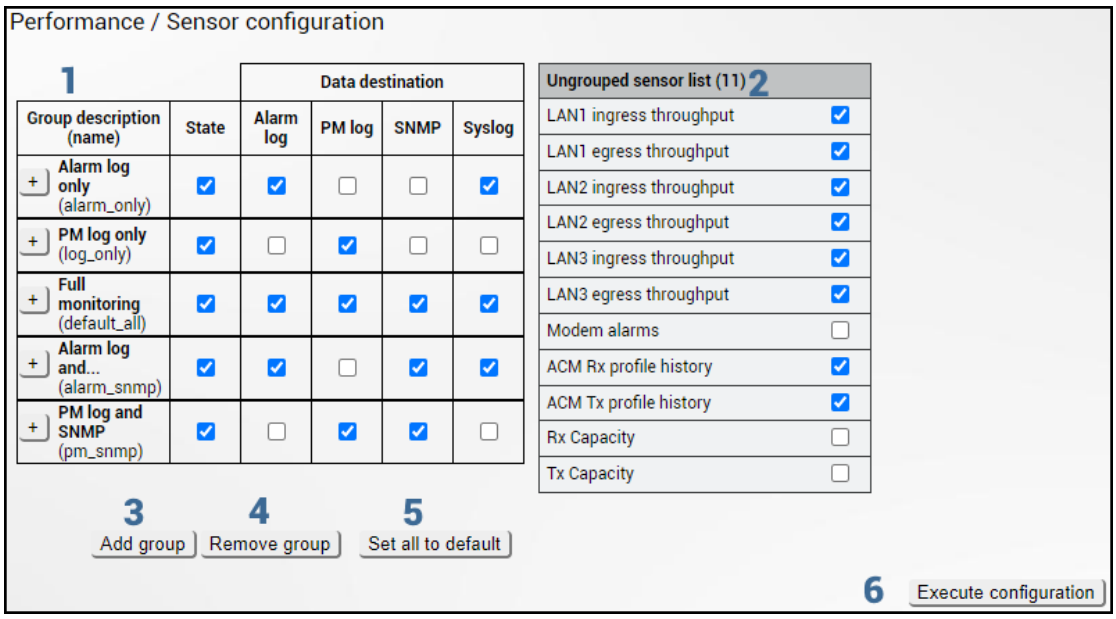


Status mode

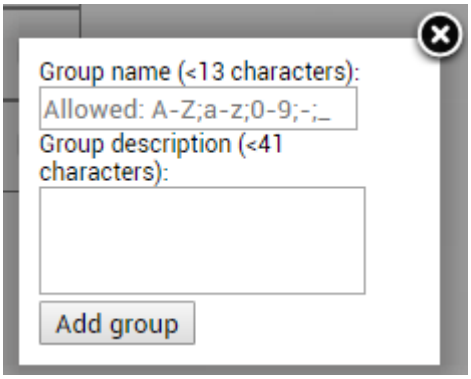


Press MODIFY button.

Modify mode

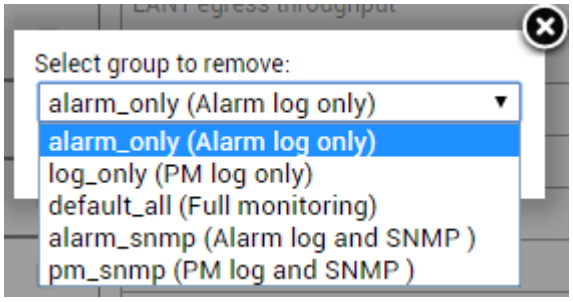


1) ***Group description (name)*** – Shows 5 groups of sensors divided by different group data destinations (event; perf; snmp), as well as indicates whether the group is enabled (State);
2) ***Ungrouped sensor list*** – Shows the list of sensors not added to any of the existing groups (status mode); 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) ***Add group*** – Allows creating a new group with a custom name and description.



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

4) ***Remove group*** – Allows deleting existing groups via a dialog window.



5) ***Set all to default*** – Restores default settings for all groups and sensors.
6) By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS.

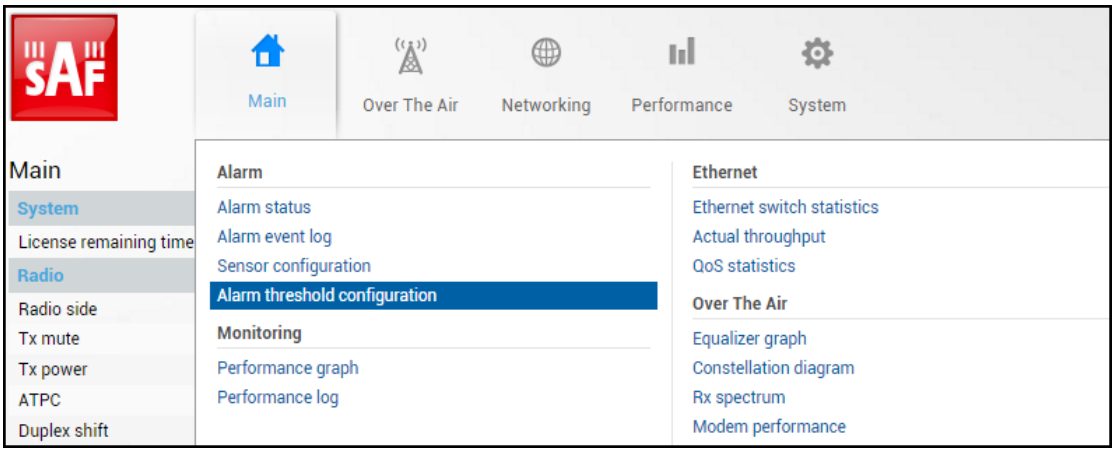
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

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 current sensor status.
log sensor list	Use to list all available sensors.
log default {all|group|sensors [<sensor>]}	Use to set 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.

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



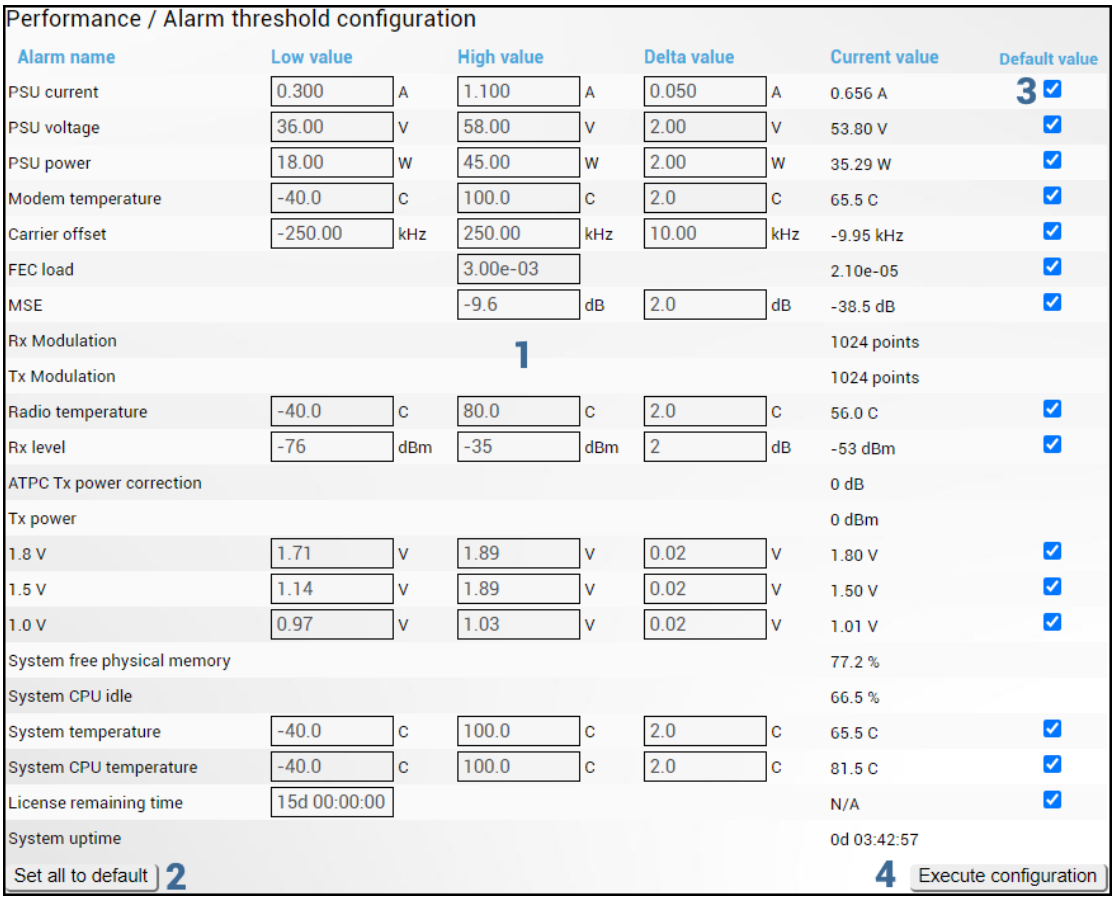
Status mode

Performance / Alarm threshold configuration

Alarm name	Low value	High value	Delta value	Current value
PSU current	0.300 A	1.100 A	0.050 A	0.656 A
PSU voltage	36.00 V	58.00 V	2.00 V	53.80 V
PSU power	18.00 W	45.00 W	2.00 W	35.29 W
Modem temperature	-40.0 C	100.0 C	2.0 C	66.0 C
Carrier offset	-250.00 kHz	250.00 kHz	10.00 kHz	-7.35 kHz
FEC load		3.00e-03		2.41e-05
MSE		-9.6 dB	2.0 dB	-38.6 dB
Rx Modulation				1024 points
Tx Modulation				1024 points
Radio temperature	-40.0 C	80.0 C	2.0 C	56.0 C
Rx level	-76 dBm	-35 dBm	2 dB	-53 dBm
ATPC Tx power correction				0 dB
Tx power				0 dBm
1.8 V	1.71 V	1.89 V	0.02 V	1.80 V
1.5 V	1.14 V	1.89 V	0.02 V	1.50 V
1.0 V	0.97 V	1.03 V	0.02 V	1.00 V
System free physical memory				77.2 %
System CPU idle				80.9 %
System temperature	-40.0 C	100.0 C	2.0 C	66.0 C
System CPU temperature	-40.0 C	100.0 C	2.0 C	80.9 C
License remaining time	15d 00:00:00			N/A
System uptime				0d 03:38:52

Press MODIFY button.

Modify mode



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/Integra-S/Integra-G/Integra-GS.

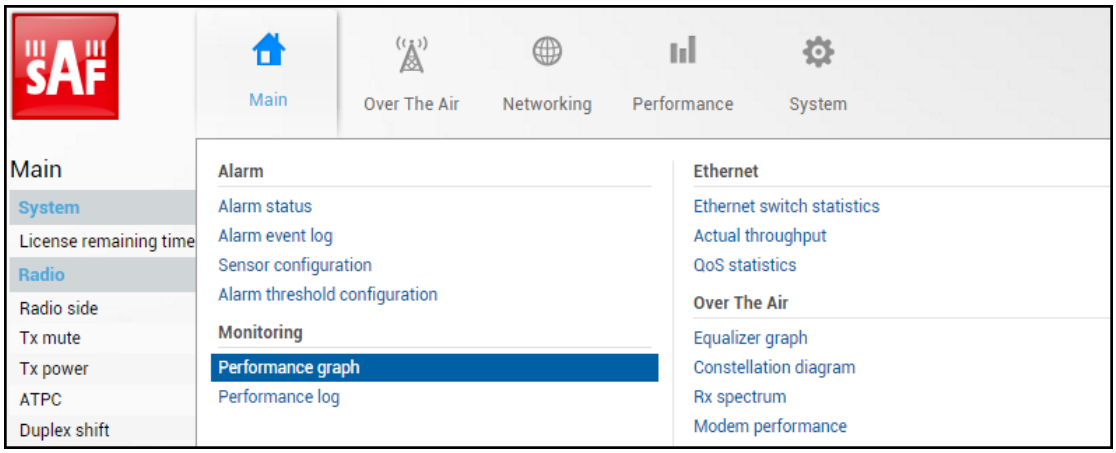
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

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

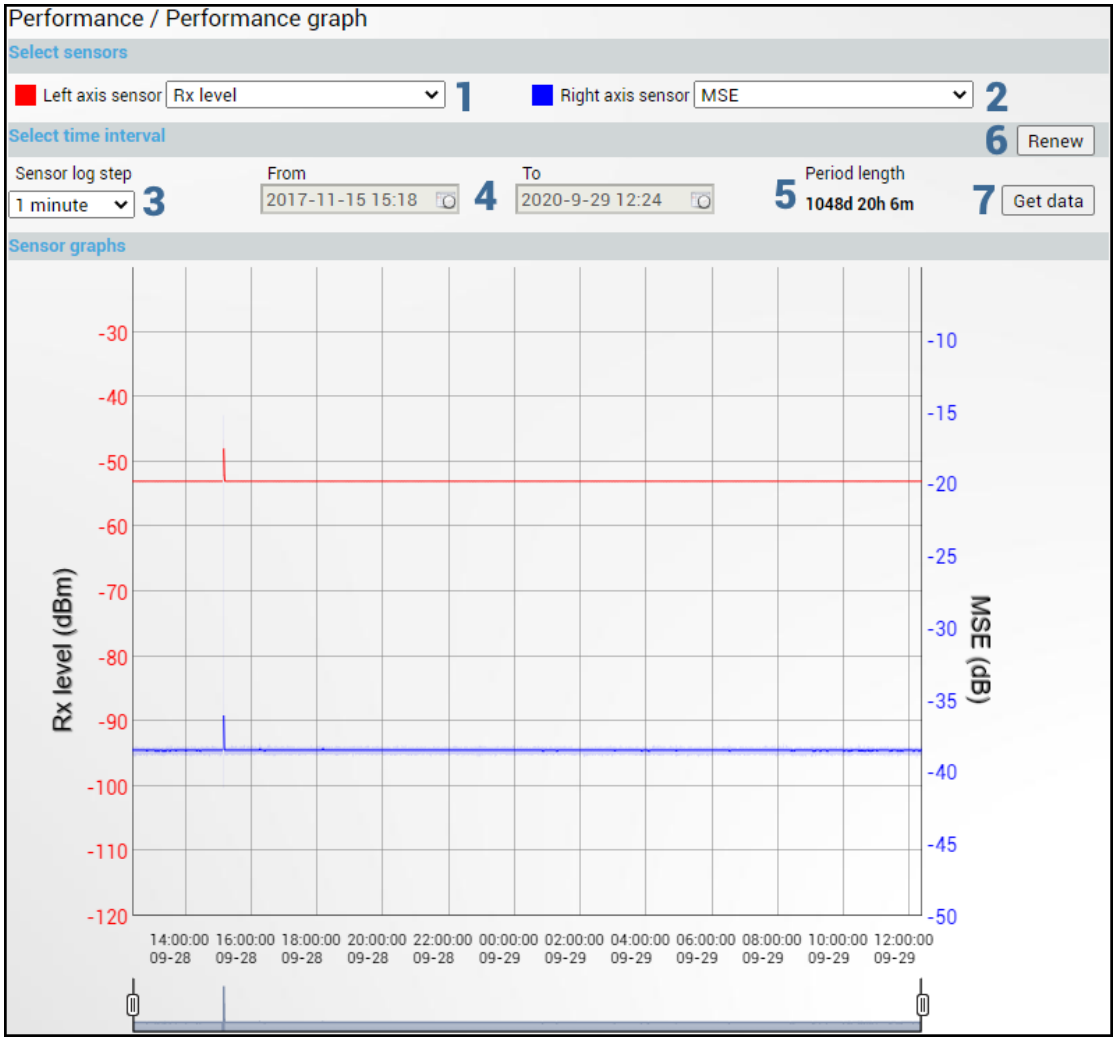
Performance → Monitoring → Performance graph

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

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



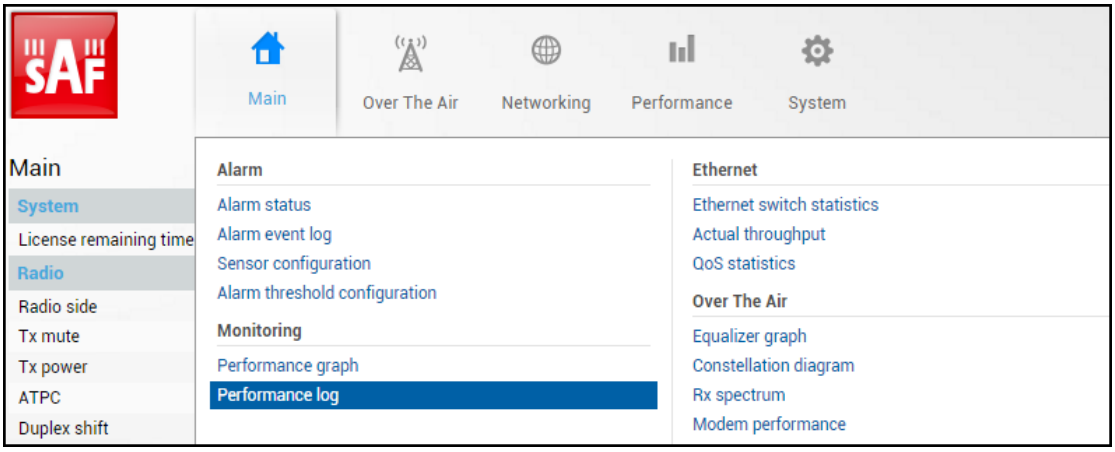
MODIFY button is deactivated in the Performance graph page.



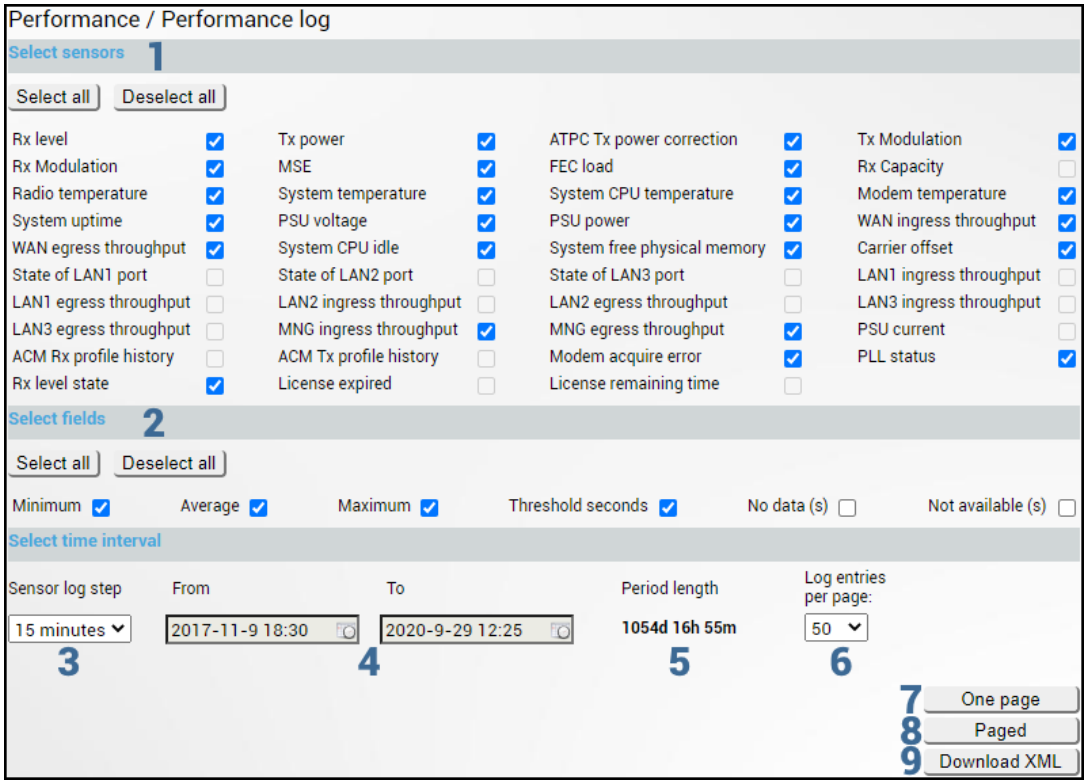
1) ***Left axis sensor*** – Allows choosing a sensor parameter colored in red and displayed on the left axis.
2) ***Right axis sensor*** – Allows choosing a sensor parameter colored in blue and displayed on the right axis.
3) ***Sensor log step*** – Allows choosing graph granularity – 1, 15, or 60 minutes.
4) Indicates start and end date/time of period displayed and allows selecting a specific period to show.
5) ***Period length*** – Indicates the length of the currently displayed period.
6) ***Renew*** – Press to show the most recent data.
7) ***Get data*** – Press to apply selected time interval changes.
8) Left and right sliders allow you to "zoom" the currently selected time period.

Performance → Monitoring → Performance log

Allows viewing and downloading performance log.



MODIFY button is deactivated on the Performance log page.



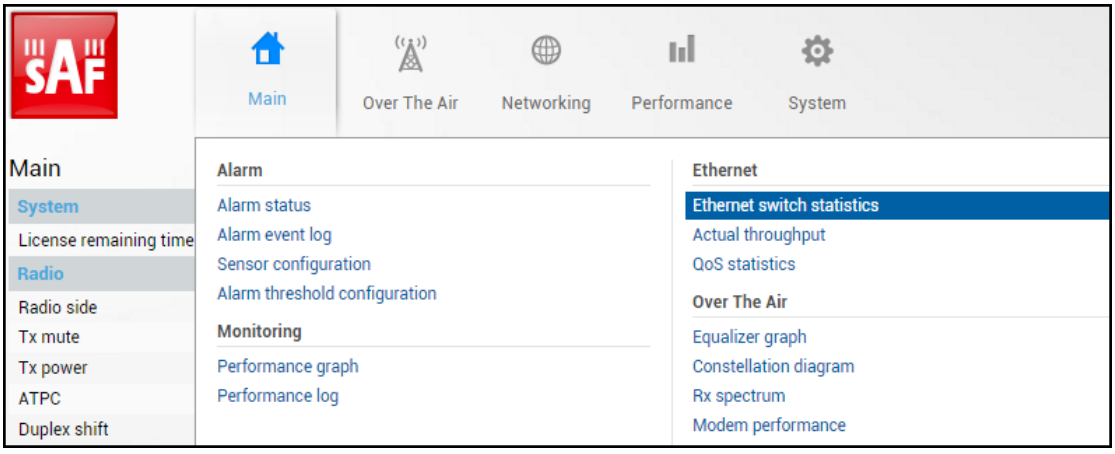
1) ***Select sensors*** – Allows choosing the sensor parameters to be displayed in the performance log.
2) ***Select fields*** – Allows choosing the parameter fields to be displayed in the performance log. “Minimum” and “Maximum” represent the minimum and maximum values in the specified sensor log step, while “Average” displays the average value; “Threshold seconds” will show the number amount of seconds in a chosen time interval when the parameter exceeded minimum or maximum alarm thresholds; “No data (s)” and “Not available (s)” show respectively the time when there was no data of according parameter and it was not available.
3) ***Sensor log step*** – Allows choosing log step – 1, 15, or 60 minutes.
4) Indicates start and end date/time of 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 for 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 {1M|15M|60M} **show last** <1…1440> <sensor>	Use to show a specified number of last performance log entries with the specified sensor log step.
log perf {1M|15M|60M} **show 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 performance log.

Performance → Ethernet → Ethernet switch statistics

Shows Ethernet switch statistics on all available switch ports.



Status mode

Performance / Ethernet switch statistics

		LAN1	LAN2	LAN3	WAN	MNG
Statistics for	1	0d 01:25:09	0d 01:25:09	0d 01:25:10	0d 01:25:10	0d 01:25:10
Ingress Pkts.	2	1219	0	0	30656	42283
Ingress Bytes	3	278098	0	0	41682836	44127807
Egress Pkts.	4	1517	0	0	31201	42009
Egress Bytes	5	1562130	0	0	41861499	42866069
Total Multicast Pkts.	6	345	0	0	N/A	32776
Total Broadcast Pkts.	7	231	0	0	N/A	0
Total Pkts. 64 Octets	8	833	0	0	N/A	20861
Total Pkts. 65 to127 Octets	9	256	0	0	N/A	1087
Total Pkts. 128 to 255 Octets	10	291	0	0	N/A	283
Total Pkts. 256 to 511 Octets	11	190	0	0	N/A	199
Total Pkts. 512 to 1023 Octets	12	214	0	0	N/A	10331
Total Pkts. 1024 to 1518 Octets	13	952	0	0	N/A	15
Total Oversize Pkts.	14	0	0	0	N/A	51514
Rx Oversize Pkts.	15	0	0	0	0	26219
Tx Oversize Pkts.	16	0	0	0	25270	25295
Total Octets	17	1840228	0	0	N/A	86993812
Total Pkts.	18	2736	0	0	N/A	84292
Tx No Errors	19	1517	0	0	N/A	42009
Rx No Errors	20	1219	0	0	N/A	42283
Total Pkts. 1519 to 1522 Octets	21	0	0	0	N/A	0
In. Octets	22	278098	0	0	N/A	44127807
Out. Octets	23	1562130	0	0	N/A	42866069
Dot1 Port In Frames	24	1219	0	0	N/A	42283
Dot1 Port Out Frames	25	1517	0	0	N/A	42009
Received Pkts. 64 Octets	26	493	0	0	0	10435
Transmitted Pkts. 64 Octets	27	340	0	0	302	10428
Received Pkts. 65 to 127 Octets	28	236	0	0	0	352
Transmitted Pkts. 65 to 127 Octets	29	20	0	0	267	735
Received Pkts. 128 to 255 Octets	30	284	0	0	0	7
Transmitted Pkts. 128 to 255 Octets	31	7	0	0	276	276
Received Pkts. 256 to 511 Octets	32	18	0	0	0	173
Transmitted Pkts. 256 to 511 Octets	33	172	0	0	26	26
Received Pkts. 512 to 1023 Octets	34	185	0	0	5059	5085
Transmitted Pkts. 512 to 1023 Octets	35	45	0	0	5087	5303
Received Pkts. 1024 to 1518 Octets	36	3	0	0	25455	12
Transmitted Pkts. 1024 to 1518 Octets	37	1046	0	0	0	3
In. Broadcast Pkts.	38	226	0	0	1	0
Out. Broadcast Pkts.	39	6	0	0	230	0
In. Multicast Pkts.	40	345	0	0	0	16232
Out. Multicast Pkts.	41	0	0	0	340	16889
Dot3 In. Pause Frames	42	0	0	0	N/A	0
Dot3 Out. Pause Frames	43	0	0	0	N/A	0
EtherStatsUndersize Pkts.	44	0	0	0	N/A	0
Fragments	45	0	0	0	N/A	0
CRC Align. Errors	46	0	0	0	N/A	0
Jabbers	47	0	0	0	N/A	0
Ingress BPS	48	633	N/A	N/A	8514	12860
Ingress PPS	49	1	N/A	N/A	6	12
Egress BPS	50	4122	N/A	N/A	8541	9347
Egress PPS	51	4	N/A	N/A	6	9
MAC learn limit drop (Ingress Pkts.)	52	0	0	0	0	0
L2 cache drop (Ingress Pkts.)	53	0	0	0	0	0
Illegal SA drop (Ingress Pkts.)	54	0	0	0	0	0
Port rate limit drop (Ingress Pkts.)	55	0	0	0	0	0
Port rate limit drop (Ingress Bytes)	56	0	0	0	0	0
PAUSE/PFC frames generated (Ingress Pkts.)	57	0	0	0	0	0
PAUSE/PFC frames generated (Egress Pkts.)	58	0	0	0	0	0
Rate limit drop for unknown unicast (Ingress Pkts.)	59	0	0	0	0	0
Rate limit drop for unknown unicast (Ingress Bytes)	60	0	0	0	0	0
Rate limit drop for broadcast (Ingress Pkts.)	61	0	0	0	0	0
Rate limit drop for broadcast (Ingress Bytes)	62	0	0	0	0	0
Rate limit drop for known multicast (Ingress Pkts.)	63	0	0	0	0	0
Rate limit drop for known multicast (Ingress Bytes)	64	0	0	0	0	0
Rate limit drop for unknown multicast (Ingress Pkts.)	65	0	0	0	0	0
Rate limit drop for unknown multicast (Ingress Bytes)	66	0	0	0	0	0
All CoSQ out Pkts.	67	2144	0	0	31948	43293
All CoSQ out bytes	68	2151700	0	0	42848639	43798556
All CoSQ dropped Pkts.	69	0	0	0	0	0
All CoSQ dropped bytes	70	0	0	0	0	0
Processed Rx Pkts.	71	1547	0	0	31382	43855
Processed Rx bytes	72	373548	0	0	42671492	45721532

Press MODIFY button.

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

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 were 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 were 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 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) ***MAC learn limit drop (Ingress Pkts.)*** – Ingress packets dropped due to MAC learning table overflow.
53) ***L2 cache drop (Ingress Pkts.)*** – Ingress packets dropped due to L2CP filter.
54) ***Illegal SA drop (Ingress Pkts.)*** – Ingress packets dropped due to invalid source MAC address.
55) ***Port rate limit drop (Ingress Pkts.)*** – Ingress packets dropped due to rate limit exceed on the port (if rate limit is configured).
56) ***Port rate limit drop (Ingress Bytes)*** – Ingress packet bytes dropped due to rate limit exceed on the port (if rate limit is configured).
57) ***PAUSE/PFC frames generated (Ingress Pkts.)*** – Priority Flow Control pause frames ingress.
58) ***PAUSE/PFC frames generated (Egress Pkts.)*** – Priority Flow Control pause frames egress.
59) ***Rate limit drop for unknown unicast (Ingress Pkts.)*** – Ingress unicast packets dropped due to rate limit which DST MAC address is absent in MAC table (Not learned).
60) ***Rate limit drop for unknown unicast (Ingress Bytes)*** – Ingress unicast packet bytes dropped due to rate limit which DST MAC address is absent in MAC table (Not learned).
61) ***Rate limit drop for broadcast (Ingress Pkts.)*** – Ingress broadcast packets dropped due to rate limit (DST MAC FF:FF:FF:FF:FF:FF).
62) ***Rate limit drop for broadcast (Ingress Bytes)*** – Ingress broadcast packet bytes dropped due to rate limit (DST MAC FF:FF:FF:FF:FF:FF).
63) ***Rate limit drop for known multicast (Ingress Pkts.)*** – Ingress known multicast packets dropped due to rate limit.

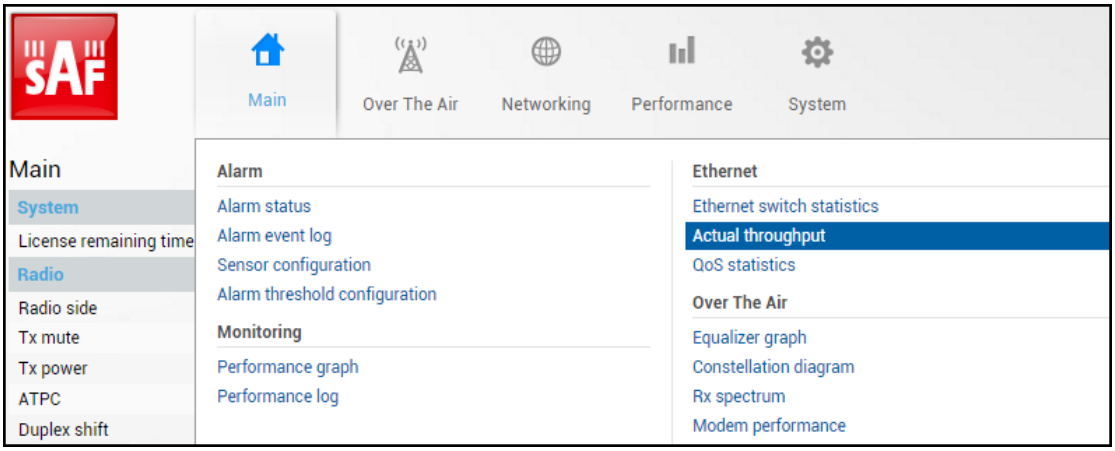
64) ***Rate limit drop for known multicast (Ingress Bytes)*** – Ingress known multicast packet bytes dropped due to rate limit.
65) ***Rate limit drop for unknown multicast (Ingress Pkts.)*** – Ingress unknown multicast packets dropped due to rate limit.
66) ***Rate limit drop for unknown multicast (Ingress Bytes)*** – Ingress unknown multicast packet bytes dropped due to rate limit.
67) ***All CoSQ out Pkts.*** – Total packet count with QoS transmitted.
68) ***All CoSQ out bytes*** – Total byte count with QoS transmitted.
69) ***All CoSQ dropped Pkts.*** – Total packet count with QoS dropped.
70) ***All CoSQ dropped bytes*** – Total byte count with QoS dropped.
71) ***Processed Rx Pkts.*** – Ingress packets processed on the port.
72) ***Processed Rx bytes.*** – Ingress packet bytes processed on the port.
73) ***Clear all data*** – Clears statistics on all switch ports.
74) ***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.



Performance / Actual throughput

Port		LAN1	LAN2	LAN3	WAN	MNG
Ingress Mbps	1	0.014	N/A	N/A	0.102	0.102
Ingress pps	2	4	N/A	N/A	11	10
Egress Mbps	3	0.068	N/A	N/A	0.053	0.054
Egress pps	4	10	N/A	N/A	6	6

MODIFY button is deactivated on this page.

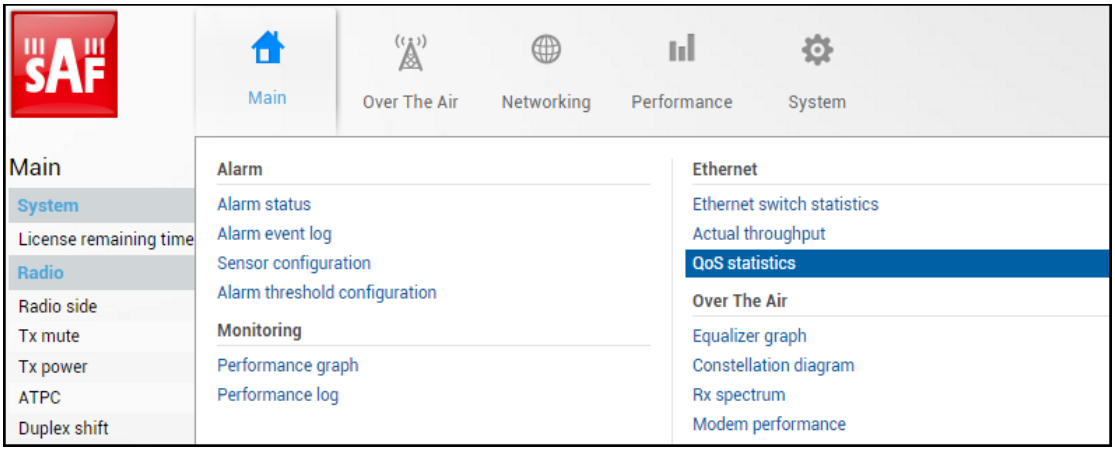
1) ***Ingress Mbps*** – Indicates megabit per second rate on the input of the port.
2) ***Ingress pps*** – Indicates packet per second rate on the input of the port.
3) ***Egress Mbps*** – Indicates megabit per second rate on the exit of the port.
4) ***Egress pps*** – Indicates packet per second rate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

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

network port show throughput	Use to show 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. Payload occupies queue 0, rest is SAF service traffic.



Status mode

Performance / QoS statistics

Queue		Port				
Statistics for 1		LAN1 1d 08:50:17 Bytes / packets	LAN2 1d 08:50:17 Bytes / packets	LAN3 1d 08:50:17 Bytes / packets	WAN 1d 08:50:17 Bytes / packets	MNG 1d 08:50:18 Bytes / packets
0	Passed	113.06 M / 231572	0 / 0	0 / 0	2.99 M / 38220	2.99 M / 38221
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
1	Passed	0 / 0	0 / 0	0 / 0	276.40 k / 1874	276.40 k / 1874
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
2	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
3	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
4	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
5	Passed	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
6	Passed	0 / 0	0 / 0	0 / 0	68 / 1	68 / 1
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
7	Passed	0 / 0	0 / 0	0 / 0	614.29 M / 1150579	644.19 M / 1375404
	Dropped	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0

Press MODIFY button.

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

1) QoS statistics for all 8 available priority queues, indicating passed and dropped packets and bytes. Elapsed time is indicated as well.
2) ***Clear all statistic*** – Allows clearing QoS statistics on all switch ports.
3) ***Clear*** – Allows clearing QoS statistics on individual switch ports.

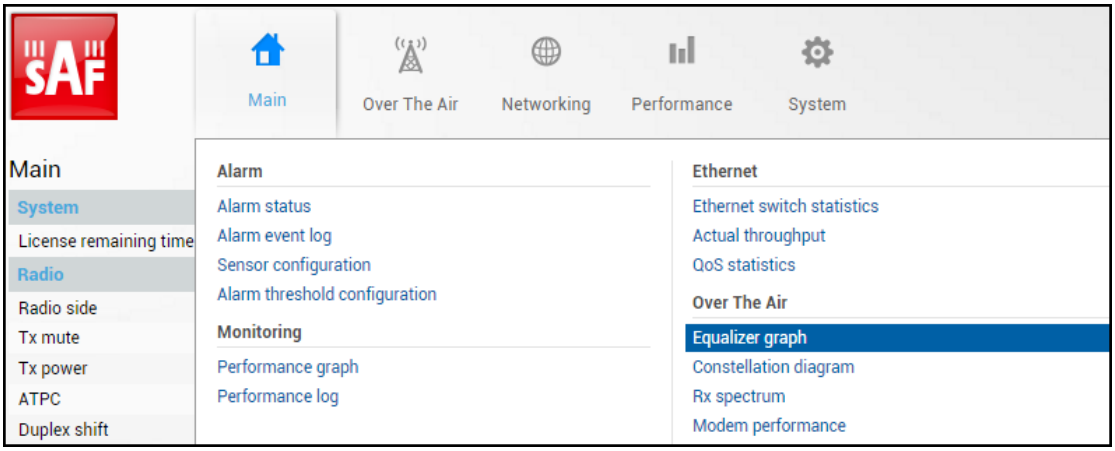
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

network qos show statistics {all|LAN1|LAN2|LAN3|WAN}	Use to check QoS statistics on all available ports.
network qos reset statistics {all|LAN1|LAN2|LAN3|WAN}	Use to clear QoS statistics on a specific switch port or all ports simultaneously.

Performance → Over The Air → Equalizer graph

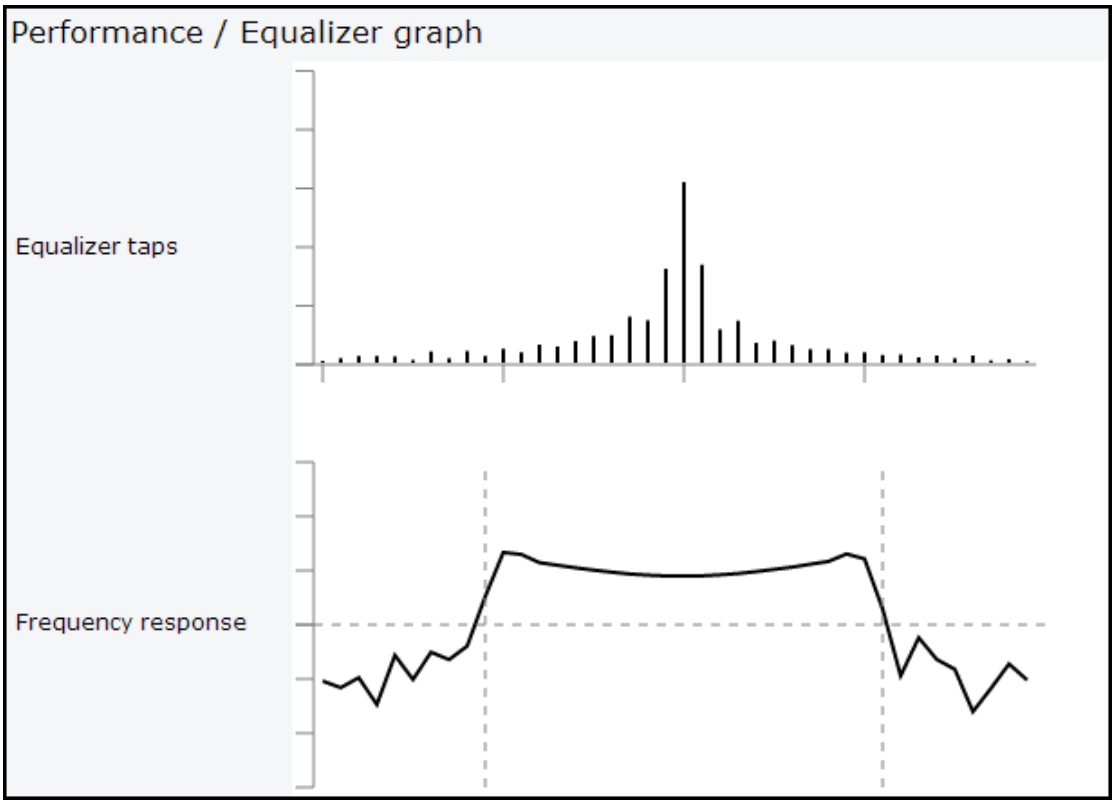
The Equalizer graph window shows adaptive equalizer taps' coefficients, which at a set time moment minimize the multipath fading effect in the channel.

For more details see Adaptive Equalizer section in Chapter 6: FUNCTIONAL DESCRIPTION.



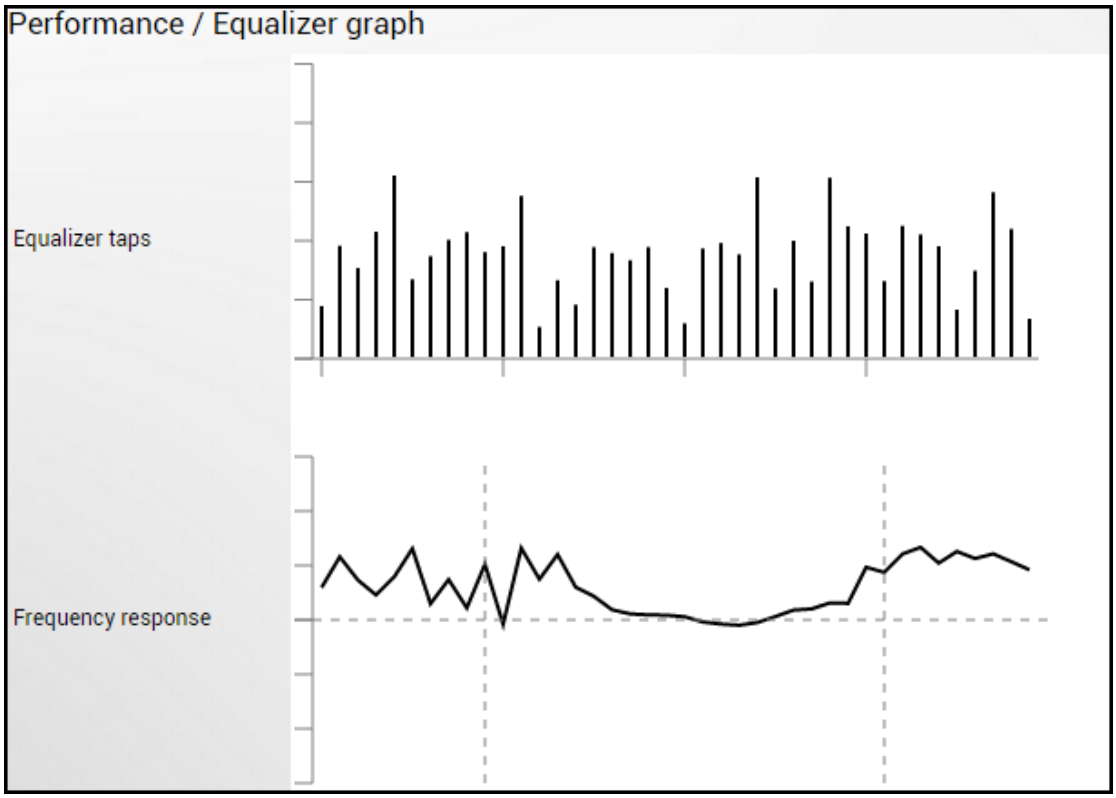
MODIFY button is deactivated on Equalizer graph page.

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



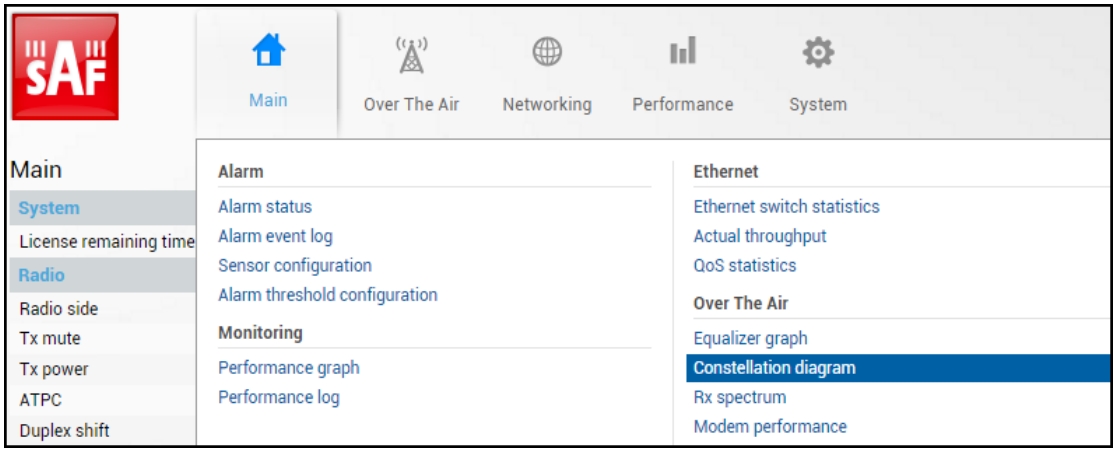
During normal operation, the frequency response curve is smooth at the center and the central equalizer tap is higher, while side towers evenly decrease. If equalizer taps and frequency response curve significantly differ from the one above, it may be an indication of multipath issues, which must be 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 – a stronger reflected signal.

Below is an example of Equalizer graph in a link aligned to the reflected signal:



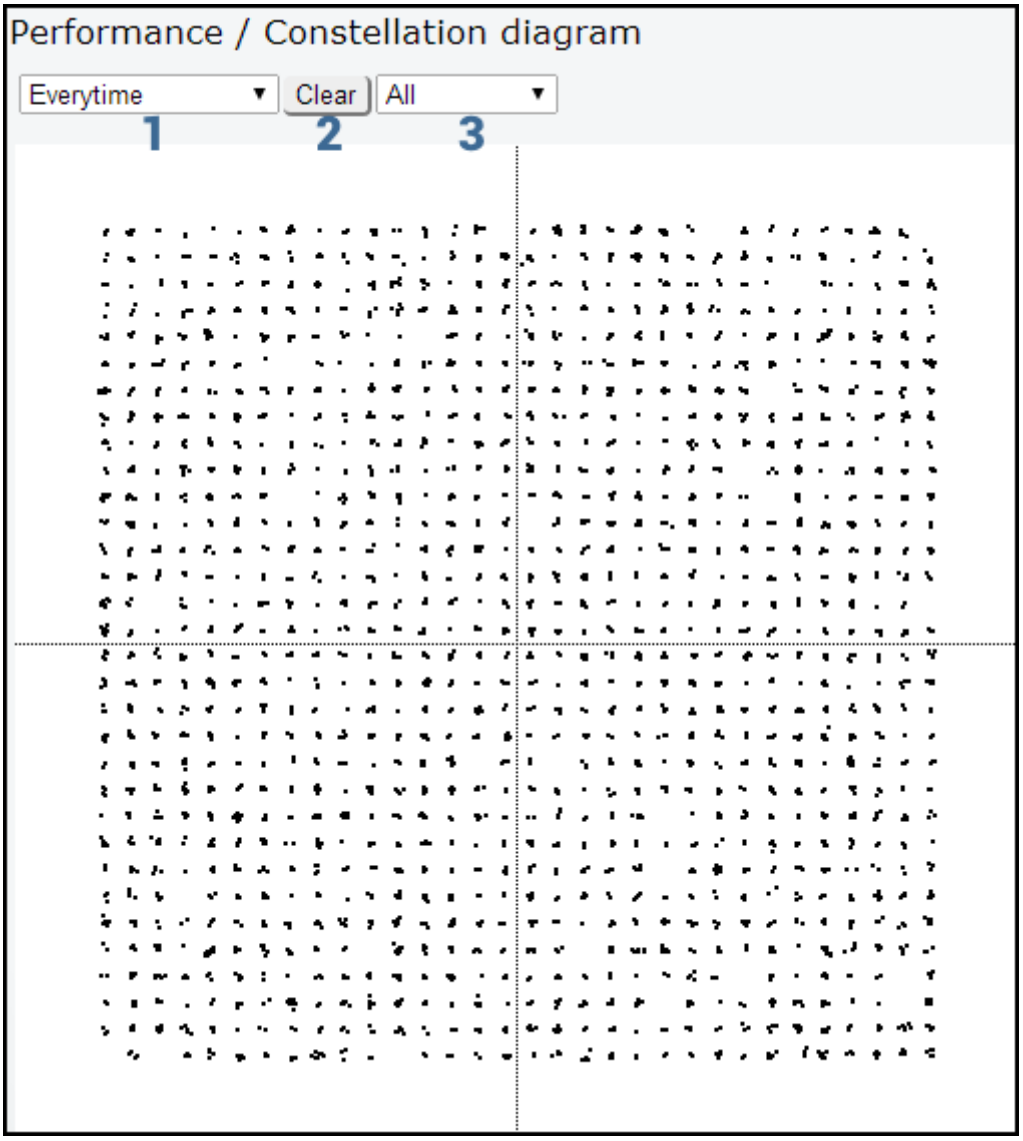
Performance → Over The Air → Constellation diagram

A constellation diagram is a representation of a signal modulated by the digital modulation schemes 1024QAM, 512QAM, 256QAM, 128QAM, 64QAM, 32QAM, 16QAM, or 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.



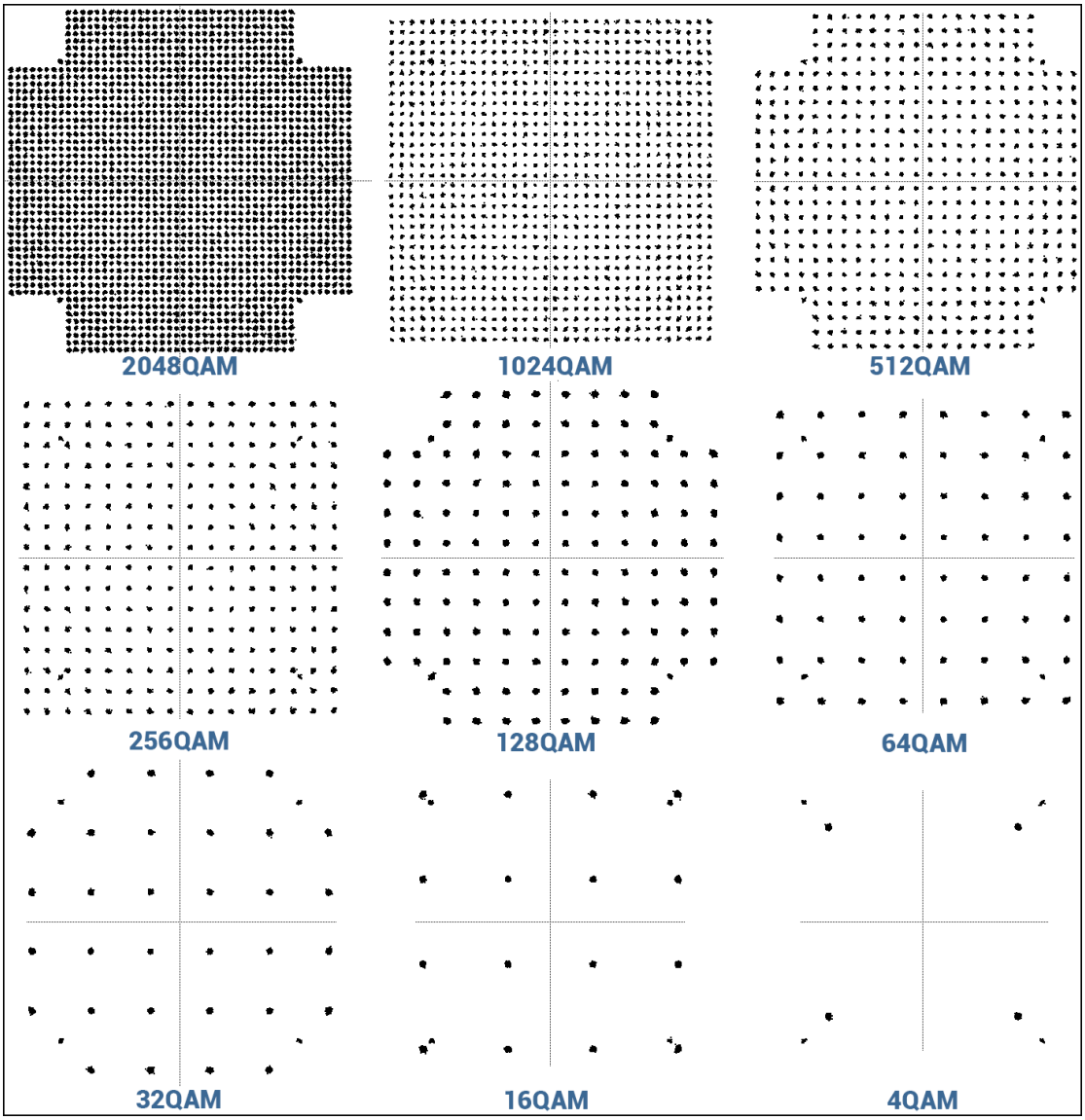
MODIFY button is deactivated on the Constellation diagram page.

Only a single user can see Constellation at a time.



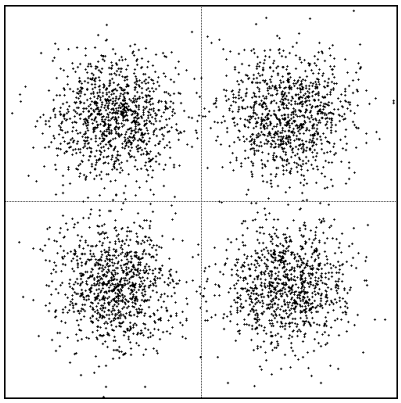
1) Allows choosing how often is constellation automatically cleared.
2) Manually clear current constellation.
3) Allows zooming to one of 4 constellation quadrants.

Examples of Integra/Integra-S/Integra-G/Integra-GS constellation diagrams under ideal conditions are shown below:

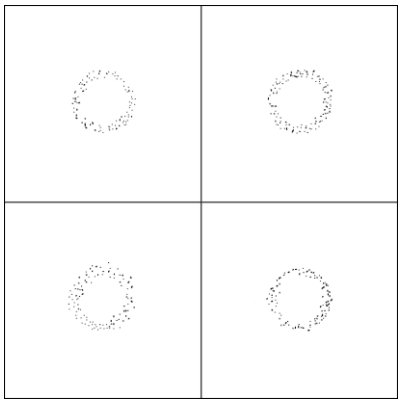


To analyze the received signal quality, some types of distortion and degradation may be evident in the constellation diagram. For example:

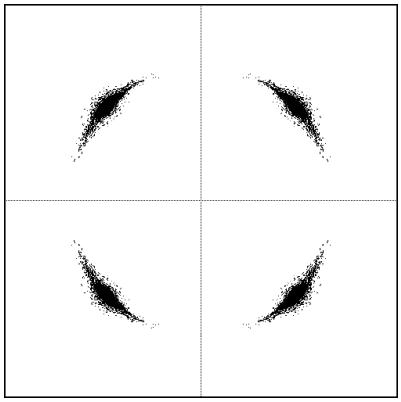
1) Gaussian noise is displayed as fuzzy constellation points:



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

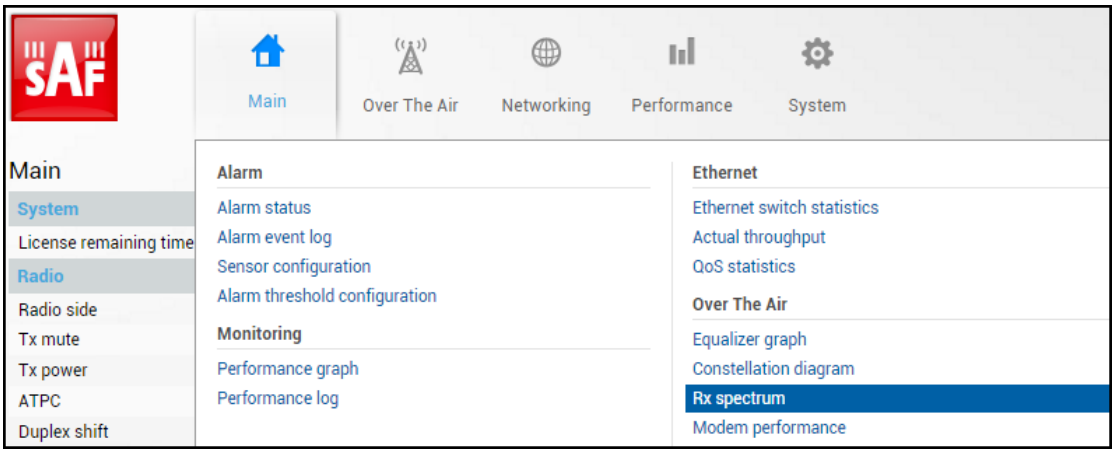


3) Phase noise is displayed as rotationally spreading constellation points:



Performance → Over The Air → Rx spectrum

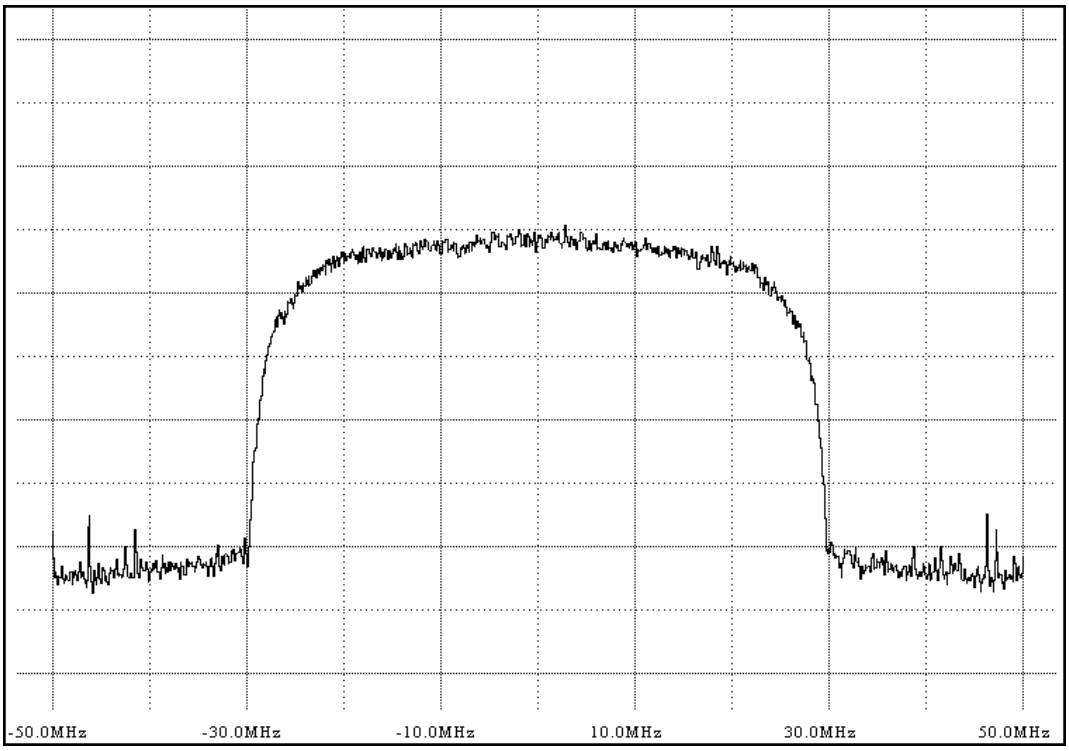
A spectrum curve is a representation of the received signal on the input of the modem. For this reason, spectrum signal levels will not correspond to the actual radio receiver's signal level. The signal appearance will depend on configured channel bandwidth. A measured spectrum curve can be used to recognize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



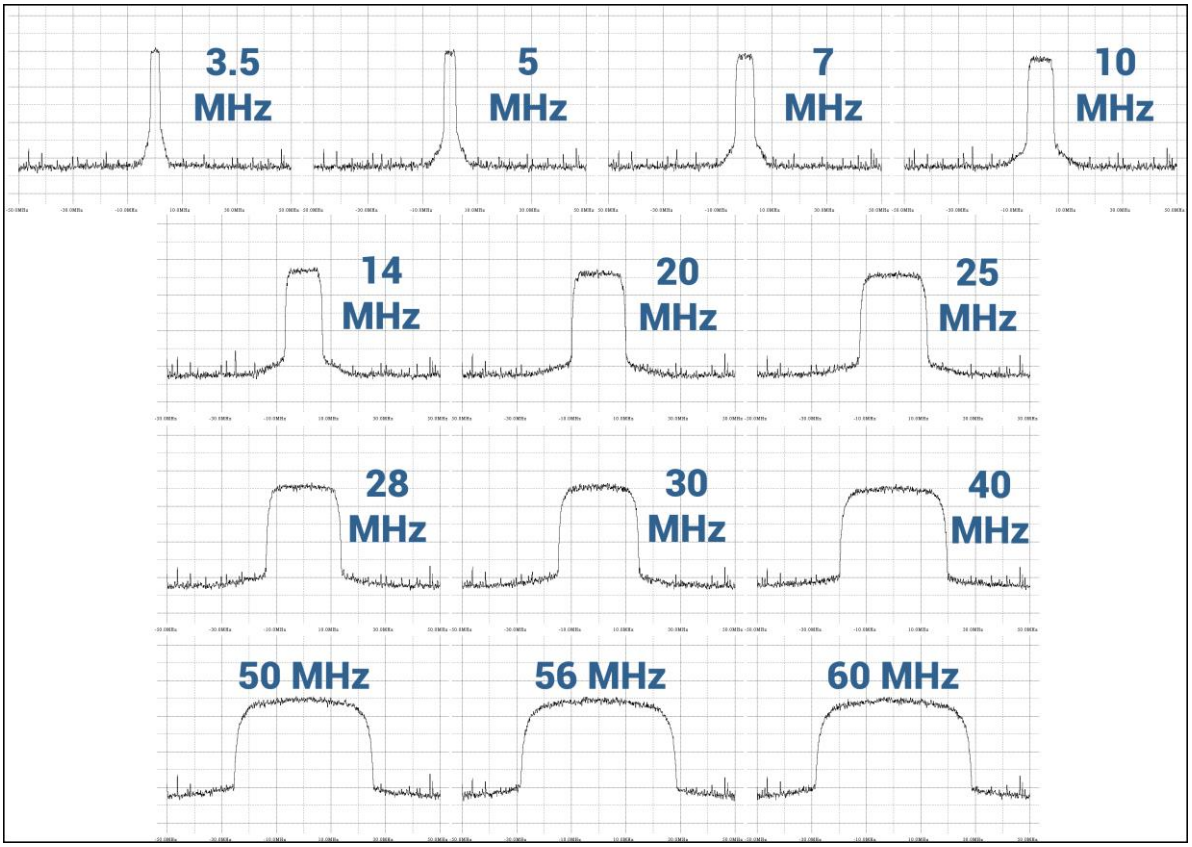
MODIFY button is deactivated on the Rx spectrum page.

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

Spectrum (60MHz):

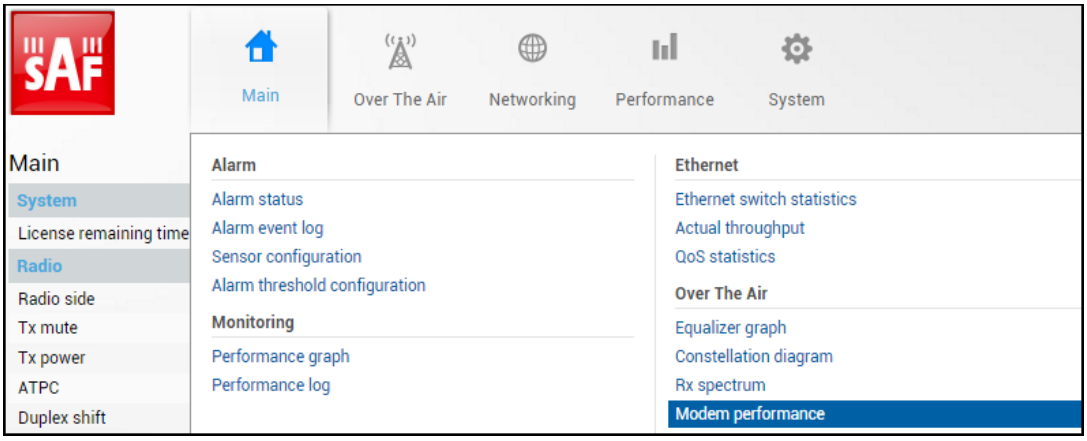


Examples of Integra/Integra-S/Integra-G/Integra-GS spectrum curves in various channel bandwidths:

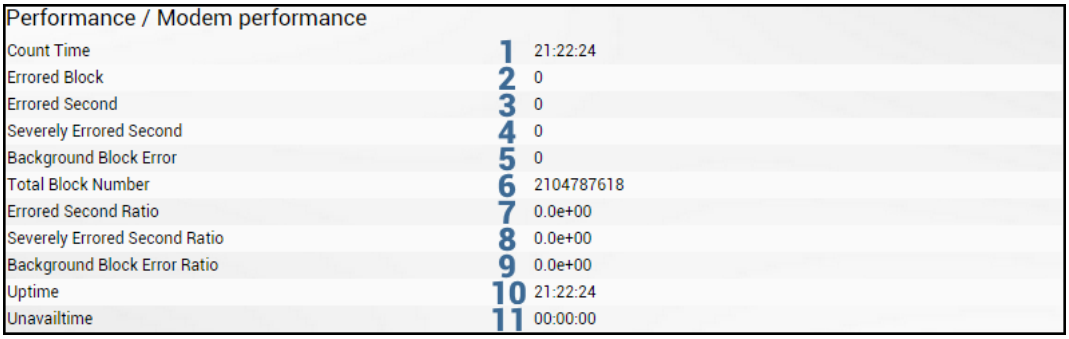


Performance → Over The Air → Modem performance

The Modem performance section shows modem statistics according to ITU-T G.826.



Status mode



Press MODIFY button.

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

1) ***Count time*** – the time during which statistics are gathered.
2) ***Errored Block (EB)*** – Number of blocks having at least one-bit error.
3) ***Errored Second (ES)*** – Number of seconds during which errored blocks were registered.
4) ***Severely Errored Seconds (SES)*** – Number of seconds that contain 30% errored blocks or one or more defects.
5) ***Background Block Error (BBE)*** – Number of errored blocks that are not part of SES.
6) ***Total Block number*** - Number of blocks received which are not part of SES.
7) ***Errored Second Ratio (ESR)*** – The ratio of ES to total seconds.
8) ***Severely Errored Second Ratio (SESR)*** – The ratio of SES to total seconds.
9) ***Background Block Error Ratio (BBER)*** – The ratio of BBE to total seconds.
10) ***Uptime*** – time in seconds during which the link was synchronized.
11) ***Unavailtime*** – time in seconds during which the link was not synchronized.
12) ***Clear*** – Clears all counters.

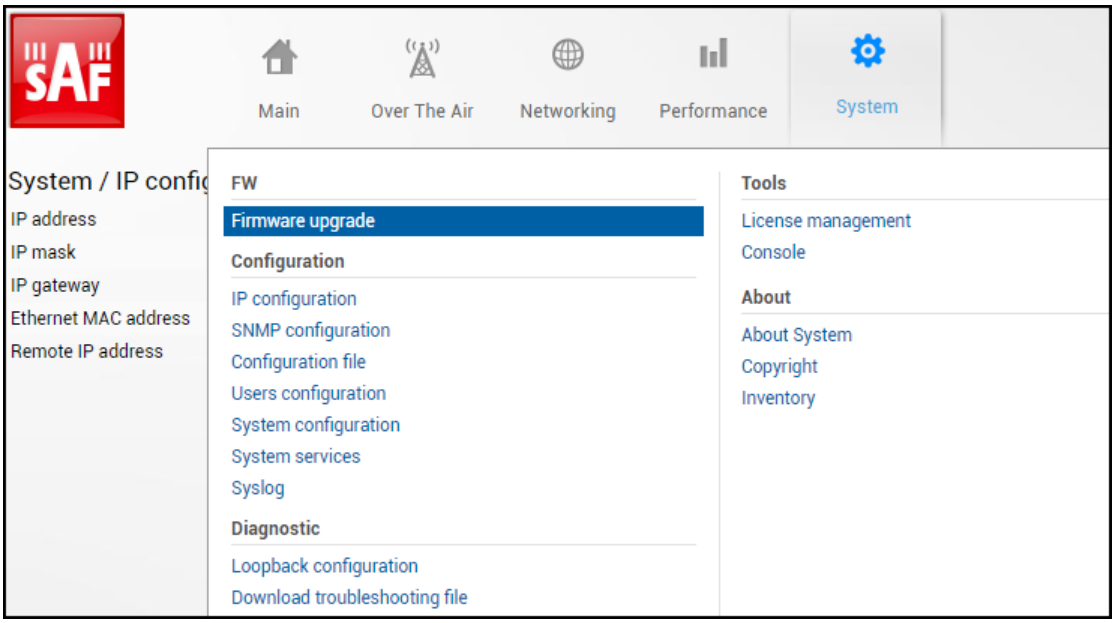
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

modem performance	Use to check modem statistics according to ITU-T G.826. See the detailed description above.
modem performance clear	Use to clear modem statistics.

System

System → FW → Firmware upgrade

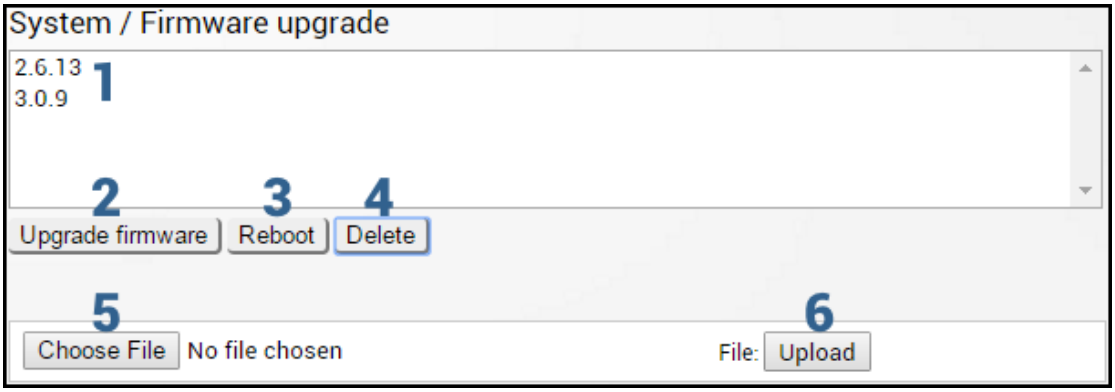
Upload the .bin firmware file and upgrade the firmware version on the “Firmware upgrade” page.



Status mode

Press MODIFY button.

Modify mode



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

If the existing Integra/Integra-S/Integra-G/Integra-GS firmware version is older than V2.5.13, firmware must be upgraded to V2.5.13 (please contact techsupport@saftehnika.com) before the upgrade to the latest firmware version.

The latest Integra/Integra-S/Integra-G/Integra-GS firmware can be downloaded at https://saftehnika.com/en/downloads in "Firmwares" section. Registration and login are required.

3) ***Reboot*** – Reboots Integra/Integra-S/Integra-G/Integra-GS (cold restart).
4) ***Delete*** – Deletes selected firmware file from the list.
5) ***Browse*** or ***Choose File*** (depending on the used web browser) – Press to browse for a firmware file on your hard disk drive.
6) ***Upload*** – Press to upload a firmware file to Integra/Integra-S/Integra-G/Integra-GS.

A maximum of 3 firmware files can be stored. You can delete unnecessary firmware files using "Delete" button.

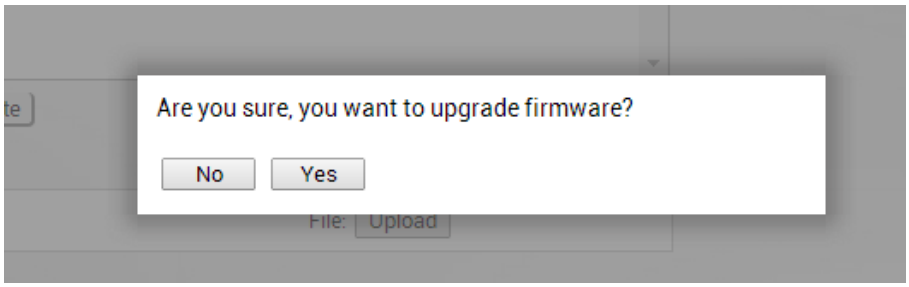
Integra series firmware upgrade via Web GUI

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

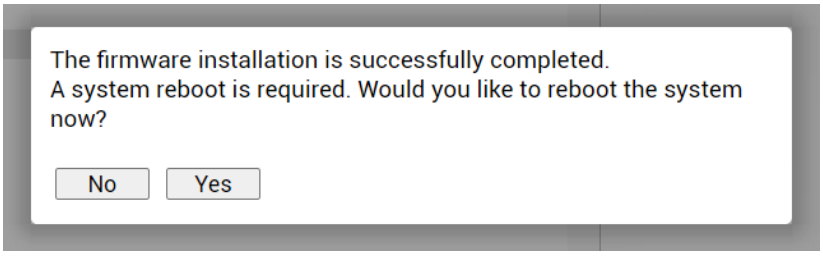
If the existing Integra/Integra-S/Integra-G/Integra-GS firmware version is older than V2.5.13, firmware must be upgraded to V2.5.13 (please contact techsupport@saftehnika.com) before the upgrade to the latest firmware version.

The main method for firmware upgrade is 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 "MODIFY" button on the right side of the page.
3) Press "Browse" or "Choose File" button (depending on the used web browser), locate *.bin firmware file on your hard disk (extracted from the firmware update package), and press "Open" button.
4) Press "Upload" button.
5) Select the uploaded firmware from the firmware list, press "Upgrade firmware" button and confirm the upgrade:



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



The remote side must be upgraded first.

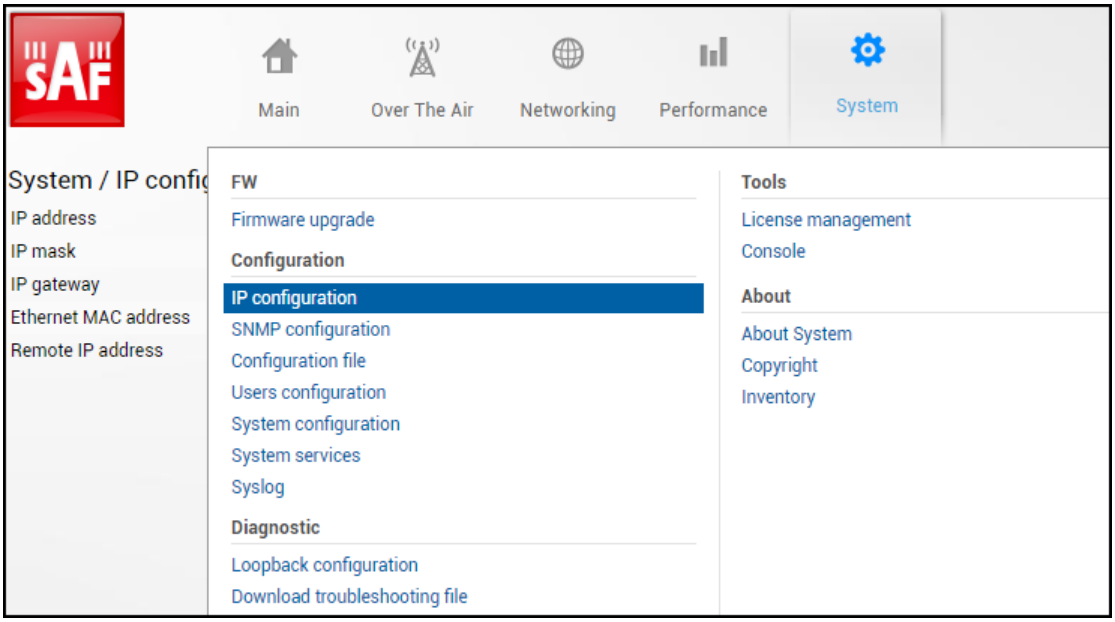
Please do not unplug power until the firmware upgrade procedure is finished - Web GUI will automatically reconnect and the login page will appear.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

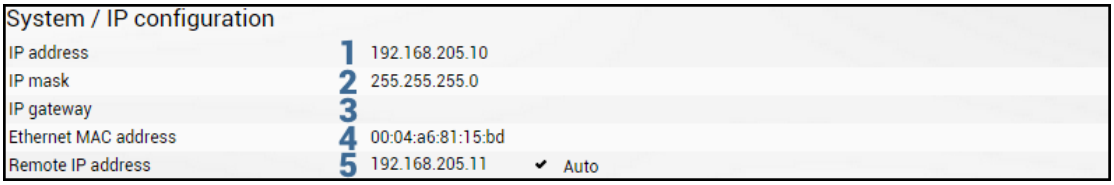
firmware info [<version>]	Use to show detailed information on current or specific Integra/Integra-S/Integra-G/Integra-GS firmware.
firmware install <version>	Use to install the firmware version uploaded. Note that the exact version needs to be entered. Check available firmware versions using the command “firmware list”.
firmware list	Use to list uploaded firmware versions.
firmware remove <version>	Use to remove the firmware version uploaded. Note that the exact version 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 the running firmware bank and bank that will be used at the next boot.
firmware upload <file>	Use to upload firmware files 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 the factory-defined emergency bank, which is used if both “fw1” and “fw2” fail.
system reboot	Use to perform a cold reboot of the radio unit.

System → Configuration → IP configuration

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

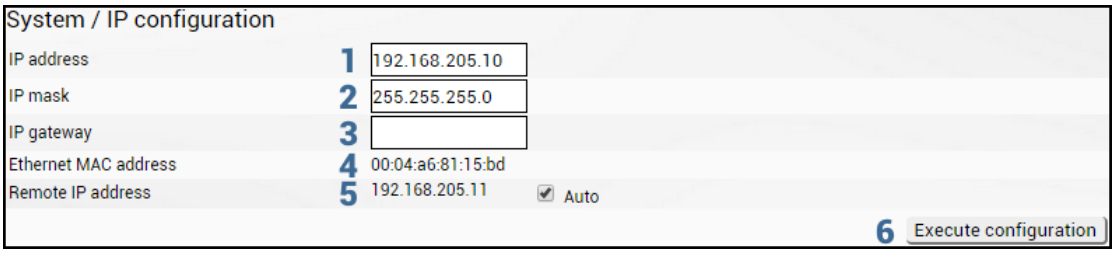


Status mode



Press MODIFY button.

Modify mode



1) ***IP address*** – Indicates the IP address of the Integra/Integra-S/Integra-G/Integra-GS you are currently logged in (status mode); allows specifying the IP address of the Integra/Integra-S/Integra-G/Integra-GS you are currently logged in to (modify mode). The Default IP address is 192.168.205.10 or 192.168.205.11 – depending on which side the specific Integra/Integra-S/Integra-G/Integra-GS is – low side has 192.168.205.10 IP address and high side – 192.168.205.11.

⚠ Integra/Integra-S/Integra-G/-Integra-GS IP addresses need to be on the same subnet.

2) ***IP Mask*** – Indicates the IP mask of the Integra/Integra-S/Integra-G/Integra-GS you are currently logged in (status mode); allows specifying the IP mask of the Integra/Integra-S/Integra-G/Integra-GS 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/Integra-S/Integra-G/Integra-GS you are currently logged in to (status mode); allows specifying the gateway address of the Integra/Integra-S/Integra-G/Integra-GS you are currently logged in (modify mode). By default, the gateway is not specified (blank).
4) ***Ethernet MAC address*** – shows the MAC address of the Integra/Integra-S/Integra-G/Integra-GS you are currently connected to.
5) ***Remote IP address*** – shows the IP address of the remote (far-end) Integra/Integra-S/Integra-G/Integra-GS. By default, the remote IP address is being 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.
6) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

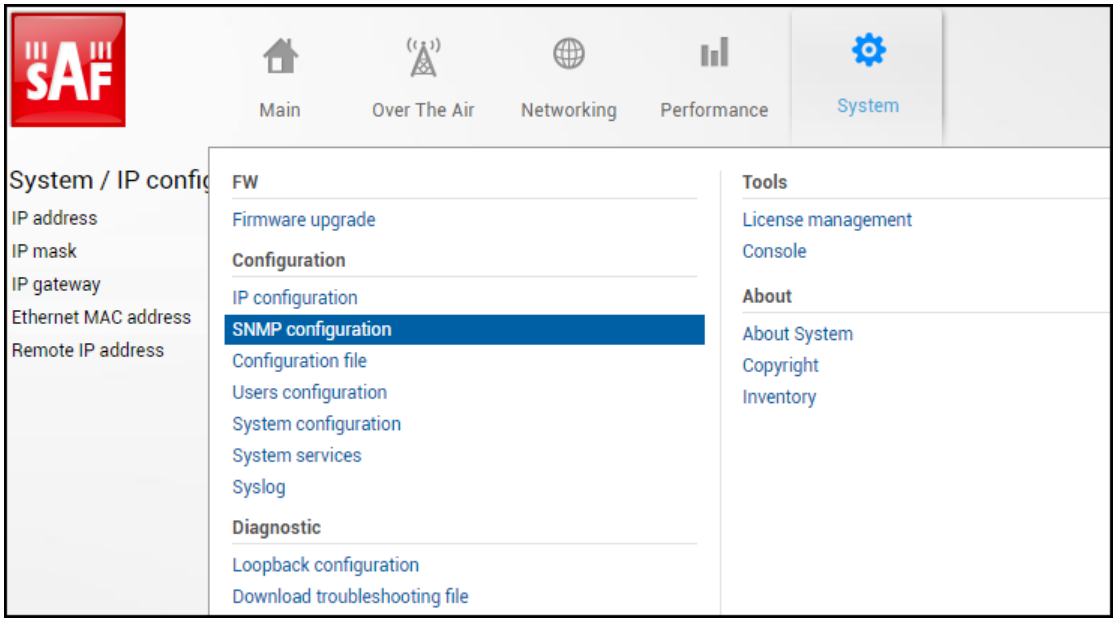
system ip addr [<IP>]	Use to show/set the IP address of the management CPU.
system ip gw [{<IP>|clear}]	Use to show/manage the IP address of the gateway.
system ip mask [<mask>]	Use to show/set subnet mask.
system ip mac	Use to show the MAC address of the management CPU.

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 automatic retrieving of the remote IP address.
system remoteip set <IP>	Use to define remote IP address (deactivates automatic retrieving of the remote IP address).
system diag ping <IP_address>	Use to ping an IP address.

System → Configuration → SNMP configuration

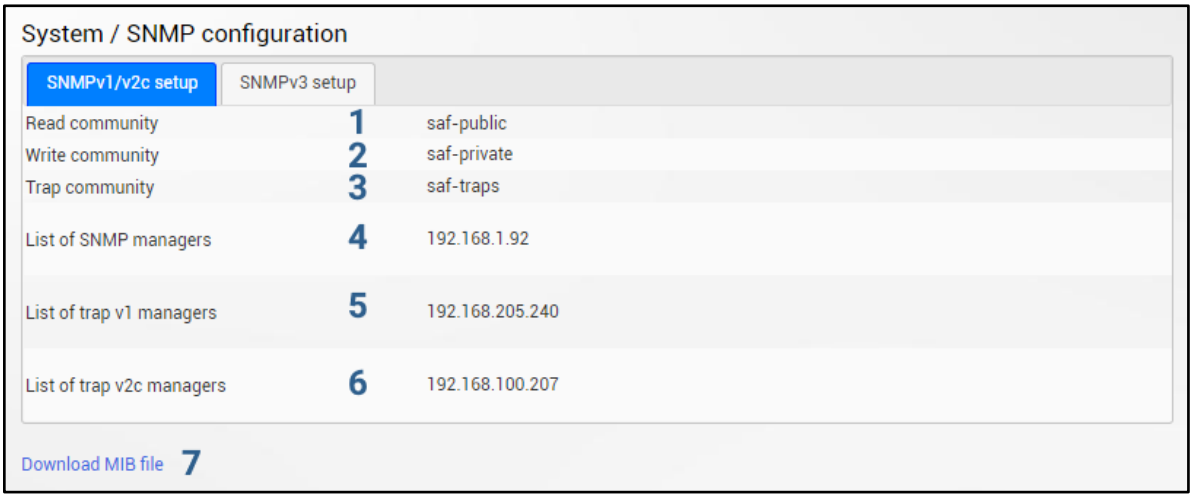
The SNMP configuration pages provide the configuration of SNMP communities, host, and trap addresses. The SAF NMS system will work only when SNMP is properly configured.

Relevant MIB files can be downloaded directly from Integra/Integra-S/Integra-G/Integra-GS Web GUI. See (7) below.



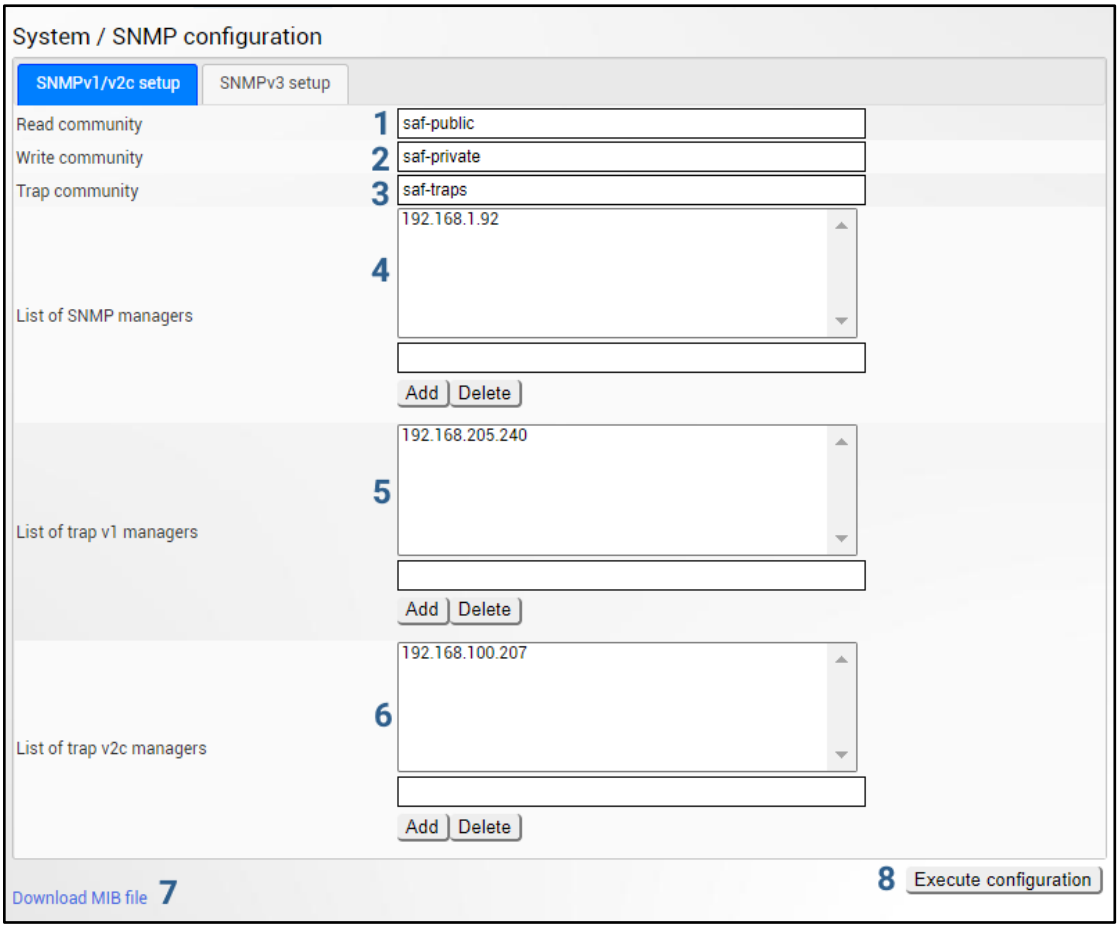
SNMPv1/2vc

Status mode



Press MODIFY button.

Modify mode



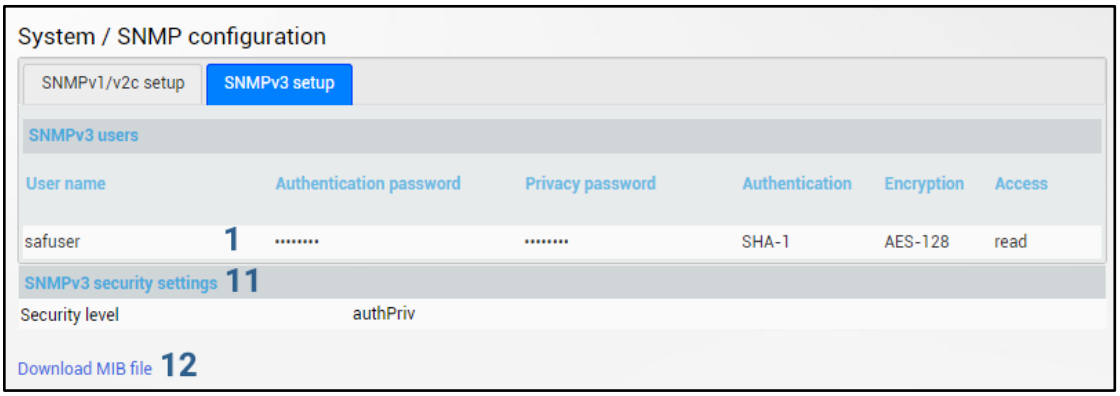
1) ***Read community*** – Indicates currently specified read community for SNMPv1/v2c (status mode); allows specifying read community for SNMPv1/v2c of the agent to enable parameters to be read (modify mode). The default read community name is “saf-public”.

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 the 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). The Integra/Integra-S/Integra-G/Integra-GS 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). The Integra/Integra-S/Integra-G/Integra-GS management controller sends SNMPv2c traps to the Trap Manager with the IP address specified here.
7) ***Download MIB file*** – Click to download Integra/Integra-S/Integra-G/Integra-GS MIB files.
8) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS.

SNMPv3 setup

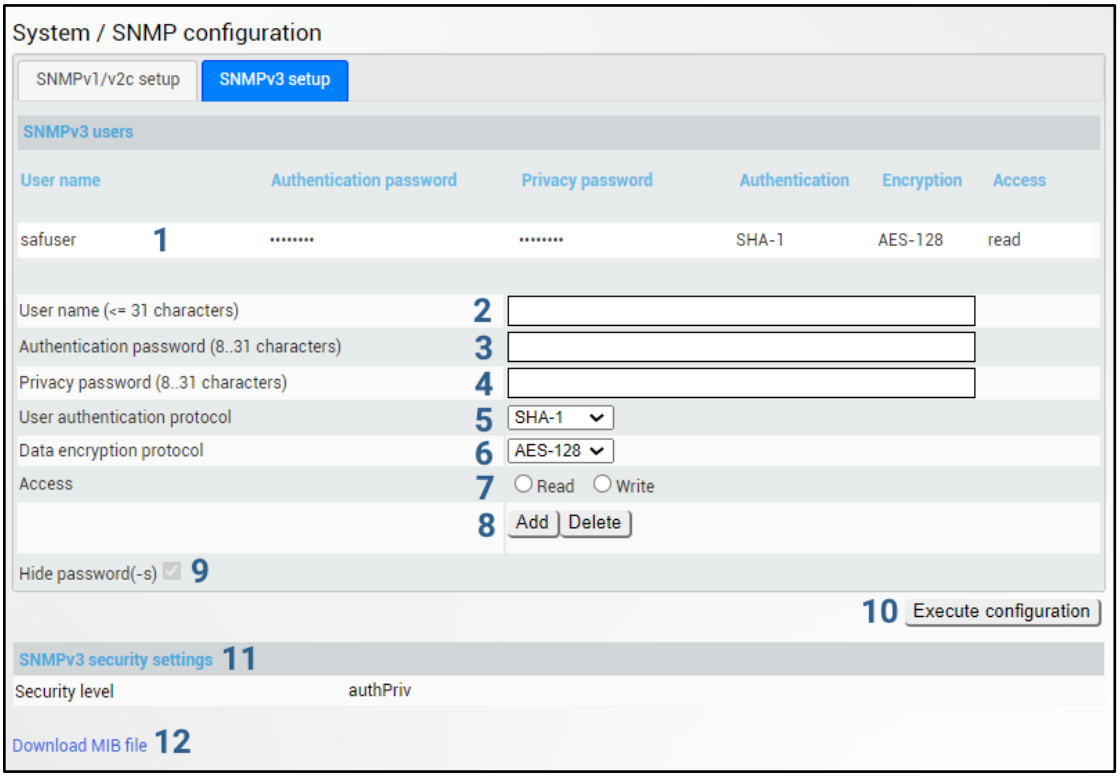
SNMPv3 primarily is improved with security settings. It does not rely on SNMP community names as it is in versions 1 and v2c.

Status mode



Press MODIFY button.

Modify mode



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 SNMPv3 authentication password. Length can be between 8 and 31 symbols.
4) ***Privacy password (8..31 characters)*** – Enter SNMPv3 data encryption password (AES protocol is used on the SNMP agent's side). Length can be between 8 and 31 symbols.
5) ***User authentication protocol*** – Select authentication protocol (SHA-1, SHA-224, SHA-256, SHA-384, SHA-512).
6) ***Data encryption protocol*** – Select data encryption protocol (DES, AES-128, AES-192, AES-256).
7) ***Access*** – Select "Read" for read-only access or "Write" for read-write access.
8) ***Add/Delete*** – Use to add or delete 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 selected SNMPv3 user.
10) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS.
11) ***SNMPv3 security settings*** – Shows SNMPv3 security settings used.
12) ***Download MIB file*** – Click to download Integra/Integra-S/Integra-G/Integra-GS MIB files.

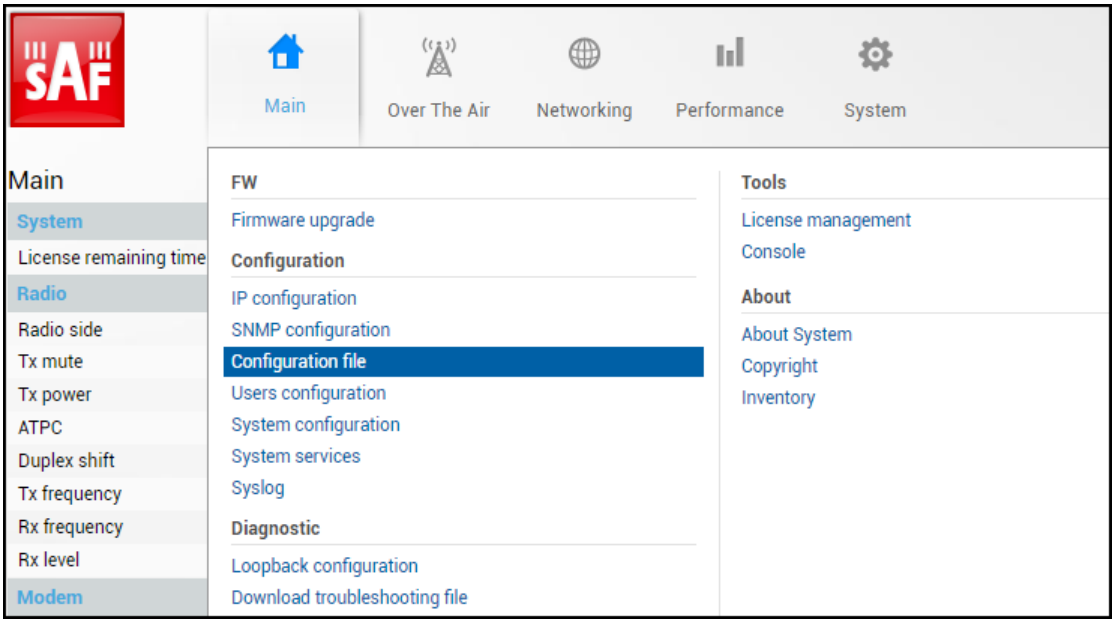
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

snmp manager {add | delete} <manager>	Use to show/add/delete manager IP address
snmp manager read-community {set | del} <read-community>	Use to show/set/delete read community name

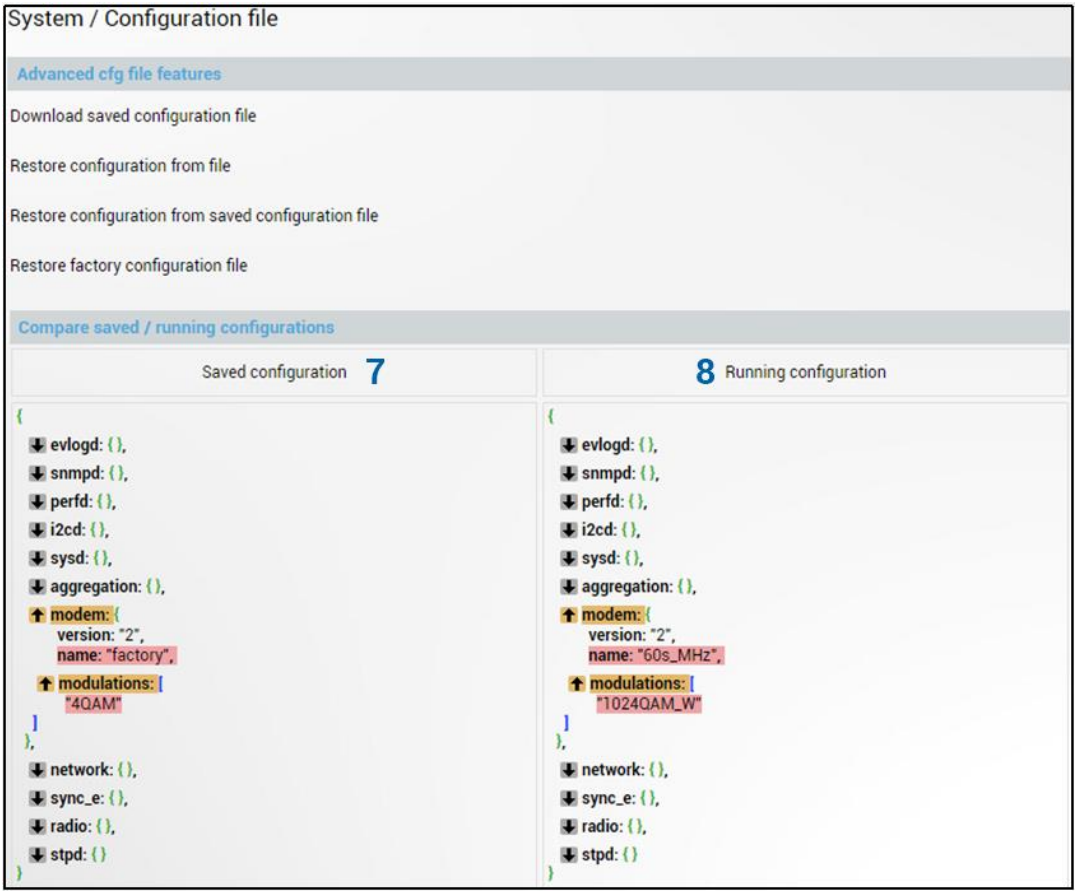
snmp manager write-community {set | del} <write-community>	Use to show/set/delete write community name
snmp showconfig {active | stored}	Use to show running or saved configuration
snmp syscontact <syscontact>	Use to show/set system contact
snmp traps trap-community {set | del} <trap-community>	Use to show/set/delete trap community name
snmp traps trapv1manager {add | delete} <trapv1manager>	Use to show/add/delete v1 trap manager IP address
snmp traps trapv2manager {add | delete} <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).

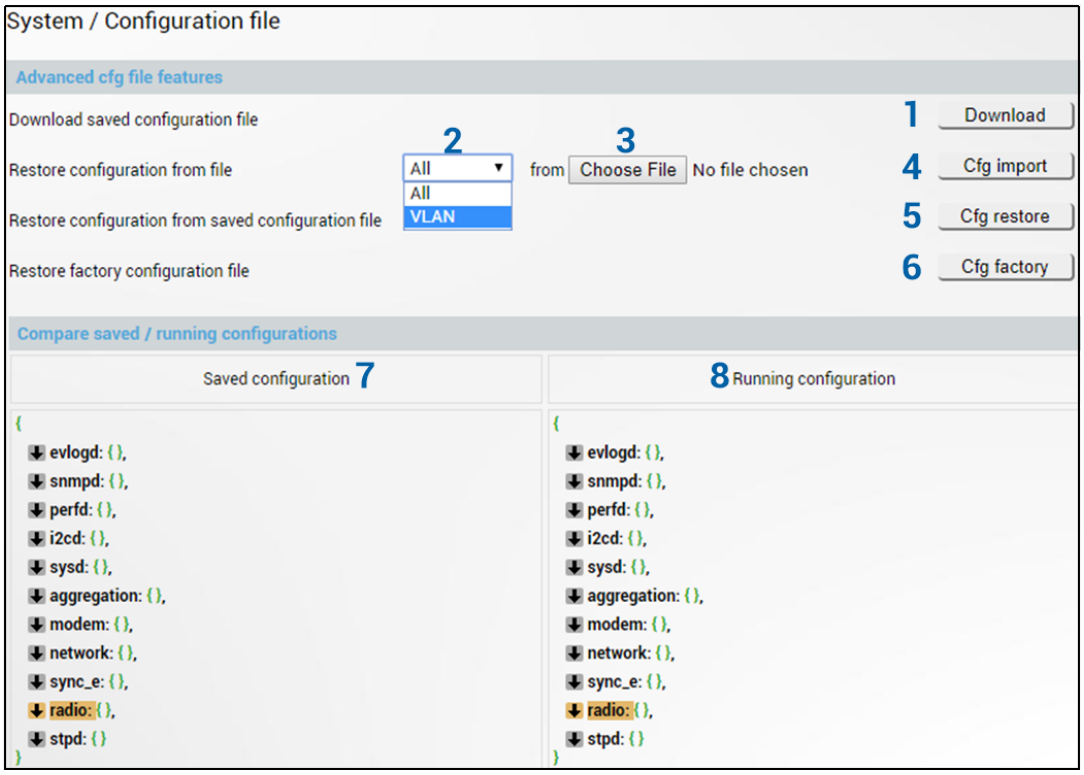


Status mode



Press MODIFY button.

Modify mode



1) ***Download*** – Press to download the system configuration txt file and save it on your hard drive.
2) ***All/VLAN*** – Select *All* to restore the complete configuration or *VLAN* to restore only VLAN 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 the Integra/Integra-S/Integra-G/Integra-GS.

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 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 currently running system configuration.

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

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

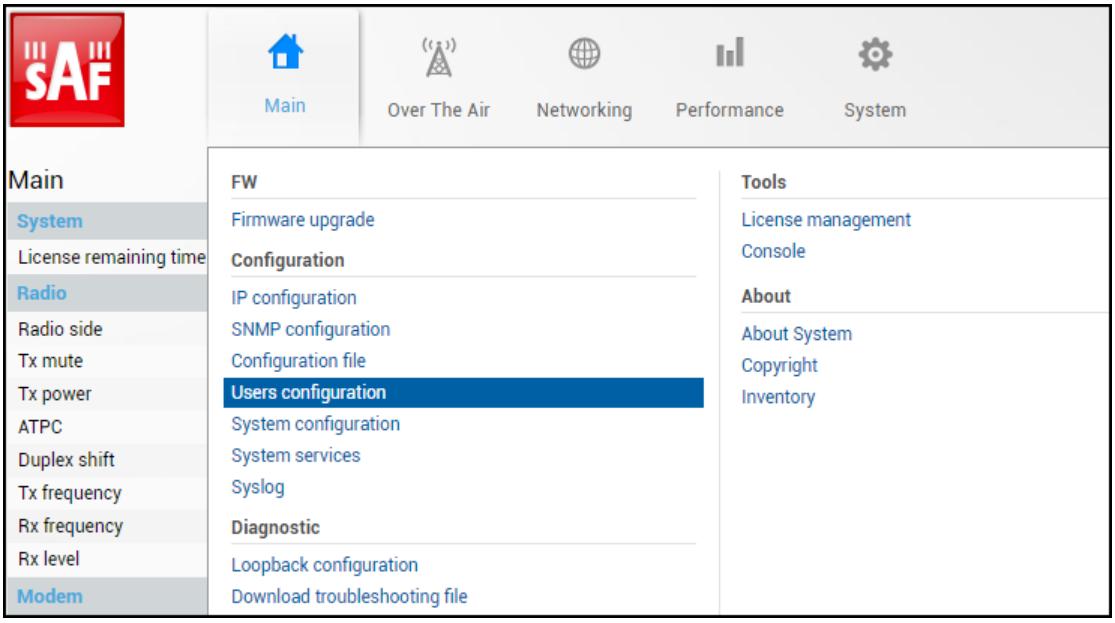
It is highly recommended to use the CLI command 'configuration browse' only after the SSH connection is established.

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 FTP directory.
configuration factory	Use to reset system configuration to factory defaults.
configuration factory aggr	Use to reset aggregation configuration to factory defaults.
configuration factory i2cd	Use to reset 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 | qos | rate | vlan}	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 sync_e	Use to reset SyncE configuration to factory defaults.
configuration factory sysd	Use to reset the whole system configuration to factory defaults.
configuration import {All | VLAN} <preset name>	Use to restore the configuration from a txt file stored in the FTP directory.
configuration load	Use to restore saved system configuration, i.e., unsaved changes will be discarded!

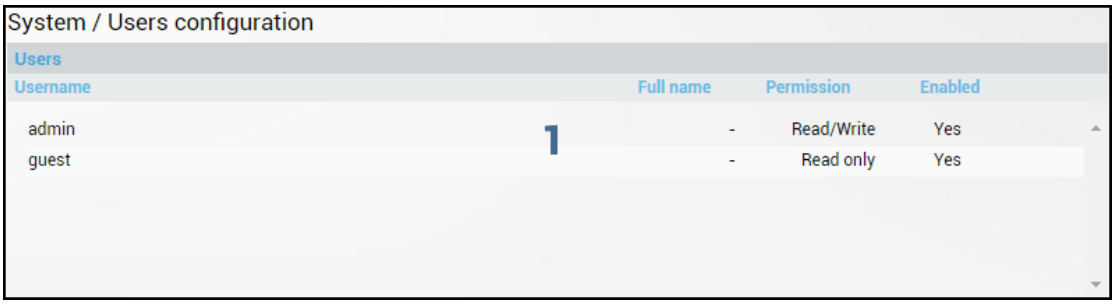
configuration status	Use to check whether the running configuration is saved.
configuration store	Use to save the running configuration.
configuration watch	Use to show entities watch status.

System → Configuration → Users configuration

Integra/Integra-S/Integra-G/Integra-GS features 2 default user accounts – *admin* (full control) and *guest* (read-only).

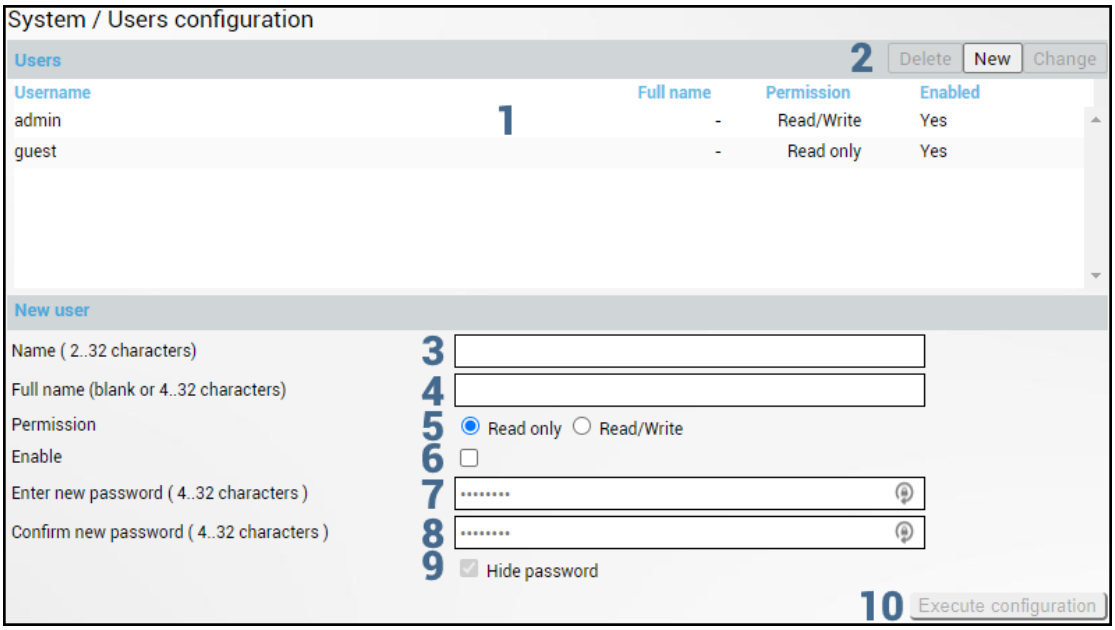


Status mode



Press MODIFY button.

Modify mode



1) ***Users*** – Shows the list of available users (Username), full name (if specified), permissions, and whether the user is active (enabled).
2) Press "New" to create a new user or click on a user from the list and choose to modify (Change) or delete the user (Delete).

New user / Selected user

3) ***Name (2..32 characters)*** – Enter a user name. The length is between 2 and 32 characters.
4) ***Full name (4..32 characters)*** – Enter the full name of the user (New user) or modify the existing user's name. The length is between 4 and 32 characters.
5) ***Permission*** – Select read-only or read/write permissions. A user with "read/write" permissions can change the configuration, while a user with read-only permissions can monitor link status only.
6) ***Enable*** – Enable or disable the user.
7) ***Enter new password (4..32 characters)*** – Enter a new password. The length is between 4 and 32 characters.
8) ***Confirm new password (4..32 characters)*** – Confirm new password. The length is between 4 and 32 characters.
9) ***Hide password*** – Uncheck to display the entered password in plaintext.
10) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS.

By default, the password for the "admin" account is '*changeme*', while no password is defined for the "guest" account (user disabled).

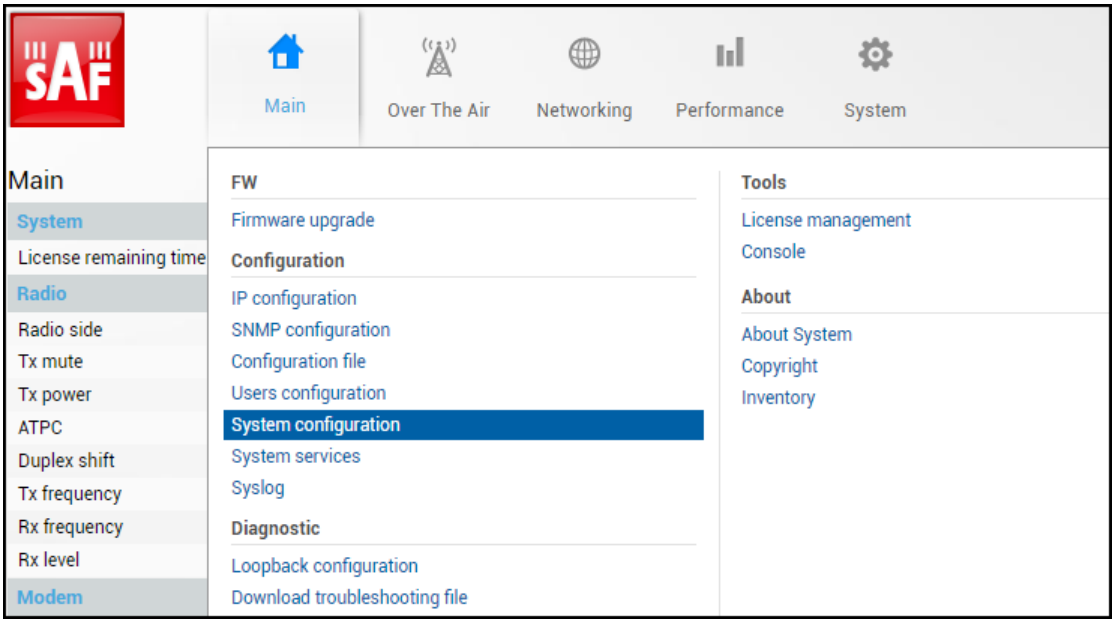
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

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 particular <username>.
system user mgmt <username> **delete**	Use to delete particular <username>. "admin" user cannot be deleted.

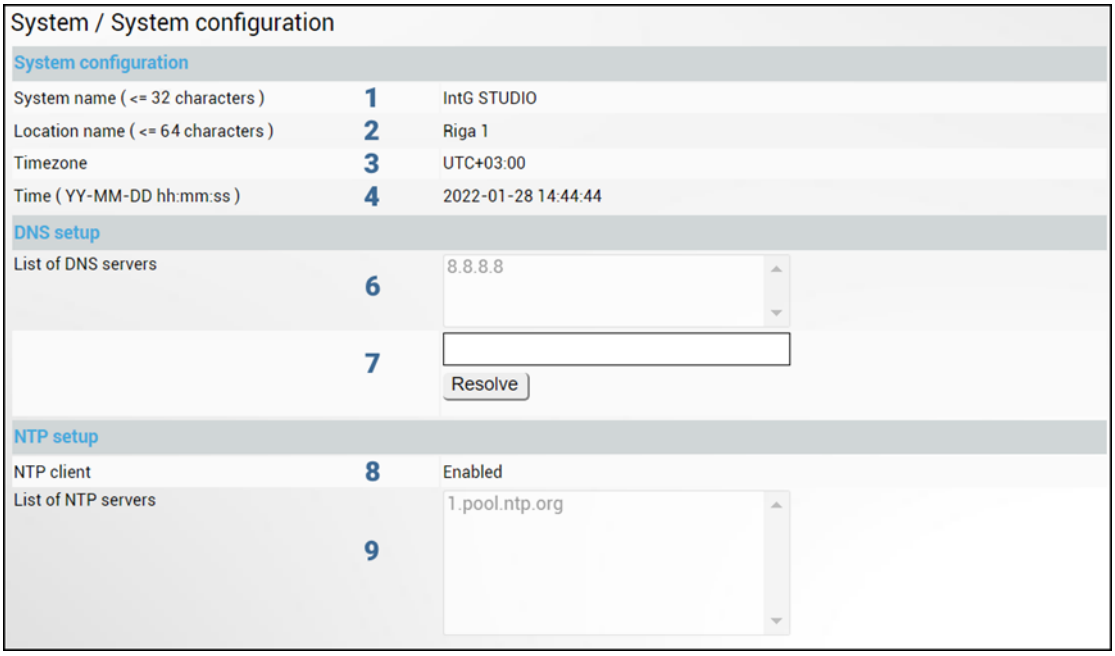
system user mgmt <username> {enable|disable}	Use to enable or disable particular <username>.
system user mgmt <username> **info**	Use to show information on particular <username>.
system user mgmt <username> **password** <password>	Use to set password for particular <username>.
system user new <username> <password> {r|w} <fullname>	Use to create 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 default.

System → Configuration → System configuration

Specify DNS servers, time settings, and system/location names.
DNS servers have to be added before adding domain names to the NTP list.

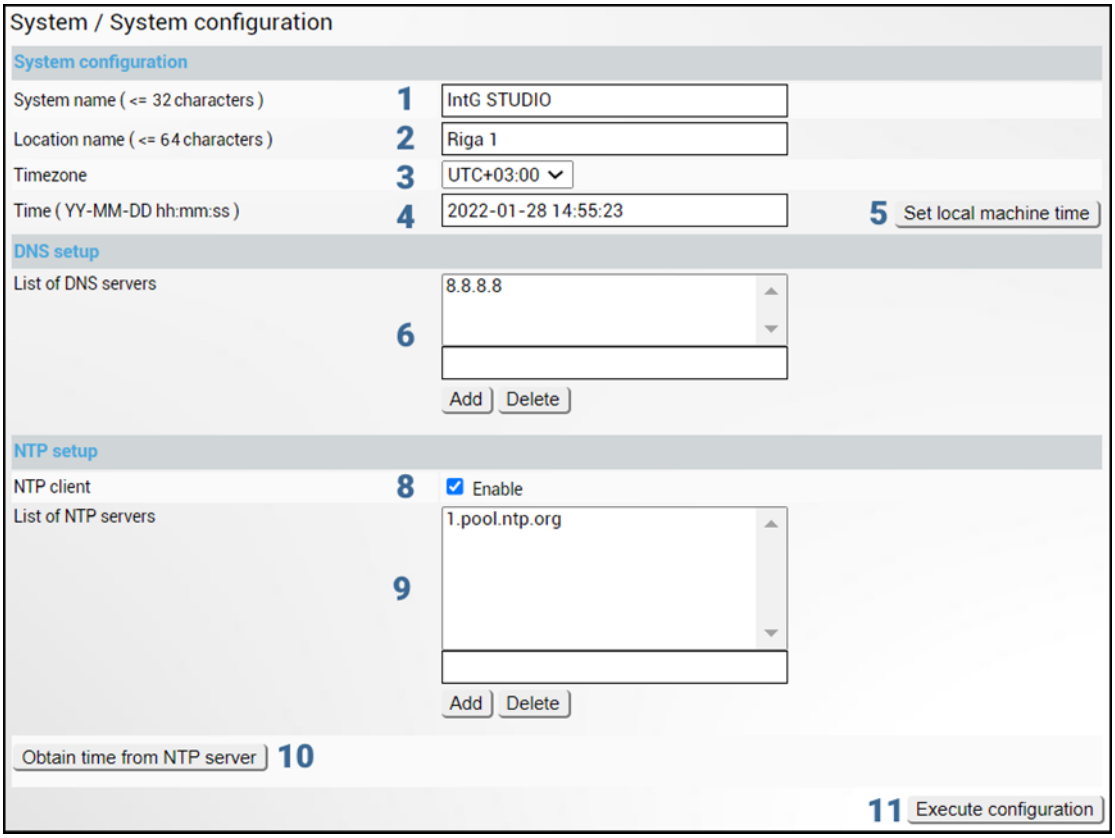


Status mode



Press MODIFY button.

Modify mode



1) ***System name*** – Allows entering a preferable system name. The maximum length of the system name cannot exceed 32 symbols. The default name is 'SAF'.
2) ***Location name*** – Allows entering preferable system location name. The maximum length of the location name cannot exceed 64 symbols. By default, the system location is not specified.

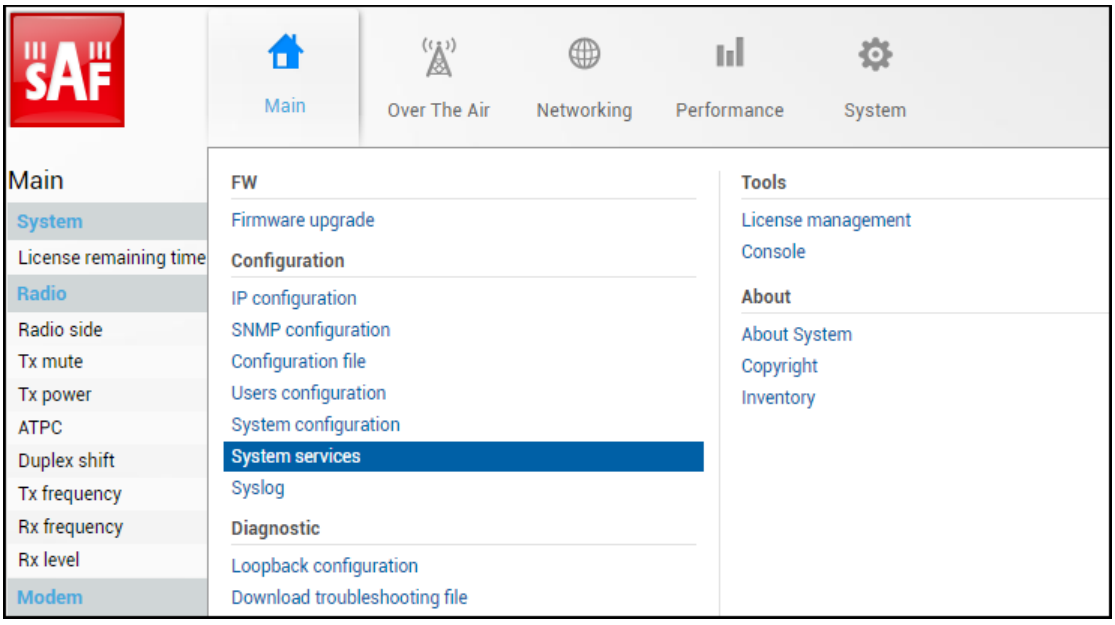
3) ***Timezone*** – Allows specifying the time zone.
4) ***Time (YY-MM-DD hh:mm:ss)*** – Allows changing system date and time manually by entering date and time in a specific syntax.
5) ***Set local machine time*** – Press to force the system to use the time set on your PC, from which you are connected to the Web GUI.
6) ***List of DNS servers*** - Allows adding or deleting IP addresses of DNS servers.
7) Possibility to resolve domain names to check if DNS requests are working.
8) ***NTP client*** – Allows enabling or disabling the NTP (Network Time Protocol) client.
9) ***List of NTP servers*** – Allows adding or deleting IP addresses or domain names of NTP servers.
10) ***Obtain time from NTP server*** – Press to force the system to obtain the time from an NTP server.
11) By pressing *„Execute configuration",* changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

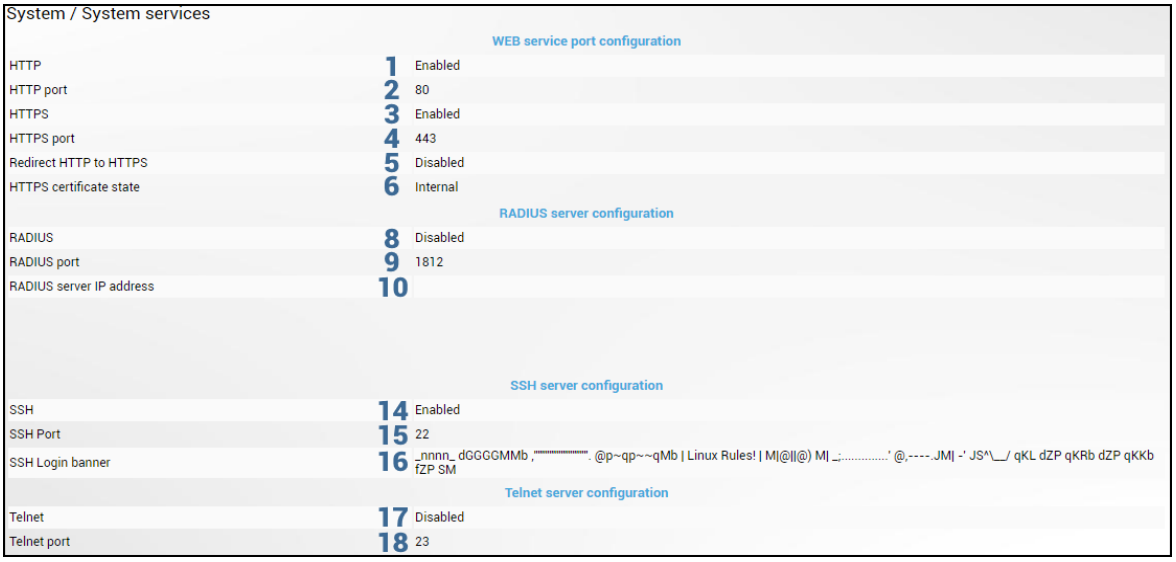
system datetime <datetime>	Use to show/set system time and date. Use "YYYY-MM-DD/hh:mm:ss" syntax for date/time.
system discovery clear	Use to clear device surroundings
system discovery list	Use to show the list of found devices using discovery protocol
system discovery refresh	Use to refresh device surroundings
system discovery remote <dst> <bcast>	Use to perform remote discovery using specified IP address and broadcast IP address
system dns dig <domain name>	Use to resolve a domain using configured DNS servers.
system dns server {add <DNSip> | clear | remove <DNSip>}	Use to add/remove DNS server with a specified IP address or to remove all DNS servers from a list.
system dns status	Use to show configured DNS servers` list.
system location <location>	Use to show/define system location.
system name <sysname>	Use to show/define system name.
system ntp {enable | disable}	Use to enable or disable NTP client.
system ntp server {add <NTPip> | clear | remove <NTPip>}	Use to add/remove NTP server with a specified IP address/hostname or to remove all NTP servers from a list.
system ntp status	Use to show NTP status and 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 time 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.

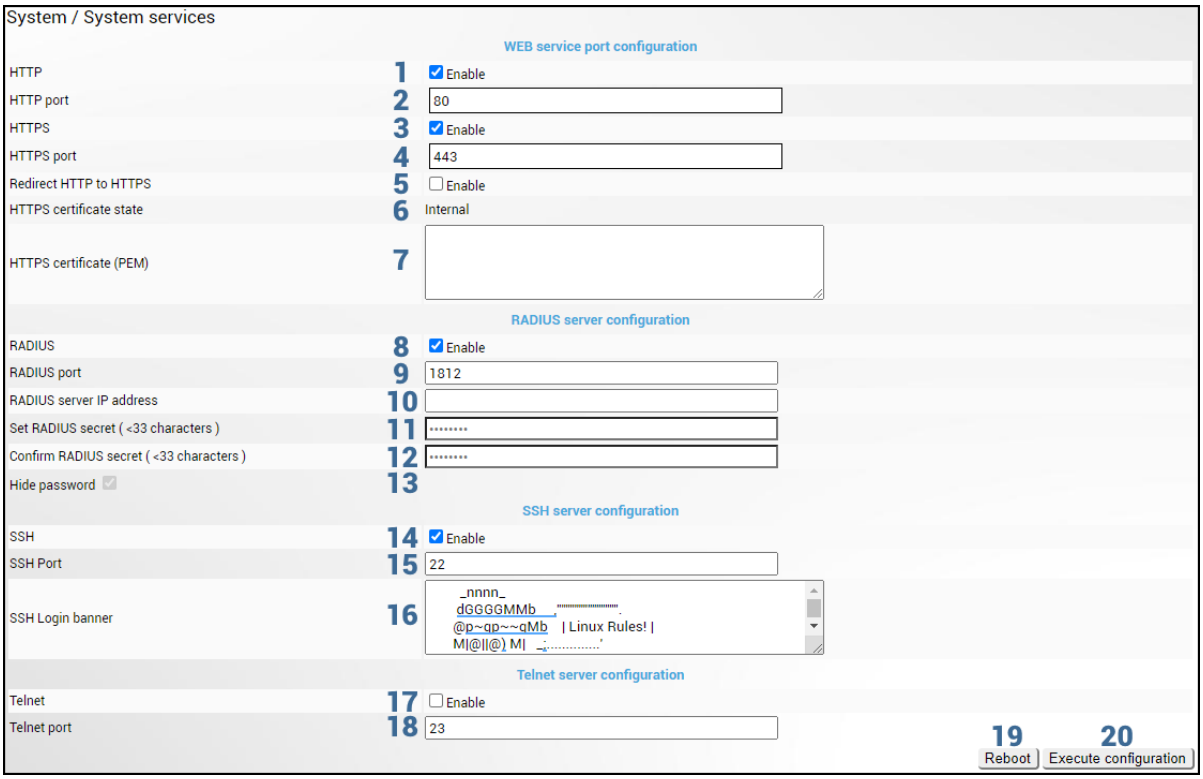


Status mode



Press MODIFY button.

Modify mode



1) ***HTTP*** – allows disabling or enabling HTTP access to 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 Web GUI. By default HTTPS access is enabled.

> By disabling both HTTP and HTTPS you will lose 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 can be 2 types of SSL certificates:
   a. *User* – user 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 for some reason can't use the User certificate and there are any errors in the User certificate usage process, then Integra will use the Internal certificate for HTTPS connections.
7) ***HTTPS certificate (PEM)*** – user can paste PEM format textual encoding of SSL certificate in this field and then the device will use this SSL certificate for HTTPS connections.
8) ***RADIUS*** - allows enabling or disabling RADIUS (Remote Authentication Dial-In User Service) server authentication for device access. By default, RADIUS server usage is disabled.
9) ***RADIUS port*** – allows specifying a port for RADIUS server access. By default, port 1812 is defined.
10) ***RADIUS server IP address*** – allows specifying RADIUS server IP address.
11) ***Set RADIUS secret*** – allows specifying RADIUS server password.

12) ***Confirm RADIUS secret*** – used for confirmation of RADIUS server password.
13) ***Hide password*** - uncheck to see the entered RADIUS server password in plain text.
14) ***SSH*** - allows enabling or disabling SSH service on the device.
15) ***SSH Port –*** allows selecting a port number for SSH service.
16) ***SSH Login banner –*** allows to enter a textual banner message that will be shown when a user will try to login to the device via SSH connection.
17) ***Telnet –*** allows enabling or disabling Telnet service on the device.
18) ***Telnet port -*** allows selecting a port number for Telnet service.
19) ***Reboot*** – allows rebooting the Integra/Integra-S/Integra-G/Integra-GS device (cold restart).
20) By pressing ***„Execute configuration"*** changes made in this section will be applied to the local side Integra 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.

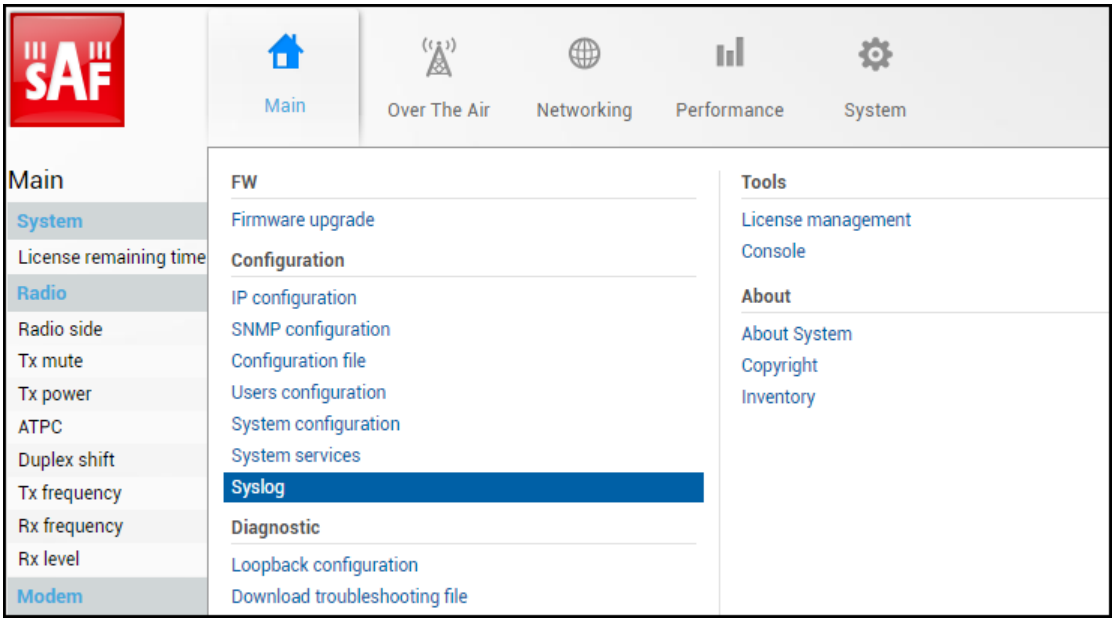
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

system service HTTP {enable | disable}	Use to show status or enable/disable HTTP service.
system service HTTP port <port>	Use to show/change the port number for HTTP service.
system service HTTPS {enable | disable}	Use to show status or enable/disable HTTPS service.
system service HTTPS port <port>	Use to show/change the port number for 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 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 SSH service.
system service ssh port {set <port> | reset | show}	Use to set/reset/show a port number of SSH service. By default, port 22 is defined.
system service ssh status	Use to show the status of SSH service.
system service status	Use to show 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 TELNET service. By default, port 23 is defined.
system service telnet status	Use to show the status of the TELNET service.

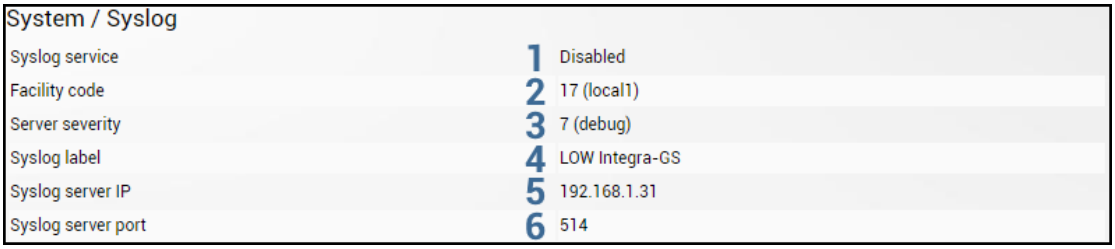
system service telnet-client <IP_address>	Use to connect to a remote Integra with the specified IP address. (This command is not supported in Web Console).
system radius addr <IP_address>	Use to define RADIUS server IP address.
system radius {enable | disable}	Use to enable/disable RADIUS configuration.
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/-S/-G/-GS supports the Syslog standard for system management message logging and sending to a monitoring Syslog server.

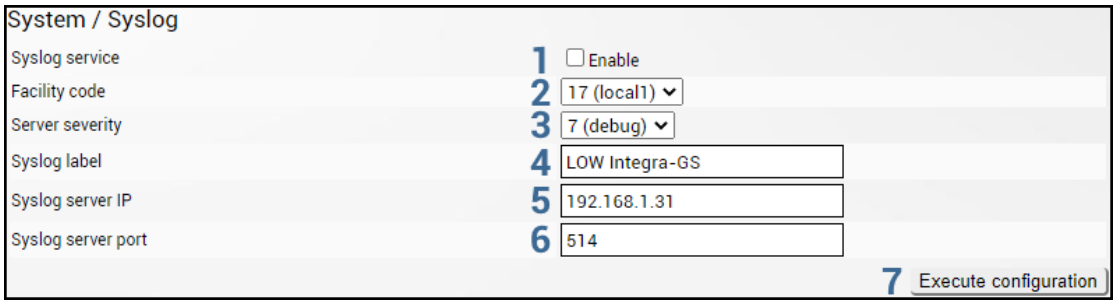


Status mode



Press MODIFY button.

Modify mode



1) ***Syslog service*** – allows enabling ☑ or disabling ☐ Syslog service on the device.
2) ***Facility code*** – allows selecting 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 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 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 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 additionally textual labeling/tagging for Syslog messages.

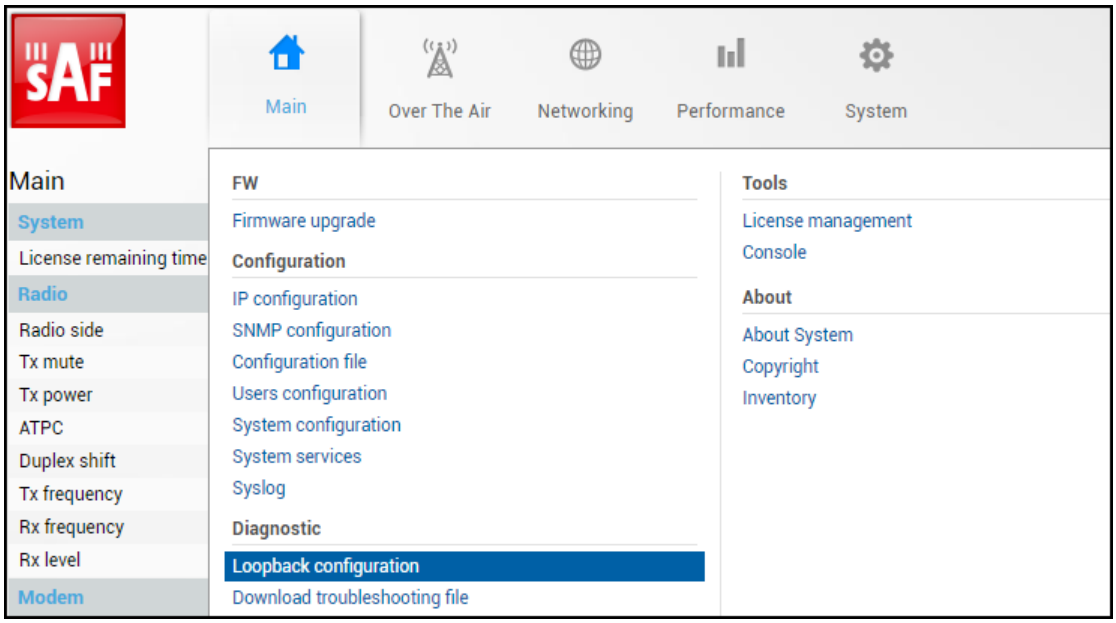
5) ***Syslog server IP*** – allows configuring an IP address for the Syslog server where the device should send Syslog messages.
6) ***Syslog server port*** – allows configuring port that the device should use for Syslog message sending.
7) By pressing *„Execute configuration"*, changes made to the corresponding section apply only to the local side Integra/Integra-S/Integra-G/Integra-GS.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

log syslog cfg	Use to show 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 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 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.



Status mode

Press MODIFY button.

Modify mode

1) ***Modem loopback*** – Indicates whether modem loopback is active (status mode); Allows enabling modem loopback by changing status to "On" and specifying loopback duration time (modify mode). During modem loopback, the signal is looped back to the local end after the modem and Integra/Integra-S/Integra-G/Integra-GS should be able to synchronize to itself. Neither MSE nor FEC load should generate an alarm (values should not be colored in red). When a loopback is activated, "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/Integra-S/Integra-G/Integra-GS.

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

Below is an example of the Main status page during modem loopback:

Main

System	Local	Remote
License remaining time	Unlimited	N/D
Radio	**Local**	**Remote**
Radio side	Low	N/D
Tx mute	Disabled	N/D
Tx power	0 dBm	N/D
ATPC	Enabled	N/D
Duplex shift	728 MHz	N/D
Tx frequency	14529 MHz	N/D
Rx frequency	15257 MHz	N/D
Rx level	-45 dBm	N/D
Modem	**Local**	**Remote**
Bandwidth	56 MHz ETSI Variable Tx power	N/D
Modem profile	1024QAM WeakFEC ACM	N/D
Modem loopback	Enabled, digital	N/D
ACM engine	Enabled	N/D
Acquire status	Locked	N/D
MSE	-50.2 dB	N/D
FEC load	0.0e+00	N/D
Current Rx modulation	1024QAM WeakFEC	N/D
Current Tx modulation	1024QAM WeakFEC	N/D
Current Rx Ethernet capacity	456.8 Mbps	N/D
Current Tx Ethernet capacity	456.8 Mbps	N/D

Ethernet			
Port	LAN1 (RJ-45)	LAN2 (SFP)	LAN3 (SFP)
State	Enabled	Disabled	Disabled
Status	Up	Down	Down

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

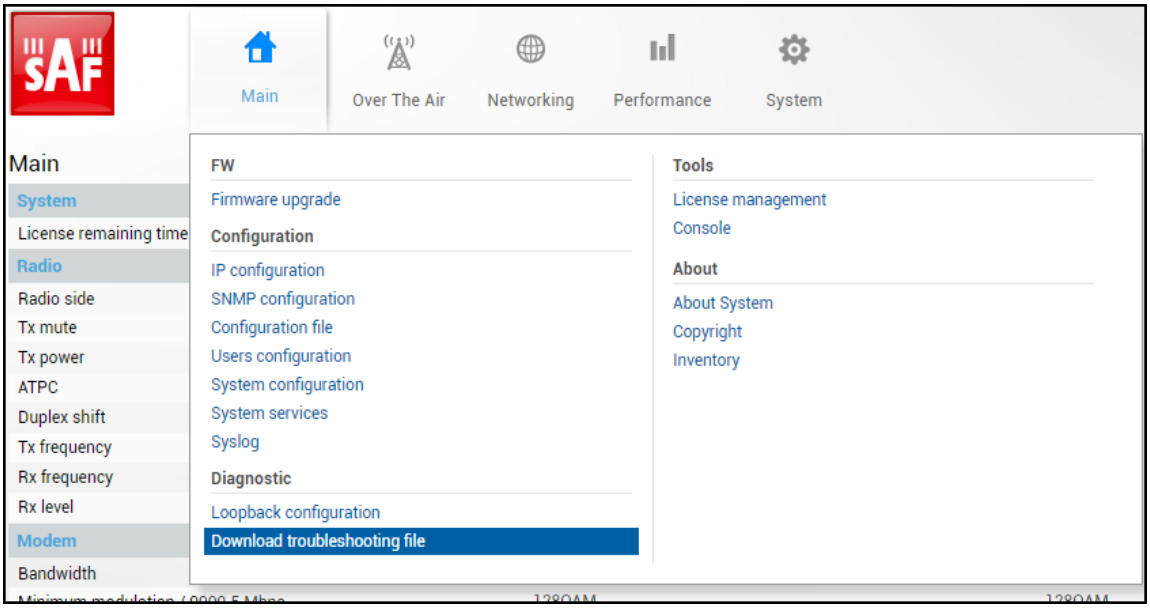
modem loopback	Use to show modem loopback status.

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” a “.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 provide the troubleshooting file.



Clicking on the link will download the troubleshooting file archive package to your hard disk drive (“Downloads” folder of your browser).

File contents:

conf	Subfolder with last configuration files
config.txt	Saved system configuration file
constell.bmp	Snapshot of modem constellation graph
devel.tar.gz	For debugging only
equ_tap.bmp	Snapshot of the adaptive equalizer taps` coefficients
eventlog.txt	Alarm-event log file
Perflog_347040100173_D15G2R02L_2023-12-22_14-36-47.zip	Archive containing performance log files with maximum 1440 entries for 1, 15, and 60-minute intervals
spectrum.bmp	Snapshot of modem Rx spectrum graph
troubleshoot.html	Information on currently running firmware and stored firmware files; system configuration including Web services, RADIUS, IP address, user, NTP configuration,

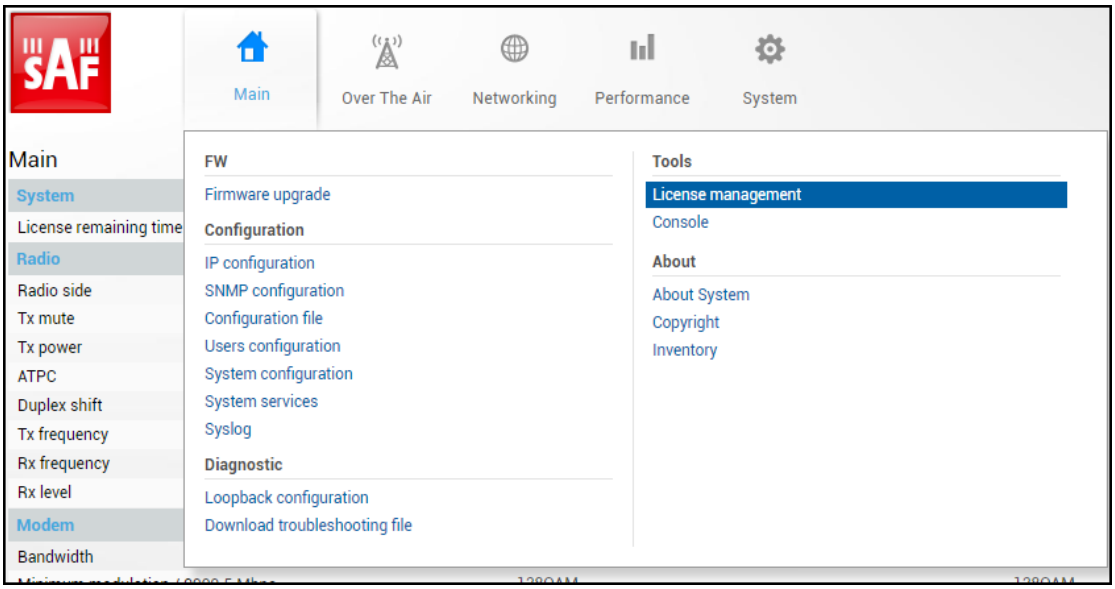
	and inventory info; SNMP v1/v2c/v3 configuration; alarm status, alarm threshold, and sensor configurations; radio status, configuration, and counters; currently active license and added license files; modem including modem status and configuration, counters, list of allowed modem profiles, header compression; Ethernet configuration and counters of LAN, WAN and MNG ports

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

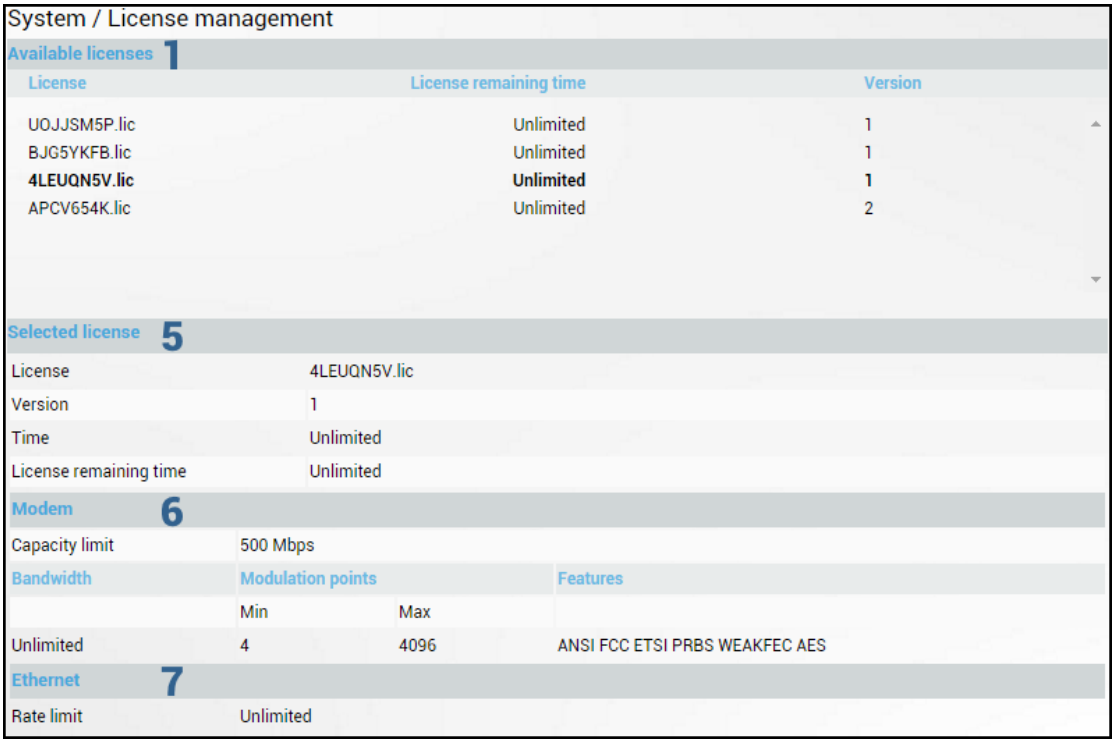
system troubleshoot clear	Use to clear ftp://misc/ directory
system troubleshoot diag	Use to show troubleshooting file diagnostics information
system troubleshoot export ftp	Use to export troubleshooting file to ftp://misc/ directory
system troubleshoot make	Use to generate troubleshooting file
system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

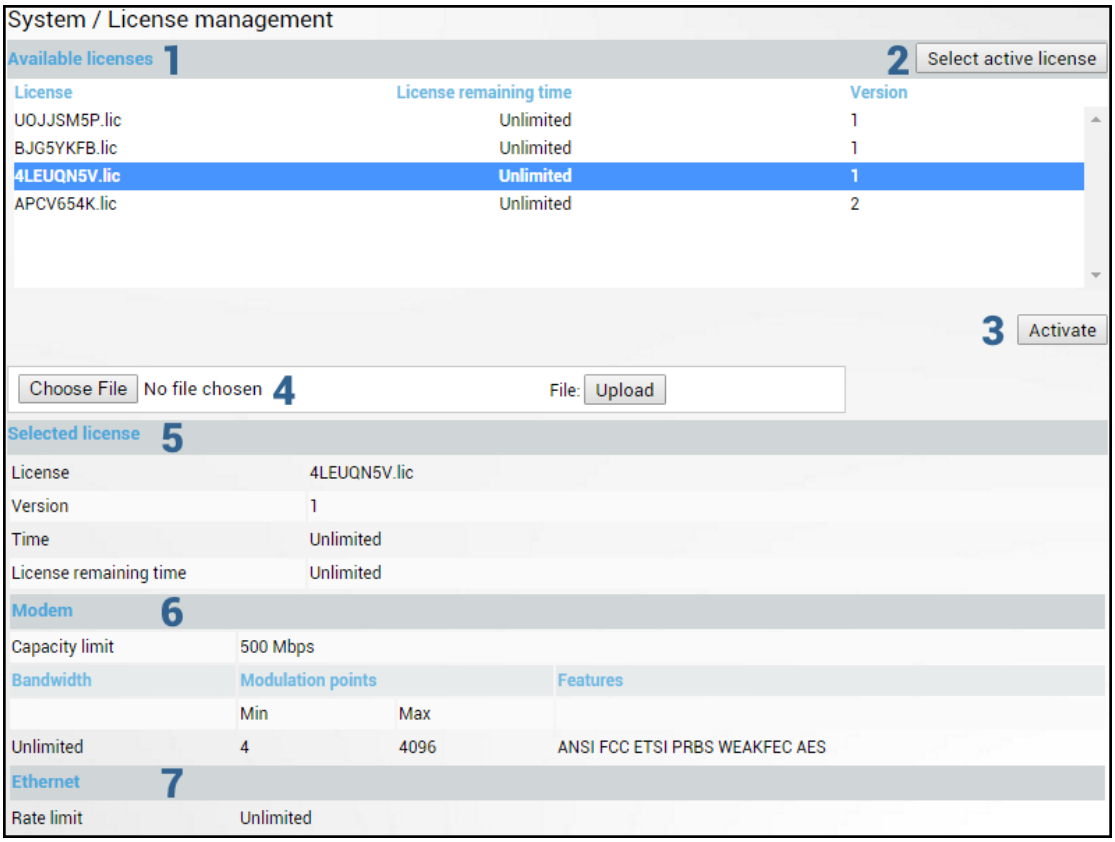


Status mode



Press MODIFY button.

Modify mode



1) ***Available licenses*** – shows a list of available licenses, remaining time, and version.
2) ***Select active license*** **–** automatically selects the currently active license from the list.

3) ***Activate*** – Select a license from the list and press "Activate" to switch to the preferable license.
4) ***Browse*** or ***Choose File*** (depending on the used web browser) ***& Upload*** – Press to browse for a license file (*.lic) on your hard disk drive. Press "Upload" to upload a license file (*.lic) to the Integra/Integra-S/Integra-G/Integra-GS.
5) ***Selected*** – shows version and time of 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.

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 uploaded the license file to the license file list from the FTP directory.
license file activate <filename>	Use to activate previously added license file.
license file restriction <filename>	Use to view the settings of a license file.

New license activation

For activating a license please follow these steps:

1) Open the License management page in Web GUI „System/Tools/License management".
2) Press „MODIFY" button.
3) Press "Browse" or "Choose File" button (depending on the used web browser), navigate to the license file (*.lic), select it, and press "Upload".
4) Choose the uploaded license from the list and press "Activate" button.

If a new license supports the current modem configuration, no configuration changes will be applied, and link synchronization will not be disrupted.

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.

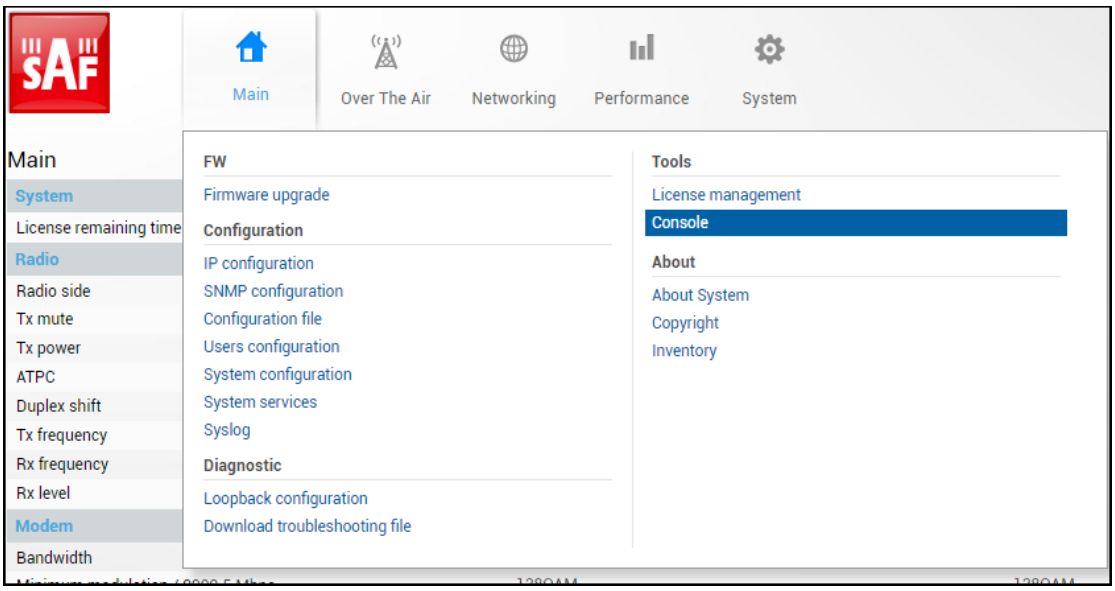
When the license expires, the modulation will drop to "4QAM FEC Limited" and the link capacity will drop to 256Kbps.

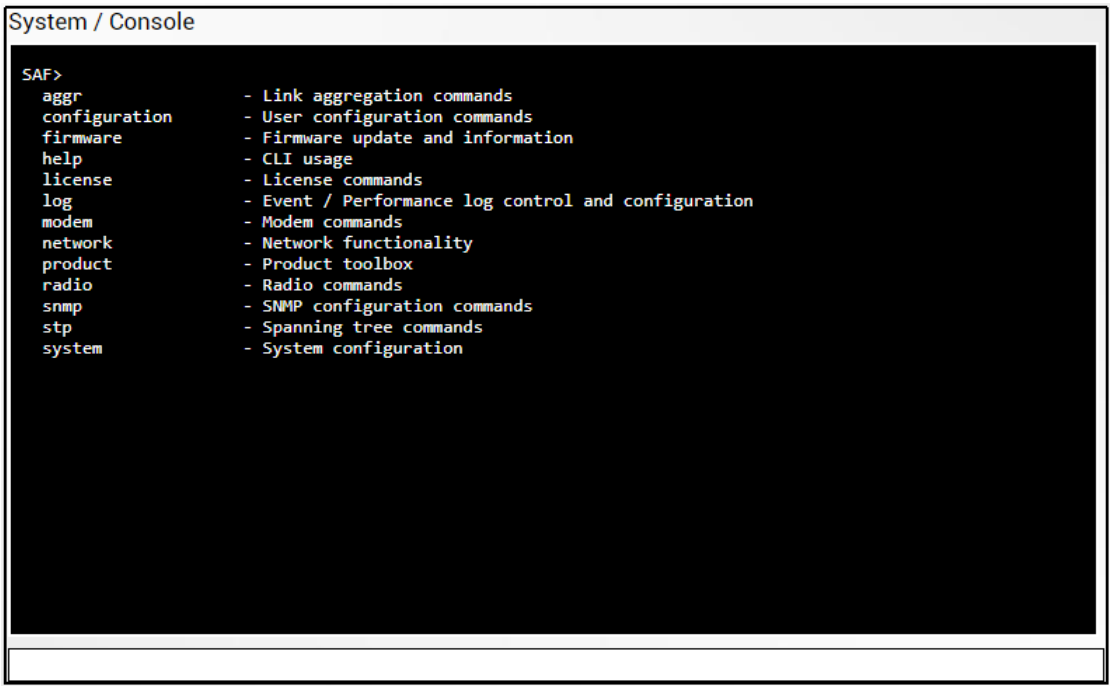
When the license expires, the next license in the list needs to be activated manually.

Version 1 licenses always have an "Unlimited" Ethernet rate limit.

System → Tools → Console

Provides CLI functionality in Web GUI.





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

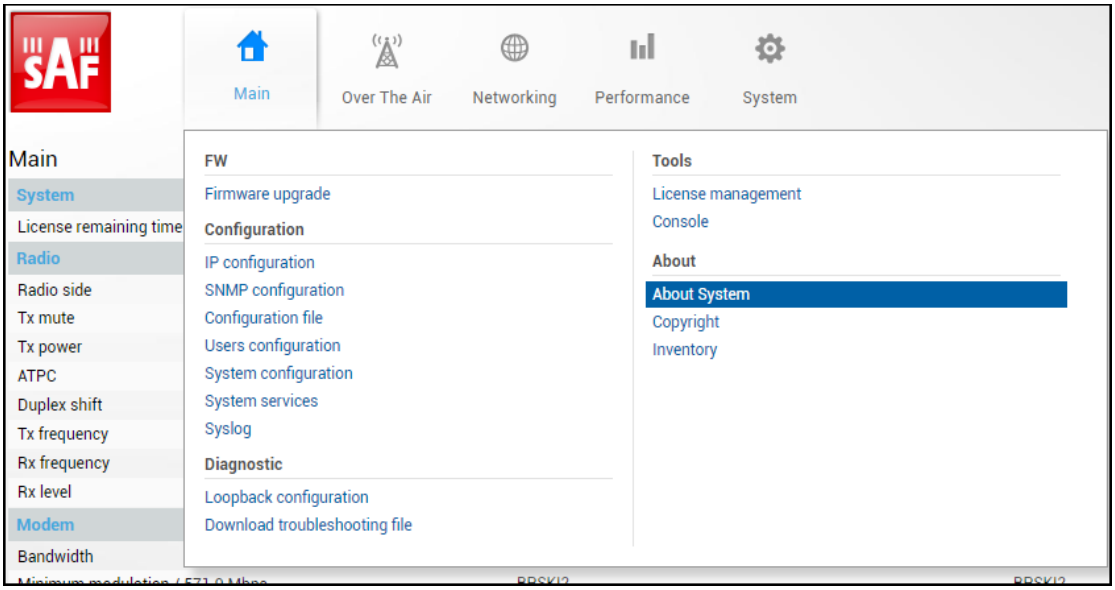
Use ↵ ENTER key to execute entered command.

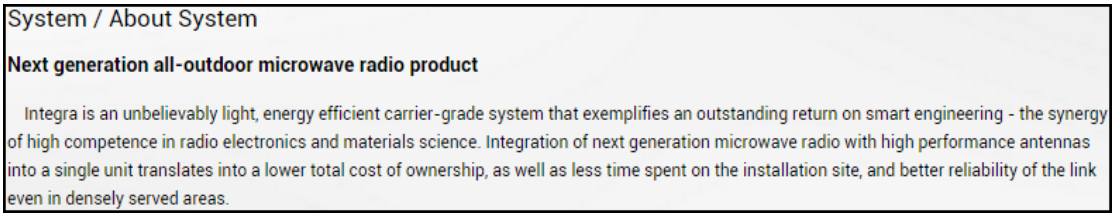
A list of valid CLI commands can be found at the end of each Web GUI page description.

Refer to Chapter 4: COMMAND LINE INTERFACE for details on how to connect to other CLI interfaces (serial, SSH, Telnet).

System → About → About System

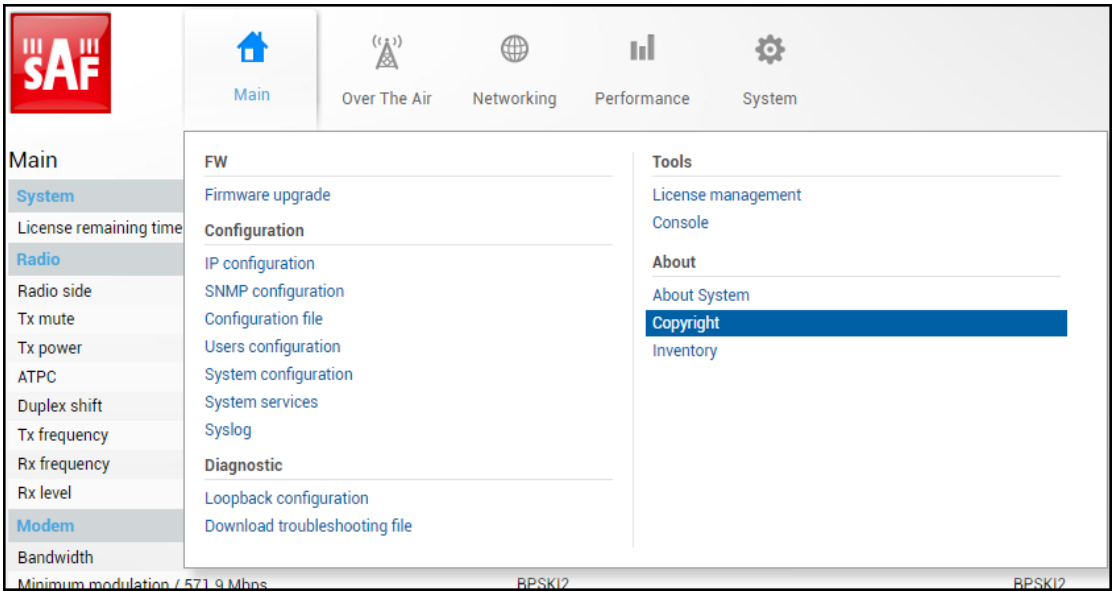
Provides a short description of Integra/Integra-S/Integra-G/Integra-GS series products.

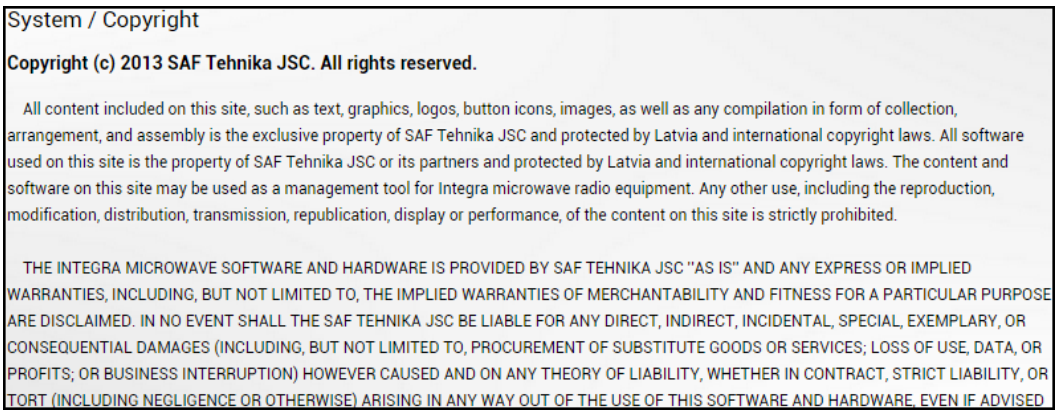




System → About → Copyright

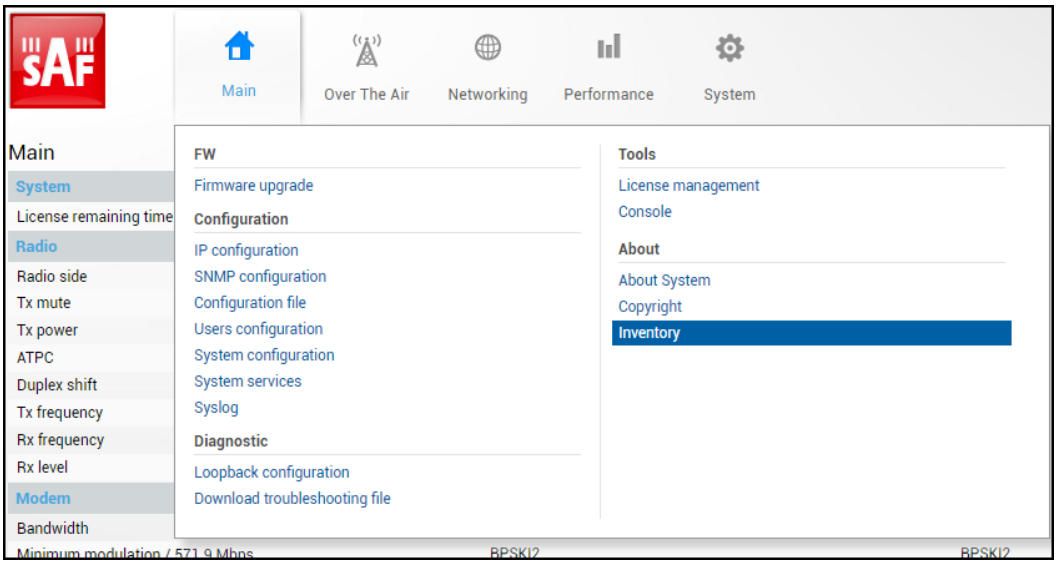
Displays copyright information.





System → About → Inventory

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



System / Inventory

MB ID	0
MB Sub ID	0
MB revision	3
MAC	000.004.166.129.073.240 - 00.04.A6.81.49.F0
Model	Integra-G
System Contact	techsupport@saftehnika.com
Device Name	SAF
Description	SAF microwave radio
Copyright	Copyright (c) 2013 SAF Tehnika JSC. All rights reserved.
Product Code	D15G2R02L
Product Serial Number	347040100173
Enterprise ID	7571

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

product info	Use to show detailed information on the Integra/Integra-S/Integra-G/Integra-GS FODU.
system number	Use to show the Integra/Integra-S/Integra-G/Integra-GS serial number.

Chapter 4: COMMAND LINE INTERFACE

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

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

The available CLI commands are found in “CLI commands” tables in each corresponding Web GUI page section in Chapter 3: WEB GUI.

For SSH, Telnet, or serial connection you can use any client supporting 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
```

Note that on the *Console* page in Web GUI (System → Tools → Console) those shortcuts will not work.

Connecting to serial RS232 interface

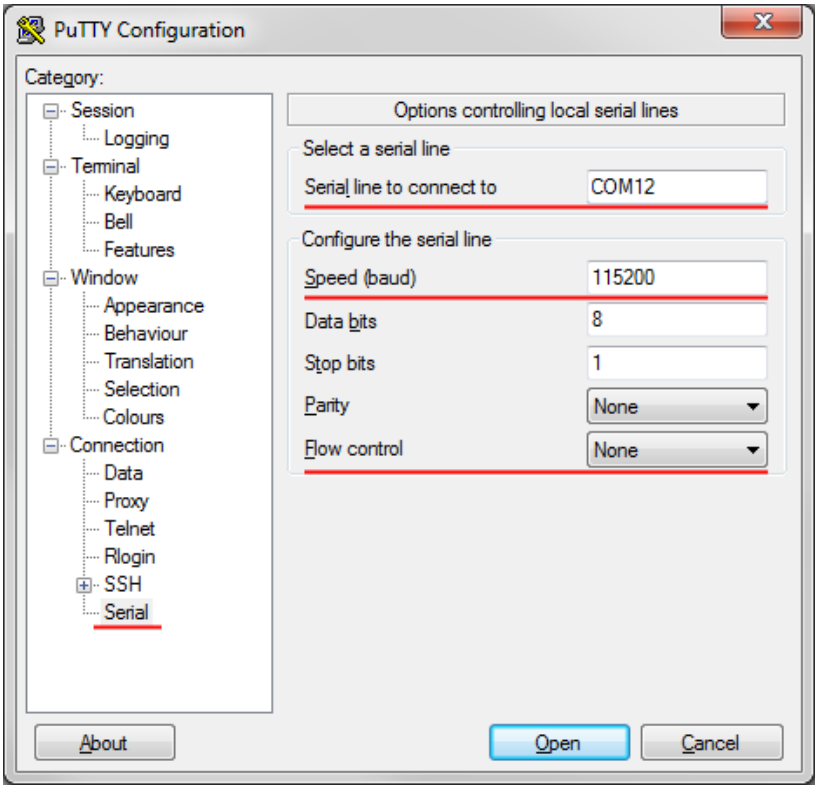
To connect to an Integra/Integra-S/Integra-G/Integra-GS serial terminal, you will require a USB cable with a USB Type B connector. Please refer to Chapter USB port for pinouts.

To connect the PC to the RS232 management port, using serial terminal-emulation software (e.g. *PuTTY*), use the following parameters:

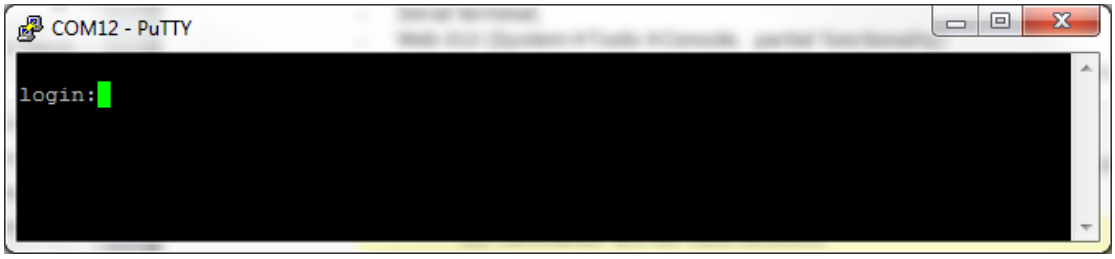
- Baud rate: 115200
- Data bits: 8
- Parity: None
- Stop bits: 1
- Data flow control: None

Below are connection steps with *PuTTY* - Windows freeware software.

1) Open *PuTTY* and go to “Serial” category. Specify the COM port number you will be using, and change “Speed (baud)” to “115200” and “Flow control” to “None”:



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



3) Enter username and password. Default credentials are as follows:
   - login: **admin**
   - password: **changeme**

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

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

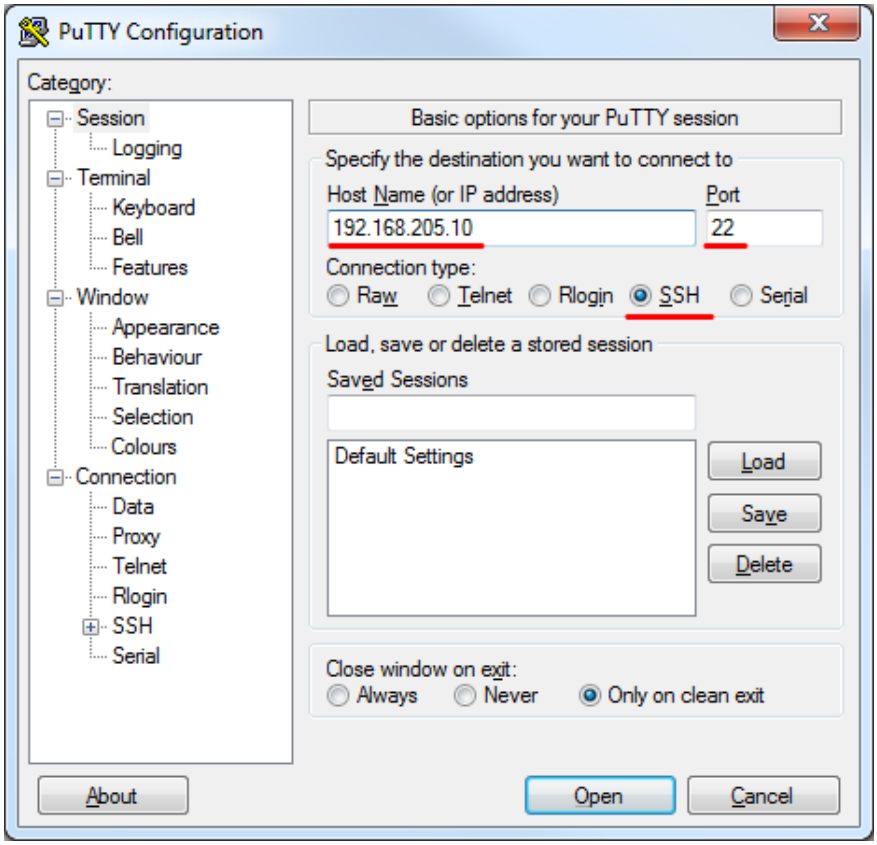
Closing the *PuTTY* window does not log off from the current serial terminal session.

Connecting to SSH

The SSH connection to the Integra/Integra-S/Integra-G/Integra-GS FODU is carried out using an Ethernet management connection. Please refer to the chapter Ethernet management connection configuration for Ethernet management port connection details.

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):



2) Press "Open", and enter login credentials (default user name is *admin* and password - *changeme*). After successful login, the following prompt should appear:

3) Enter username and password. Default credentials are as follows:
   - login: **admin**
   - password: **changeme**

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

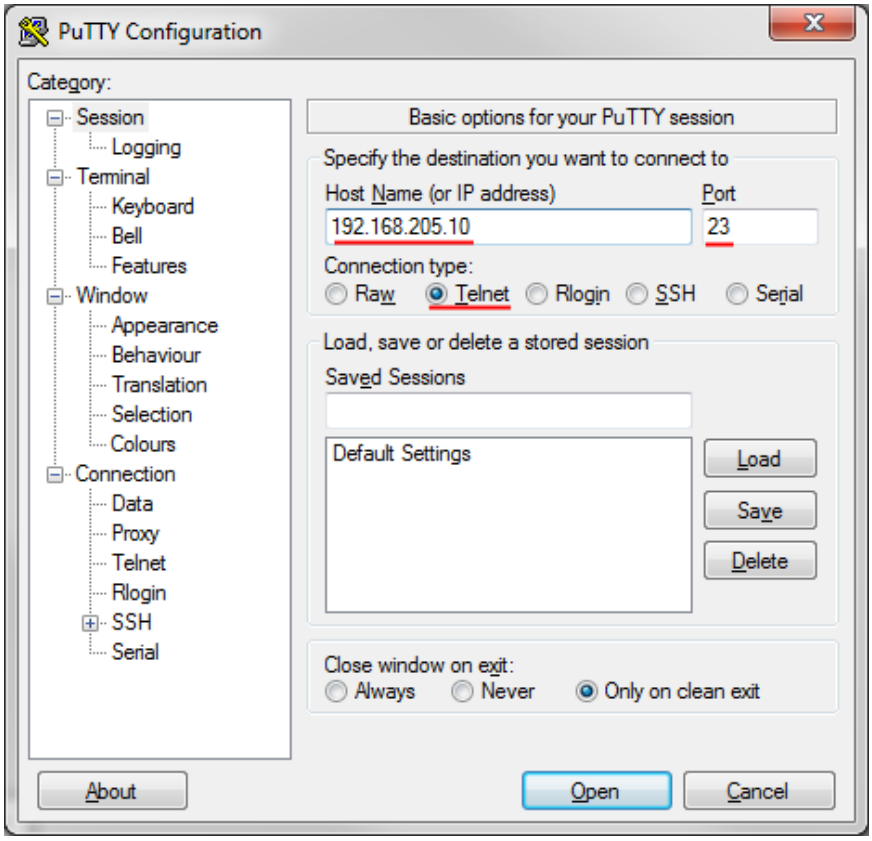
Connecting to Telnet

A Telnet connection to the Integra/Integra-S/Integra-G/Integra-GS FODU is carried out using the Ethernet management connection. Please refer to Chapter Ethernet management connection configuration for Ethernet management port connection details.

By default Telnet service is disabled. See the chapter System → Configuration → System services on how to manage system services.

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).



2) Press “Open” to connect. After a successful connection following prompt should appear:

3) Enter username and password. Default credentials are as follows:
   - login: **admin**
   - password: **changeme**

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

Chapter 5: 17/24GHz

Polarization Considerations

Polarizations at both ends of the link must be opposite for the 17/24 GHz Integra/ Integra-S/Integra-G/Integra-GS FODUs.

For example:

***If High side** radio is installed in **Horizontal polarization**,*

***then Low side** radio must be installed in **Vertical polarization**:*

Changing the radio side

1) Access the Web GUI of the remote side radio first. Check its current radio side value on the Main page:

Radio	Local	Remote
Radio side	Low	High

2) Go to “System -> Console” and execute the command “**radio side high**” to change the radio side to High (in this particular example) or “**radio side low**” to change the radio side to Low. You will lose the connection to your remote side now.
3) Access the Web GUI of the local side radio. Check its current radio side value on the Main page:

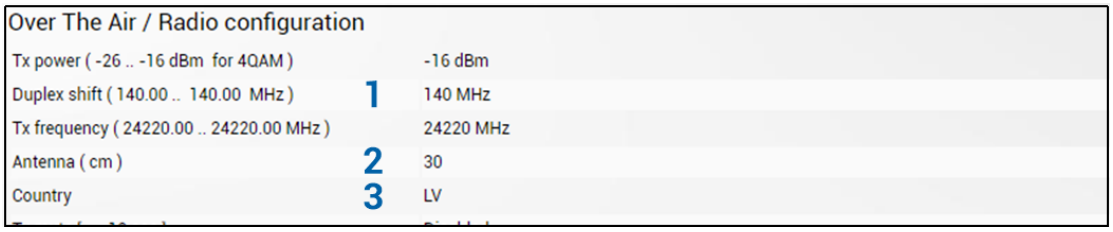
Radio	Local	Remote
Radio side	High	Low

4) Go to “System -> Console” for the local side unit and execute the command “**radio side low**” to change the radio side to Low (in this particular example) or “**radio side high**” to change the radio side to High. The connection to your remote side now will be restored.
5) Save the configuration on both radios.

Radio configuration – extra fields

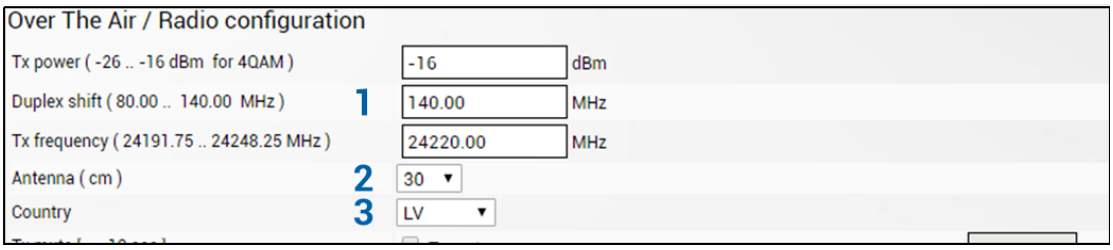
This chapter describes **only the differences** in the configuration for the 17/24 GHz Integra/Integra-S/Integra-G/Integra-GS FODUs. For the configuration in general, refer to the chapter Over The Air → Radio → Configuration.

Status mode



Press MODIFY button.

Modify mode



1) ***Duplex shift*** – Indicates the value between the transmitter frequency and receiver frequency (status mode); allows specifying the value of duplex shift in MHz (modify mode).
2) ***Antenna*** – Indicates the set size of the installed antenna (status mode); allows specifying the diameter of the installed antenna in cm (modify mode). Max Tx power settings depend on national regulatory EIRP allowance and antenna size. Available values - 20, 30, 60, 99, 120 cm.
3) ***Country*** – Indicates the set country code (status mode); allows specifying the country code (modify mode). Max Tx power settings depend on national regulatory EIRP allowance and antenna size. Available values - AU, AT, BE, BG, CA, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IR, IT, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE, UK, US, Custom.

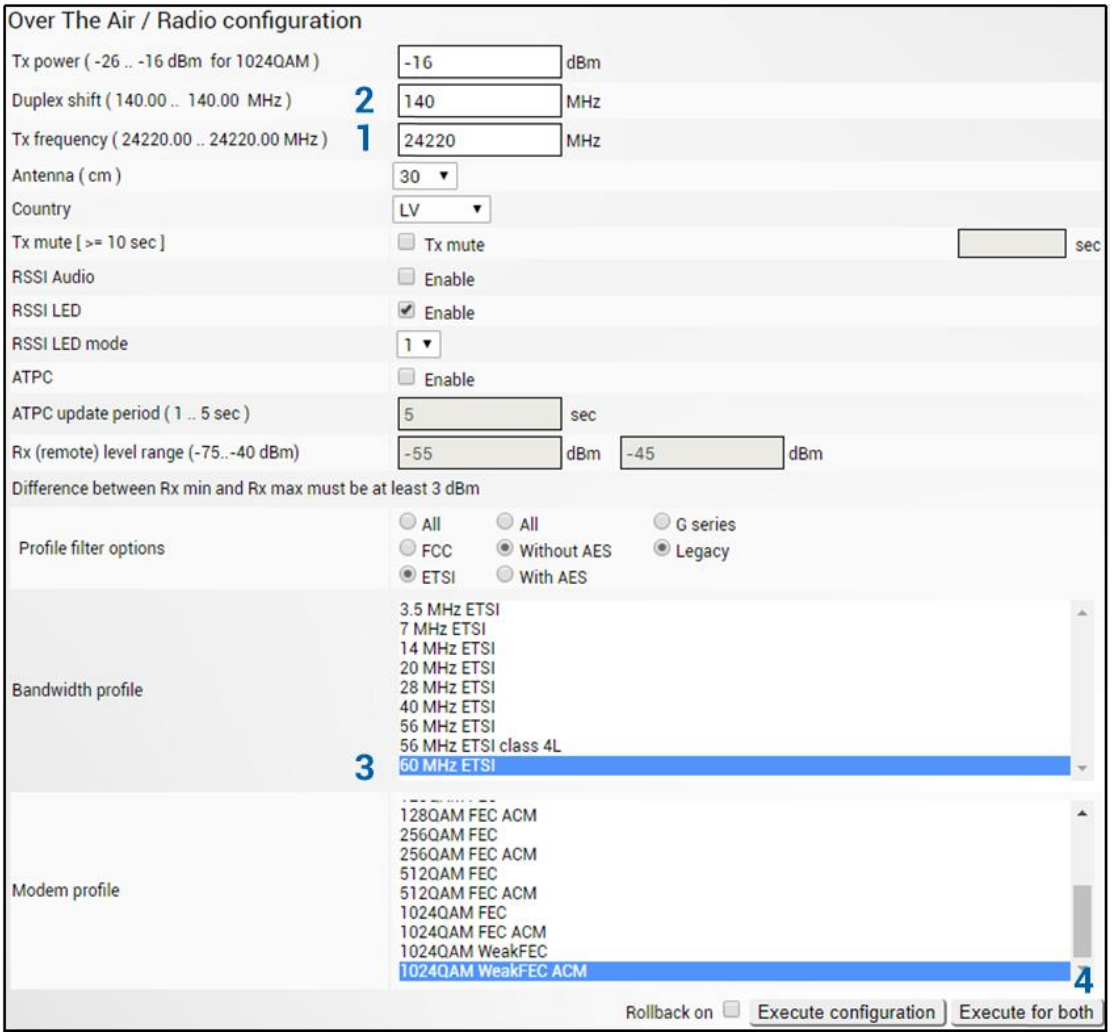
CLI commands (Chapter 4: COMMAND LINE INTERFACE)

radio duplex-shift [<value>]	Use to show/define the value of the duplex shift in kHz.
radio eirp set <antenna> <country>	Use to define antenna size in cm and country code.
radio [status]	Use to show radio status and existing values.

Setting bandwidth to 60MHz

This chapter describes only the differences in setting 60 MHz bandwidth for the 17/24 GHz Integra/Integra-S/Integra-G/Integra-GS FODUs. For the configuration in general, refer to the chapter Over The Air → Radio → Configuration.

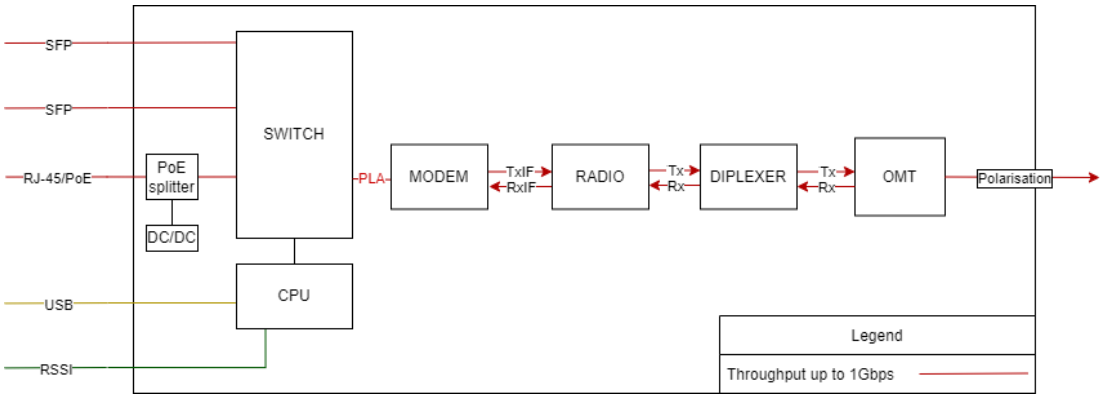
1) Access the Web GUI. Configure the Tx frequency to 17130MHz (17GHz) or 24080MHz (24GHz) if it is low side unit. If it is a high side unit, configure the Tx frequency to 17270MHz (17GHz) or 24220MHz (24GHz).
2) Configure the Duplex shift to 140 MHz.
3) Configure the Bandwidth profile by selecting the needed 60 MHz profile (ETSI/FCC, with/without AES, "G-series"/Legacy).
4) Configure the Modem profile and press "Execute for both".
5) Save the configuration on both radios.



Chapter 6: FUNCTIONAL DESCRIPTION

Integra-G block diagram

The general internal block diagram of Integra-G is shown below. It has a built-in Gigabit Ethernet Network Processor that has three LAN ports: LAN1 - 1Gbps PoE port that you need to use for powering Integra-G (please refer to *Powering Integra/Integra-S/Integra-G/Integra-GS FODU and connecting to PC* for more information), LAN2, and LAN3 SFP ports. Please refer to *SFP ports* to see the SFP compatibility. To get more information about other interfaces, please refer to *Chapter* 8: INTERFACES section.



Information about built-in cooling fans

Integra-S/Integra-GS 6-13GHz 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.

The cooling fans are turned on in the following situations:

1) When the device is powered up (cooling fan operation time 2 minutes).
2) After the reboot of the device (cooling fan operation time 2 minutes).
3) Once after 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 will be 20°C and 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.

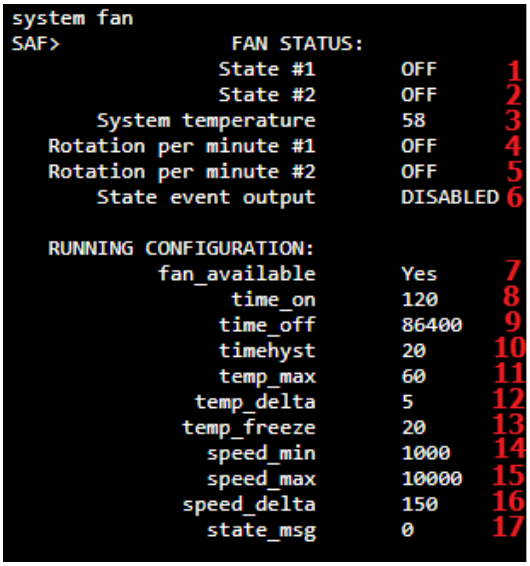
The following fan status conditions are possible:

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:



1) ***State #1*** – shows the operational status of 1st fan in the device.
2) ***State #2*** – shows the operational status of 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 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 reached 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 fan rotation speed falls below this value in ON status, then the device will detect that fan is rotating too slow and will generate an alarm.
15) ***speed_max*** – shows 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 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 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 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 if 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 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 cooling fans is errored

If SNMP trap sending is configured on the device, they will be also sent for fan alarms.

CLI commands (Chapter 4: COMMAND LINE INTERFACE)

system fan events <enable | disable>	Use to enable or disable fan status indication in the event log
system fan	Use to view fan status condition

ACM (Adaptive Coding and Modulation)

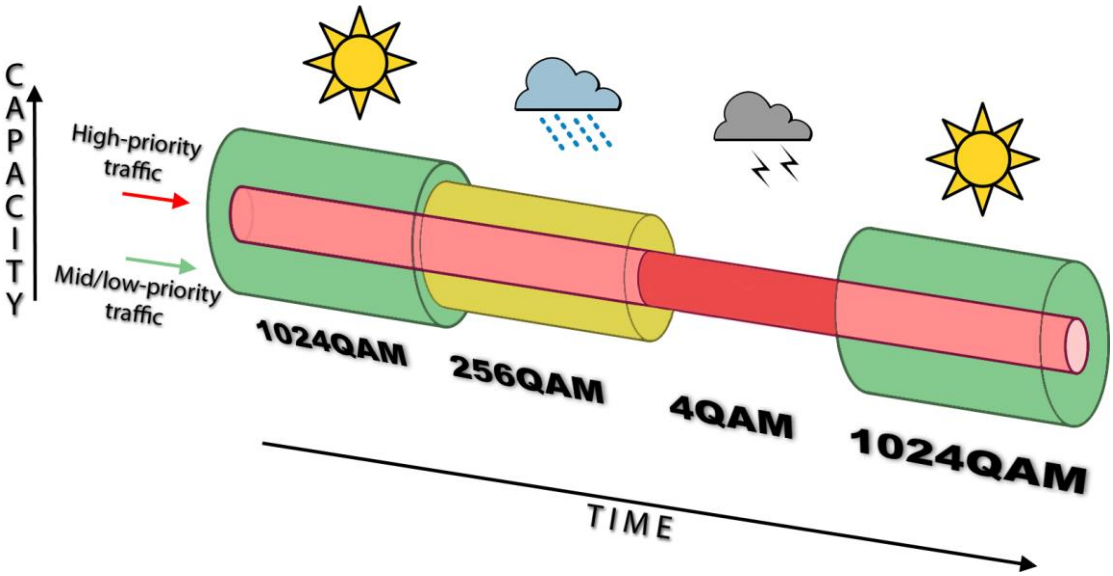
ACM technology allows operators to achieve high-capacity data transmission over microwave links and improve link utilization. This reduces both operational and capital expenditures for maintaining high-capacity links. ACM can maintain the highest link spectral efficiency possible at any given time in 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, and video conferencing can operate at more relaxed availability levels. With the use of QoS prioritizing ACM can allocate the required availability based on the priority. As a result, high-priority services such as voice enjoy 99.995% availability, while low-priority services like video streaming are allocated lower priorities.

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

For example, when bad weather has decreased the channel capacity of a link, ACM maintains high-priority services – such as voice data – with full bandwidth capacity while adapting the bandwidth capacity of low- and mid-priority services such as Internet browsing.



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

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

An ACM profile defines the link parameters (modulation) for a given range of the MSE (Mean Square Error), 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. Each ACM profile has a different spectral efficiency, derived from its modulation and FEC mode.

FEC mode can be Weak or Strong depending on FEC overhead size – smaller or weaker respectively. As a result, Weak FEC mode provides higher throughput (5…10%) sacrificing 2-4dB of sensitivity, and vice versa for StrongFEC.

To maintain linearity, Tx power decreases for higher modulations. Tx power difference between 4QAM and 1024QAM is 8dB.

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

Once the MSE exceeds the threshold of the current ACM profile, an ACM switching process will be initiated. In the case of degradation in the link performance, the new ACM profile will include lower modulation, decreasing the link bitrate. The ACM switching rate is hitless, meaning that no data will be lost during a change of ACM profiles.

MSE values for ACM downshift and upshift can be found in the table below.

MSE for ACM (fixed / variable power, dB)

	3.5 MHz	5 MHz
16QAM SF→4QAM SF	-17.9 / -19.9	-18.0 / -19.7
4QAM SF→16QAM SF	-19.9 / -22.3	-19.4 / -20.9
32QAM SF→16QAM SF	-22.1 / -23.7	-22.2 / -23.3
16QAM SF→32QAM SF	-24.0 / -24.3	-23.6 / -25.5
64QAM SF→32QAM SF	-24.6 / -25.7	-24.3 / -25.3

32QAM SF→64QAM SF	-26.1 / -27.4	-26.0 / -27.5
128QAM SF→64QAM SF	-28.3 / -28.6	-27.5 / -28.7
64QAM SF→128QAM SF	-29.7 / -30.5	-29.1 / -30.9
128QAM WF→128QAM SF	-31.5 / -30.5	-31.4 / -30.9
128QAM SF→128QAM WF	-32.3 / -32.0	-32.7 / -32.0

	7 MHz	10 MHz
16QAM SF→4QAM SF	-18.0 / -18.9	-18.0 / -18.5
4QAM SF→16QAM SF	-19.5 / -20.5	-19.1 / -20.4
32QAM SF→16QAM SF	-21.5 / -22.9	-21.8 / -22.2
16QAM SF→32QAM SF	-23.2 / -25.0	-23.2 / -24.4
64QAM SF→32QAM SF	-24.3 / -24.4	-23.8 / -23.4
32QAM SF→64QAM SF	-25.9 / -26.5	-25.5 / -26.3
128QAM SF→64QAM SF	-26.9 / -27.5	-27.5 / -27.4
64QAM SF→128QAM SF	-28.5 / -29.7	-28.9 / -29.7
256QAM SF→128QAM SF	-30.3 / -31.6	-30.4 / -31.1
128QAM SF→256QAM SF	-32.0 / -35.2	-31.9 / -34.1
256QAM WF→256QAM SF	-32.9 / -34.1	-33.3 / -33.6
256QAM SF→256QAM WF	-34.3 / -35.5	-34.9 / -34.9

	14 MHz
16QAM SF→4QAM SF	-18.2 / -18.3
4QAM SF→16QAM SF	-19.6 / -20.3
32QAM SF→16QAM SF	-21.7 / -21.3
16QAM SF→32QAM SF	-23.4 / -23.5
64QAM SF→32QAM SF	-23.7 / -23.8
32QAM SF→64QAM SF	-25.5 / -26.2
128QAM SF→64QAM SF	-27.1 / -27.3
64QAM SF→128QAM SF	-28.7 / -29.9
256QAM SF→128QAM SF	-30.1 / -31.2
128QAM SF→256QAM SF	-31.8 / -34.7
512QAM SF→256QAM SF	-33.3 / -34.3
256QAM SF→512QAM SF	-34.7 / -36.5
512QAM WF→512QAM SF	-36.5 / -37.3
512QAM SF→512QAM WF	-38.1 / -39.1

	20 MHz FCC	20 MHz ETSI	25 MHz
16QAM SF→4QAM SF	-16.7 / -17.9	-16.7 / -18.2	-16.2 / -17.5
4QAM SF→16QAM SF	-18.4 / -20.2	-18.3 / -19.9	-18.8 / -20.3
32QAM SF→16QAM SF	-20.5 / -20.8	-20.6 / -21.6	-20.9 / -21.2
16QAM SF→32QAM SF	-22.3 / -23.4	-22.7 / -23.5	-22.5 / -23.6
64QAM SF→32QAM SF	-23.5 / -23.9	-23.2 / -24.2	-23.2 / -23.8
32QAM SF→64QAM SF	-25.2 / -26.5	-25.2 / -26.5	-25.2 / -25.8
128QAM SF→64QAM SF	-26.3 / -27.0	-26.5 / -27.1	-26.2 / -26.9
64QAM SF→128QAM SF	-28.2 / -29.4	-28.2 / -29.2	-27.7 / -28.5
256QAM SF→128QAM SF	-24.8 / -30.5	-29.8 / -30.5	-29.4 / -30.1
128QAM SF→256QAM SF	-31.6 / -33.5	-31.3 / -34.1	-31.3 / -32.9
512QAM SF→256QAM SF	-32.6 / -33.6	-32.9 / -33.7	-32.8 / -33.1
256QAM SF→512QAM SF	-34.3 / -36.0	-34.5 / -35.9	-34.3 / -34.8
1024QAM SF→512QAM SF	-36.1 / -36.8	-36.4 / -37.0	-36.4 / -36.4
512QAM SF→1024QAM SF	-37.5 / -39.0	-37.8 / -39.0	-37.5 / -38.2
1024QAM WF→1024QAM SF	-38.6 / -38.8	-38.3 / -38.8	-38.0 / -37.7
1024QAM SF→1024QAM WF	-39.9 / -39.9	-39.6 / -40.2	-39.6 / -39.0

	28 MHz	30 MHz	40 MHz FCC	40 MHz ETSI
16QAM→4QAM	-17.0 / -17.5	-17.2 / -17.5	-16.9 / -17.9	-17.1 / -17.4
4QAM→16QAM	-18.6 / -19.9	-18.8 / -19.6	-18.7 / -19.7	-18.8 / -19.5
32QAM→16QAM	-20.2 / -20.9	-21.2 / -20.7	-20.8 / -21.7	-20.9 / -20.9
16QAM→32QAM	-22.6 / -23.2	-22.5 / -23.0	-22.5 / -23.6	-22.4 / -23.0
64QAM→32QAM	-22.9 / -23.6	-24.1 / -23.6	-23.6 / -23.7	-23.7 / -23.4
32QAM→64QAM	-24.7 / -25.3	-25.5 / -25.6	-24.9 / -25.4	-24.8 / -25.3
128QAM→64QAM	-26.5 / -26.7	-27.0 / -26.9	-26.9 / -26.6	-26.9 / -26.6
64QAM→128QAM	-27.9 / -28.6	-28.0 / -28.6	-28.2 / -28.8	-28.0 / -28.8
256QAM→128QAM	-29.6 / -30.1	-29.9 / -30.1	-30.0 / -30.3	-30.0 / -30.5
128QAM→256QAM	-31.3 / -33.1	-31.4 / -33.1	-31.3 / -32.4	-31.6 / -32.5
512QAM→256QAM	-32.8 / -33.1	-33.2 / -32.8	-32.9 / -33.1	-32.7 / -33.1
256QAM→512QAM	-34.5 / -35.2	-34.5 / -35.0	-34.3 / -34.6	-34.2 / -34.8
1024QAM→512QAM	-36.3 / -36.1	-36.2 / -36.4	-36.2 / -36.0	-36.1 / -36.1
512QAM→1024QAM	-36.5 / -37.9	-37.4 / -38.1	-37.1 / -37.6	-37.1 / -37.5
2048QAM→1024QAM	-38.1 / -38.4	-39.3 / -38.1	-39.4 / -37.5	-39.4 / -37.5
1024QAM→2048QAM	-39.4 / -39.0	-40.5 / -39.0	-40.0 / -38.4	-39.9 / -38.6

	50 MHz	56 MHz	60 MHz FCC	60 MHz ETSI
16QAM→4QAM	-17.3 / -17.8	-17.3 / -17.1	-17.2 / -18.1	-17.6 / -18.0
4QAM→16QAM	-18.7 / -19.7	-18.5 / -19.5	-18.5 / -19.1	-18.0 / -18.4
32QAM→16QAM	-20.8 / -20.8	-20.8 / -20.6	-20.8 / -20.9	-21.0 / -21.0
16QAM→32QAM	-22.3 / -23.1	-22.2 / -22.8	-21.9 / -22.6	-22.1 / -22.0
64QAM→32QAM	-23.4 / -23.9	-23.8 / -23.2	-23.7 / -23.7	-23.6 / -23.9
32QAM→64QAM	-24.2 / -25.6	-24.7 / -25.1	-24.8 / -25.1	-24.9 / -24.4
128QAM→64QAM	-26.7 / -26.8	-26.6 / -27.2	-27.1 / -27.1	-26.6 / -27.1
64QAM→128QAM	-27.9 / -28.7	-27.7 / -28.2	-27.9 / -27.8	-27.8 / -28.1
256QAM→128QAM	-29.8 / -30.1	-29.7 / -29.5	-29.7 / -29.5	-29.8 / -31.0
128QAM→256QAM	-30.9 / -32.6	-30.8 / -32.1	-30.9 / -31.8	-30.9 / -30.4
512QAM→256QAM	-32.7 / -33.1	-33.0 / -32.5	-32.6 / -32.8	-33.0 / -32.9
256QAM→512QAM	-33.9 / -34.8	-33.9 / -34.4	-34.0 / -34.6	-33.8 / -34.3
1024QAM→512QAM	-36.0 / -36.1	-35.9 / -35.6	-36.1 / -35.9	-36.3 / -35.5
512QAM→1024QAM	-36.8 / -37.5	-36.8 / -37.1	-36.7 / -37.1	-36.7 / -36.5
2048QAM→1024QAM	-39.1 / -37.5	-38.7 / -37.1	-38.9 / -37.2	-38.9 / -37.0
1024QAM→2048QAM	-39.7 / -38.6	-39.3 / -38.0	-39.3 / -38.1	-39.3 / -38.2

For example, the link is configured to 2048QAM modulation in 60MHz FCC bandwidth. To operate with the highest modulation (and maximum capacity), MSE should be <-38.9dB in fixed ACM mode or <-37.2dB in variable ACM mode. If MSE exceeds this threshold, ACM will downshift to 1024QAM StrongFEC. Degrading further below -36.1/-35.9dB will downshift to 512QAM modulation. The last ACM downshift will happen after exceeding -17.2/-18.1dB and the link will lose synchronization when MSE reaches -6.8dB.

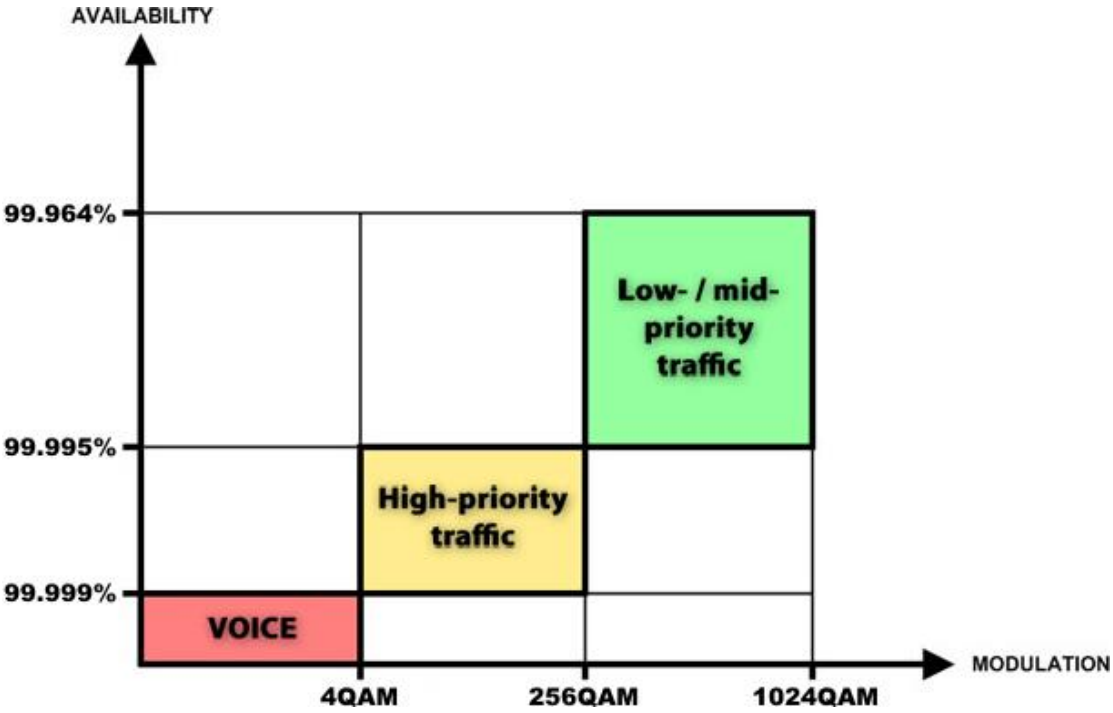
When MSE improves, upshift thresholds will be used. ACM will upshift back to 2048QAM modulation when MSE exceeds -39.3/-38.1dB in fixed ACM and variable ACM modes respectively.

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

The following real-world example illustrates the benefits of ACM. Consider an Integra/Integra-S/Integra-G/Integra-GS link operating at 23 GHz with 60 MHz channel spacing and an integrated antenna with 40.5 dBi (60cm/2ft) gain. The link is operating in a moderate rain zone G (30mm/h) at a distance of 11.3 kilometers (7 miles).

The system operation is set to a minimal payload of 74Mbps (4QAM) Ethernet for 99.999% annual availability.

Most of the time system would operate at a full capacity of 474Mbps (1024QAM) instead of 74 Mbps (4QAM). The system automatically monitors MSE and changes the capacity without interrupting the data transmission and losing any frames (hitless).



In comparison, a system using 1024QAM without ACM and providing similar capacity would offer only 99.964% of availability. You would have to decrease the distance, decrease modulation, or increase antenna sizes to achieve 99.999% availability for the given link.

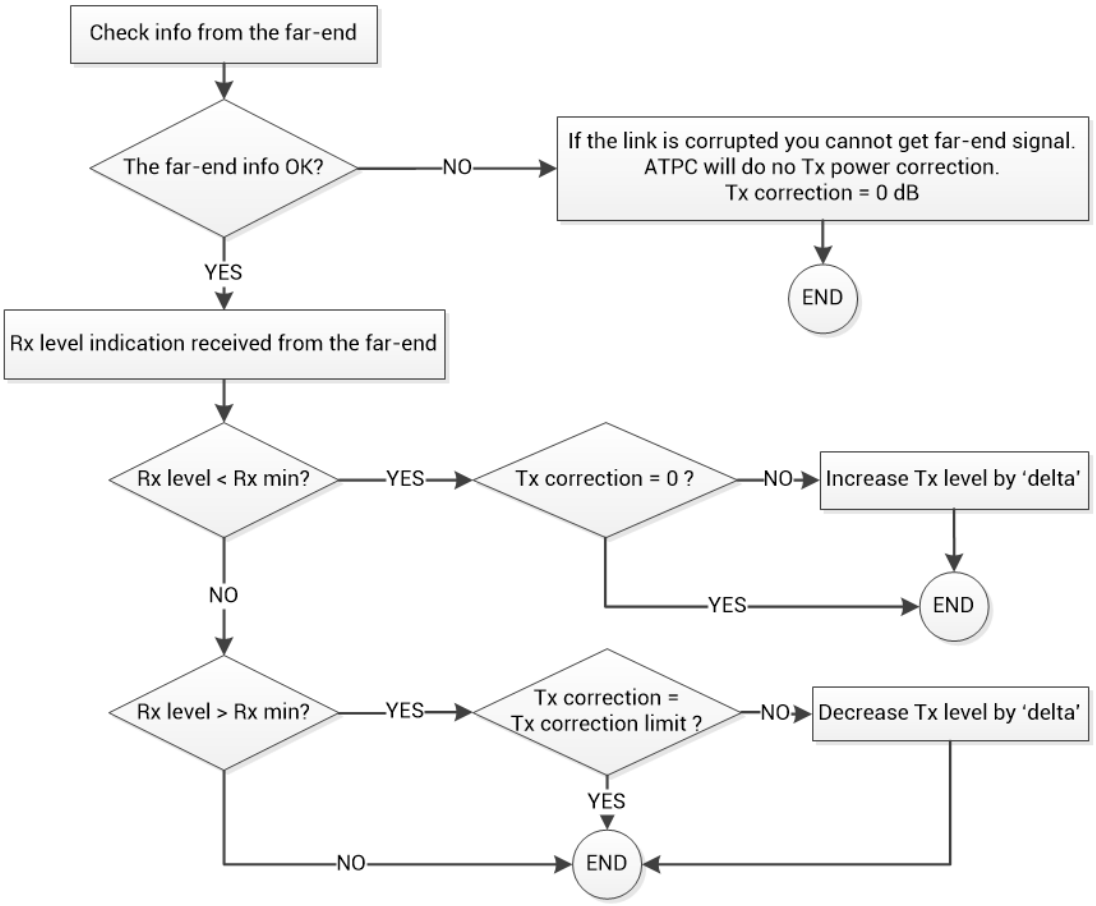
This example demonstrates how the new technology, based on an ACM mechanism, can play a key role in the development of cost-effective next-generation wireless access networks, by taking advantage of traffic evolution from synchronous TDM traffic to packet IP-based traffic.

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 momentary conditions. The lower average Tx power also extends the equipment's mean time between failures.

ATPC can be used together with ACM to control the transmitted power in any given ACM profile. Different 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 receives information about the Rx level from the far-end Integra through the service channel. Depending on the received Rx level parameter, the local Integra adjusts the transmitter power per the algorithm shown below.



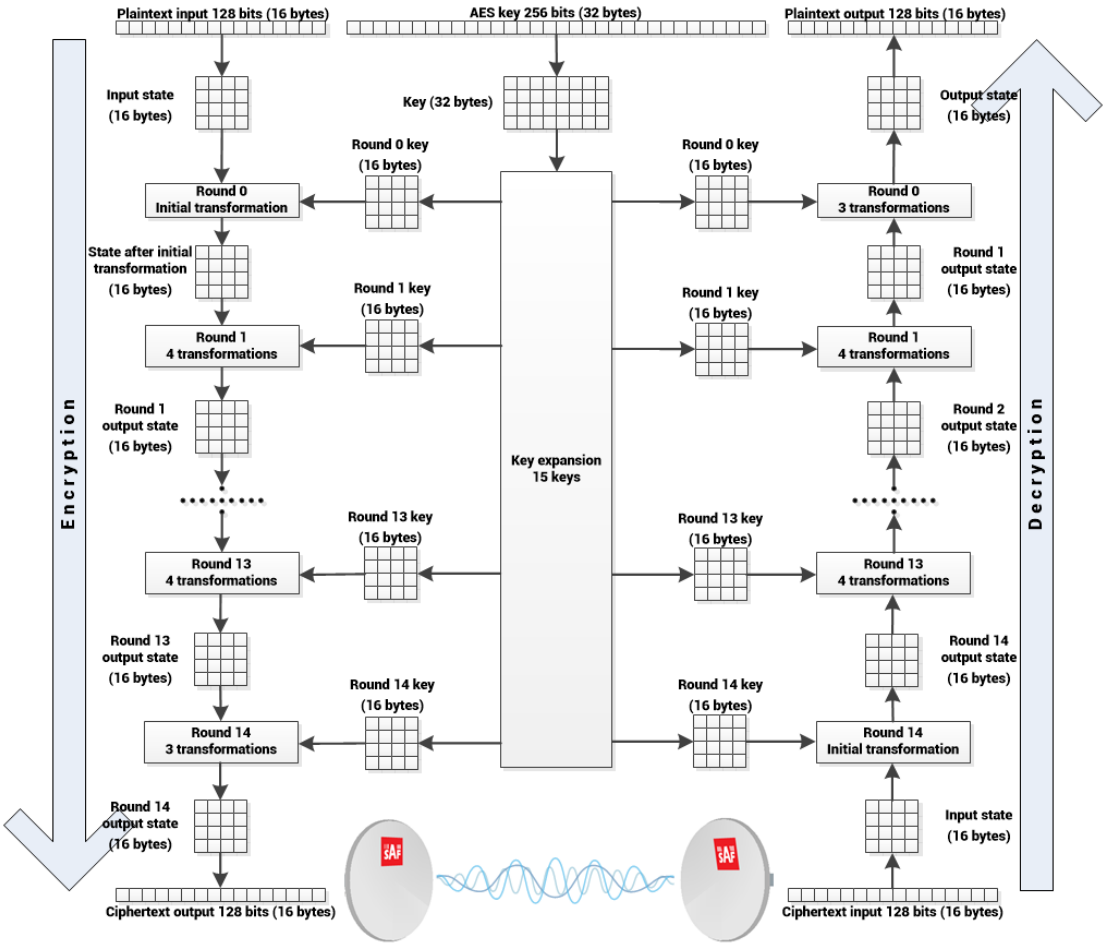
Rx level – the Rx level value received from the far-end site
Rx max – maximum permissible Rx level at the far-end site
Rx min – minimum permissible Rx level at the far-end site
Tx correction – value by what ATPC has decreased Tx power
Tx correction limit – defined maximum of Tx correction
Delta – the value by which Tx power is changed according to the far-end Rx level indication (1dB by default)

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$·hî*".

AES (Advanced Encryption Standard) is a standardized version of 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.

SAF's AES-256 encryption fully complies with Federal Information Processing Standards Publication 197 (2001).



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.

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.

AES encryption is not supported for Variable Tx power bandwidth profiles.

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 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:

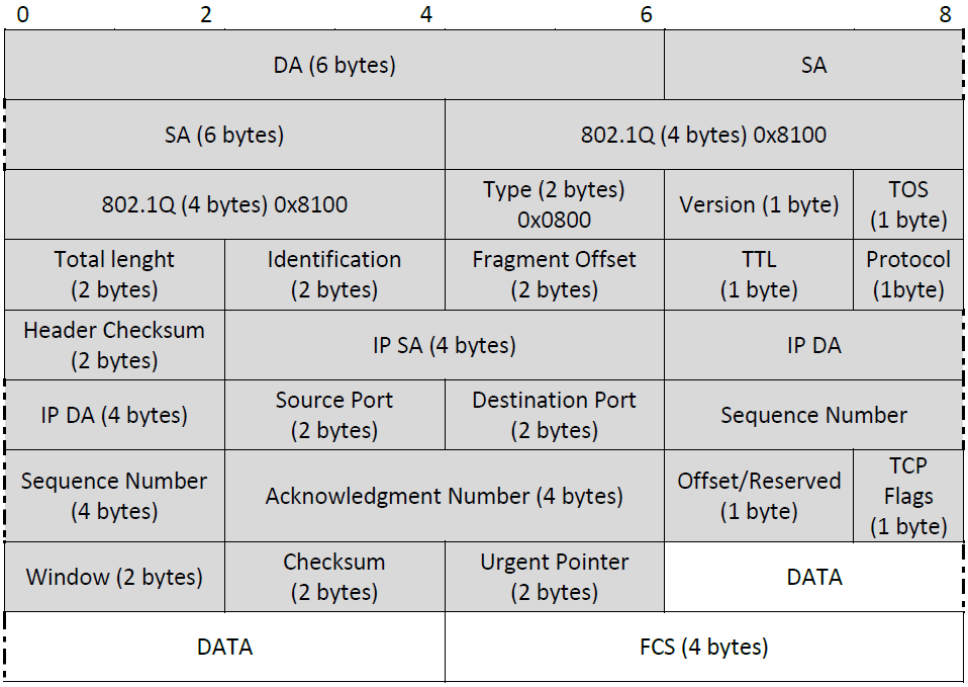
- VLAN
- IPv4
- IPv6
- UDP
- TCP

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 a 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.



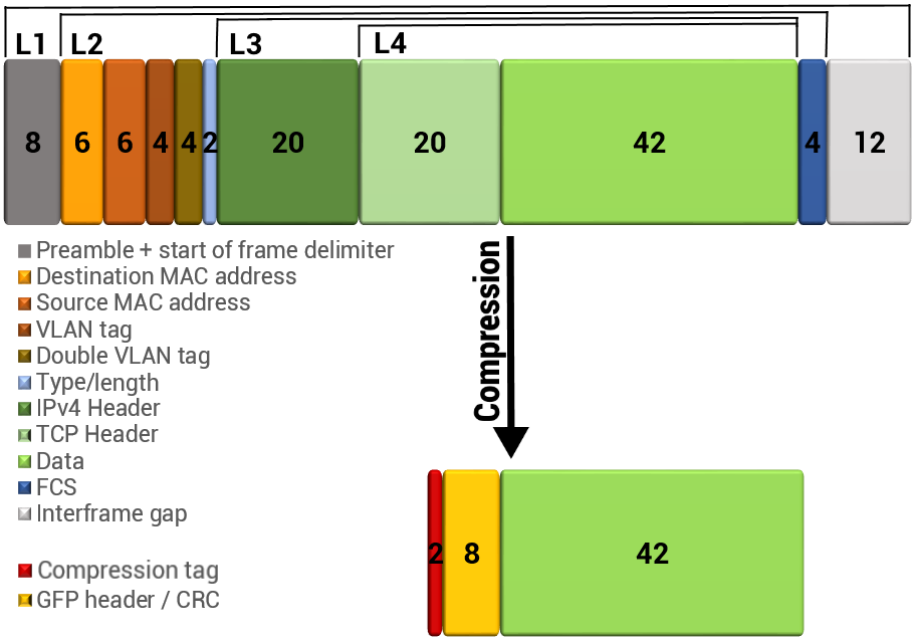
Header Replacement

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 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:



Header Compression Statistics

The average compression gain is calculated by reading the byte counters in a resolution period of 1s.

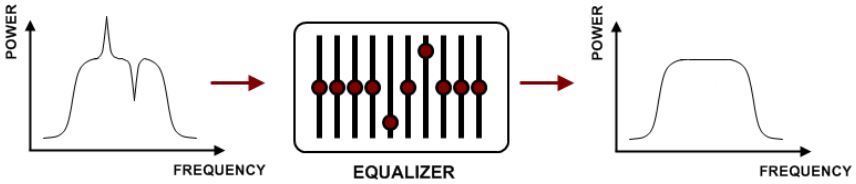
The compression measure the net compression gain and the gross compression gain:

- 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 and outgoing bytes including the PLA and the GFP overheads.

Adaptive equalizer

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

In Integra/Integra-S/Integra-G/Integra-GS, the adaptive equalizer is realized as a complex-arithmetic 40-taps digital FIR (Finite Impulse Response) filter. In other words, the equalizer is a selective frequency amplifier and attenuator, a device, which in application to IF (Intermediate Frequency) band-limited signal is schematically shown in the picture below:



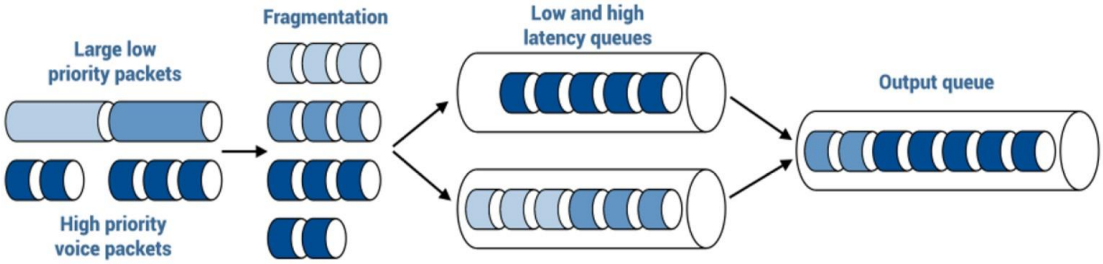
Fragmentation and interleaving

When transmitting delay or jitter-sensitive traffic, like, for example, Voice over IP, it must be transmitted across the network within a specific amount of time to ensure high quality.

The problem is that a high-priority packet needs to be transmitted across the link at the same time the link is committed to transmitting some large packet. Without fragmentation and interleaving active, the high-priority packet will wait behind this large packet until it is sent completely and this could introduce a delay that will make the VoIP packet unusable for an active VoIP conversation.

Packet fragmentation and interleaving allow for reducing delays and jitters by splitting packets into fragments and interrupting the transmission of low-priority fragments. To achieve the best results packet fragmentation and interleaving should be enabled on lower-priority queues. As result, packets and packet fragments are arranged and transmitted according to the priorities. The fragmented datagrams are reassembled at the receiving side.

The figure below illustrates the process of fragmentation and interleaving. When large low-priority packets and small high-priority (like voice) packets arrive at the same time, the large packets are fragmented into small fragments, which are then added to the queues along with the high-priority packets.



The “price” for using fragmentation and interleaving is that it creates an extra overhead. Depending on the size of fragments produced overhead is approx. 1-3%. The resulting latency decrease might reach up to 1.5%.

FTP directory

The FTP directory of Integra/Integra-S/Integra-G/Integra-GS can be used in combination with CLI commands to backup/restore system configuration, upload another FW version, and upload a new license file.

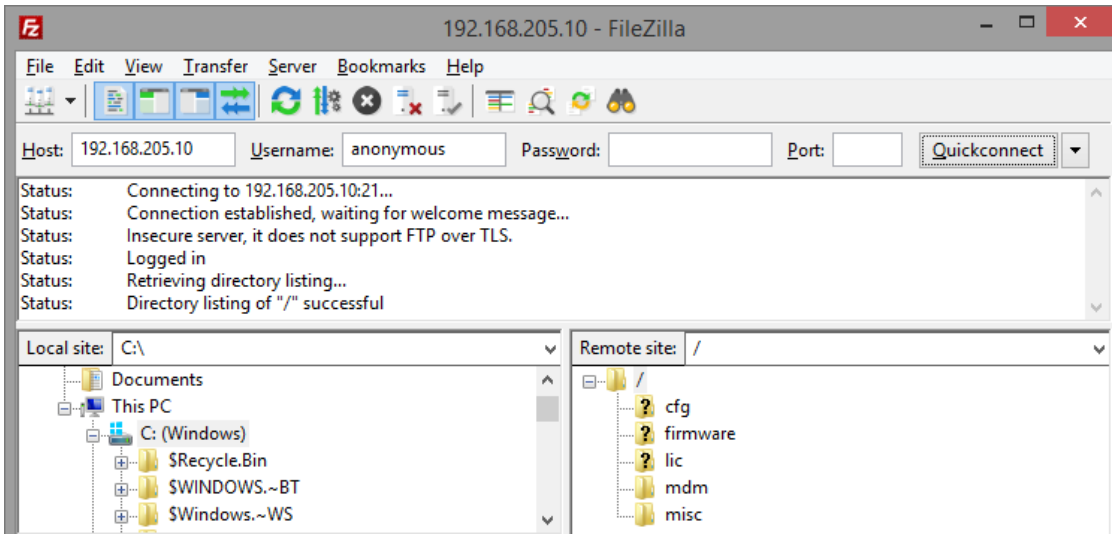
The FTP directory is a separate area of internal memory in Integra/Integra-S/Integra-G/Integra-GS.

The FTP directory function is deactivated by every restart of Integra/Integra-S/Integra-G/Integra-GS and all files from this special area are wiped out.

Use CLI command **system service ftp enable** to activate the FTP directory function.

After *system service ftp* is enabled it is possible to connect to Integra/Integra-S/Integra-G/Integra-GS by using your favorite FTP client. The username is **anonymous** and the password is empty.

Here is an example of an FTP connection to Integra/Integra-S/Integra-G/Integra-GS using FileZilla:



FTP area has several sub-directories separating every sub-function:

cfg	For managing system configuration backup/restore files. More information in Chapter System → Configuration → Configuration file.
firmware	For uploading firmware files. For more information see Chapter System → FW → Firmware upgrade and CLI commands of Chapter Over The Air → Radio → Configuration.
lic	For uploading license files. For more information see Chapter System → Tools → License management
mdm	For service use only.
misc	For service use only.

After finishing your work with the FTP directory, deactivate it by CLI command **system service ftp disable**.

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) **integraBsystemServicesFtpSwitch** variable to “2”.
2) Check if the FTP server is enabled by reading (SNMP GET command) the following variable: **integraBsystemServicesFtpSwitch**.
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 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/Integra-S/Integra-G/Integra-GS).
4) Initiate the upload of the transferred firmware file by setting **integraBsystemServicesFwUpload** 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 the timeout error during this time. In about 30 seconds, the newly uploaded firmware should be seen in **integraBsystemServicesFwAvailView** list (see the next step) and available for installation.

5) View information about the firmware versions already available for installation by reading **integraBsystemServicesFwAvailView** 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 **integraBsystemServicesFwRemove** variable (setting to “n", where “n” is the index number of selected firmware file from **integraBsystemServicesFwAvailView** list). All items can be removed by setting **integraBsystemServicesFwRemoveAll** variable to “1".
7) Install the required candidate firmware by setting **integraBsystemServicesFwInst** variable to “n", where “n” is the index number of the selected firmware file from **integraBsystemServicesFwAvailView** list. Please note that the installation execution usually takes up to 30 seconds, and SNMP read/write requests will return the timeout error during this time.
8) In about 30 seconds, initiate system reboot by setting **integraBsystemServicesReboot** to “1”.
9) After the system reboots, check the current FW version by reading **integraBsystemServicesFwCurrInfo** variable.
10) As additional functionality, a user can switch between two firmware banks (fw1 and fw2) using **integraBsystemServicesFwSwitchNext** 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 **integraBsystemServicesFwSwitchRunning** variable. The firmware bank selected for the next startup can be checked by reading **integraBsystemServicesFwSwitchNext** 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:

integraBsystemServicesReboot (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.1)	WRITE	Set "1" to initiate a system reboot.
integraBsystemServicesFtpSwitch (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.2)	READ-WRITE	Status and on/off switch for the FTP server (set "1/2” to disable/enable).
integraBsystemServicesFwCurrInfo (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.3)	READ-ONLY	Currently running FW information.
integraBsystemServicesFwAvailView (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.4)	READ-ONLY	List of the uploaded FW files available for installation.
integraBsystemServicesFwRemove (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.5)	WRITE	Set “n” to remove the n-th FW file from the uploaded FW list.
integraBsystemServicesFwRemoveAll (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.6)	WRITE	Set “1” to remove all FW files from the uploaded FW list.
integraBsystemServicesFwUpload (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.7)	WRITE	Set "1" to start the upload and make the FW available for installation.

integraBsystemServicesFwInst (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.8)	WRITE	Set “n” to install the n-th FW file from the uploaded FW list.
integraBsystemServicesFwSwitchRunning (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.9)	READ-ONLY	Currently running FW bank.
integraBsystemServicesFwSwitchNext (.1.3.6.1.4.1.7571.100.1.1.7.1.4.14.10)	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 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"
```

2) Add client (Integra) data by editing the clients` configuration file: /etc/freeradius/clients.conf. Add the following lines specifying Integra 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, *radiuspass_1* is the RADIUS secret word.

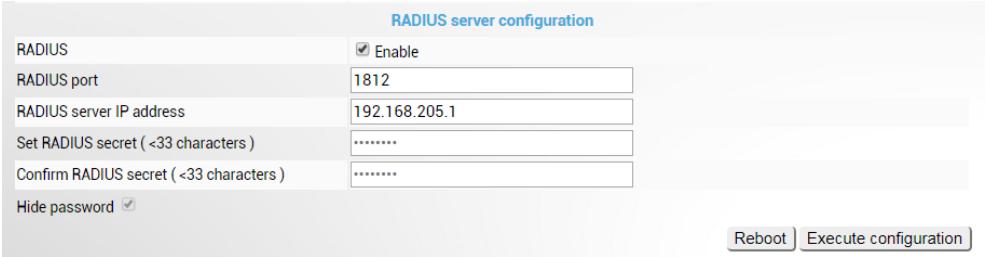
```
#  the "ipaddr" or "ipv6addr" fields.  For compatibility, the 1.x
#  format is still accepted.
#


client 192.168.205.10 {
secret = radiuspass_1
}
```

3) Restart FreeRADIUS.
4) Set up the RADIUS configuration in Integra 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 and should have the same secret word as Integra.



5) Execute a configuration, save the configuration changes and reboot Integra.
6) Log in to Integra using the secure HTTPS connection.
7) Proceed to assigning administrative rights to a user if needed, see 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
~
```

2) For providing the specified attribute to the user that 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"
```

3) Restart FreeRADIUS.
4) Log in to Integra using the secure HTTPS connection.

Chapter 7: TOOLS

Link Layer Discovery tool

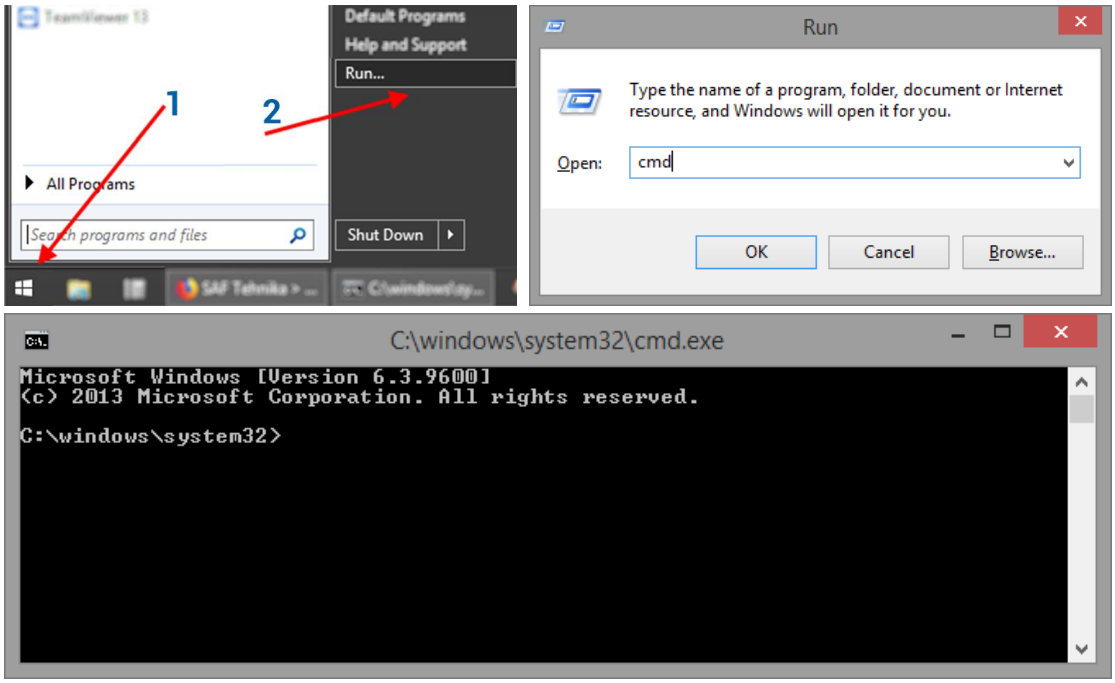
The Link Layer Discovery Tool is a command-line application for MS Windows. It sends requests to the LLD server application which runs on all Integra series devices. The tool is used to discover Integra/Integra-S/Integra-G/Integra-GS/ Integra-W/Integra-WS devices and reset their passwords or settings.

The application runs on the following version of Windows: Windows Vista, Windows 7, Windows 8, and Windows 10.

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 "Tools" section. Login required.

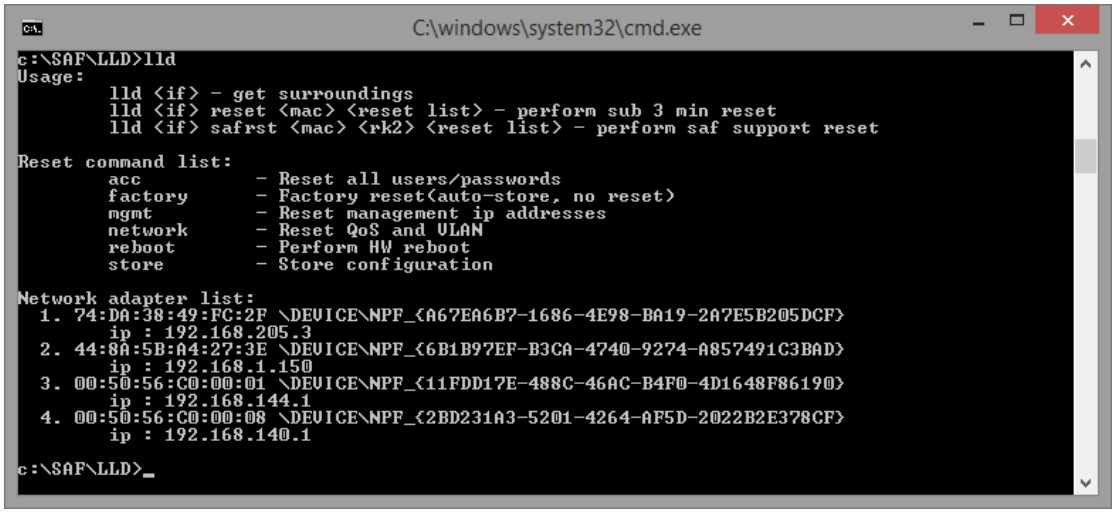
1) Unzip the LLD.zip file you downloaded to a directory of your choice, for example, C:\SAF\LLD\.
2) The application is started via the command prompt (Start menu→Run→type "cmd"→press ENTER). The Command-line console window should appear.



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 pressing ENTER.



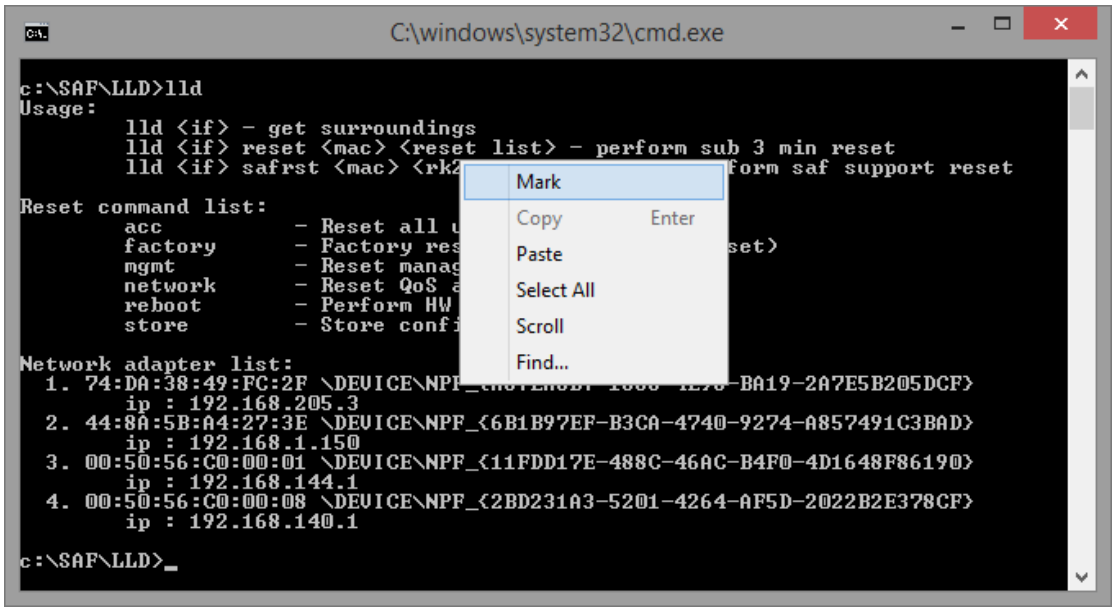
5) Available commands and the network adapter list should be shown. To scan for Integra devices, the command should be run as follows:

lld <network interface>

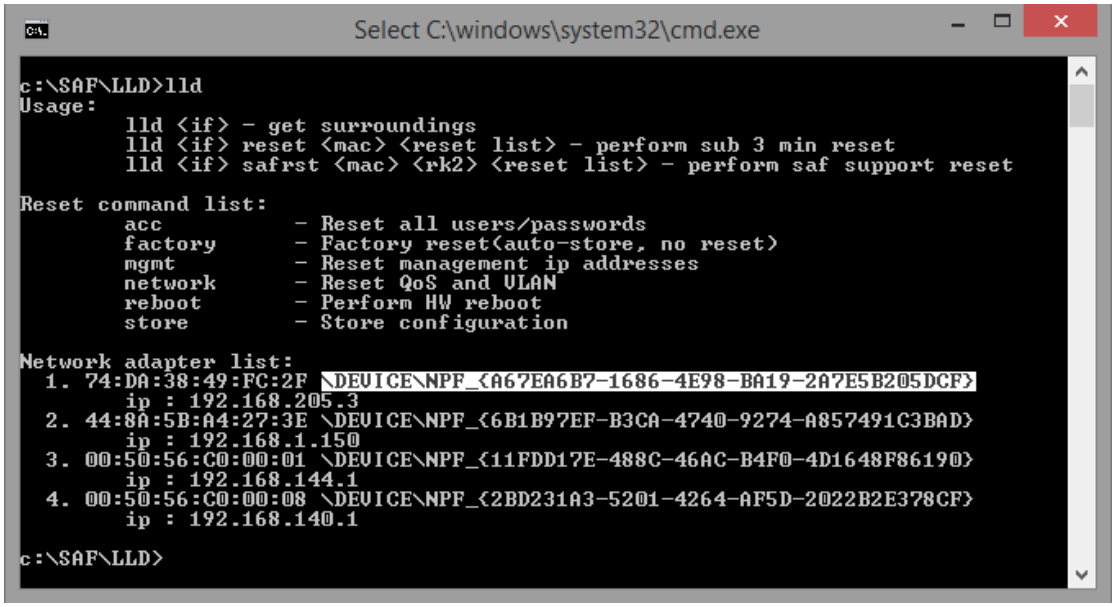
For example:

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”:

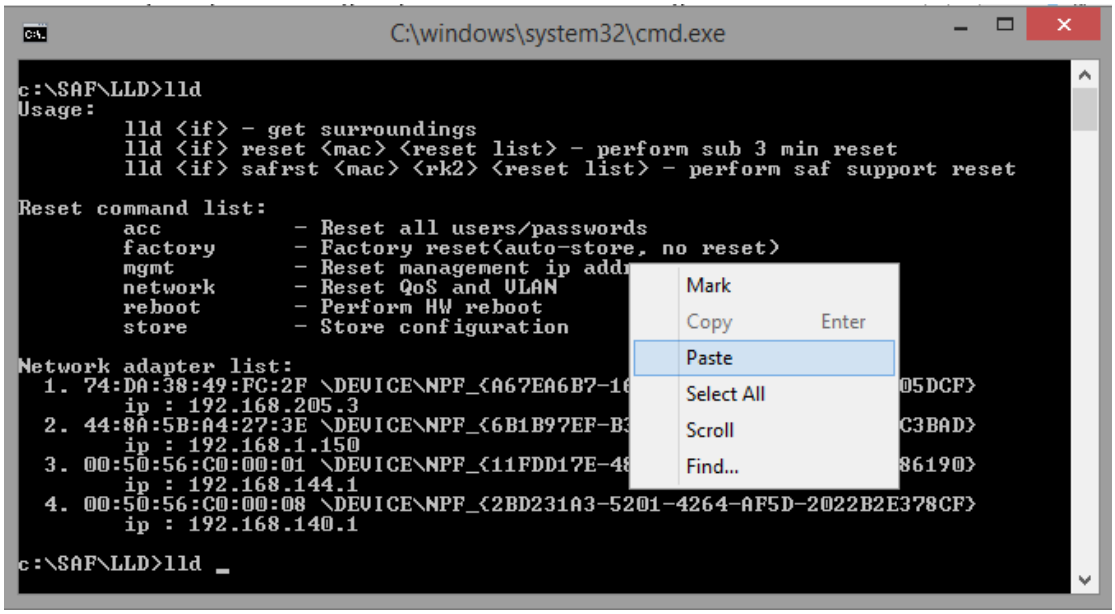


Then by holding the left button select the interface address:

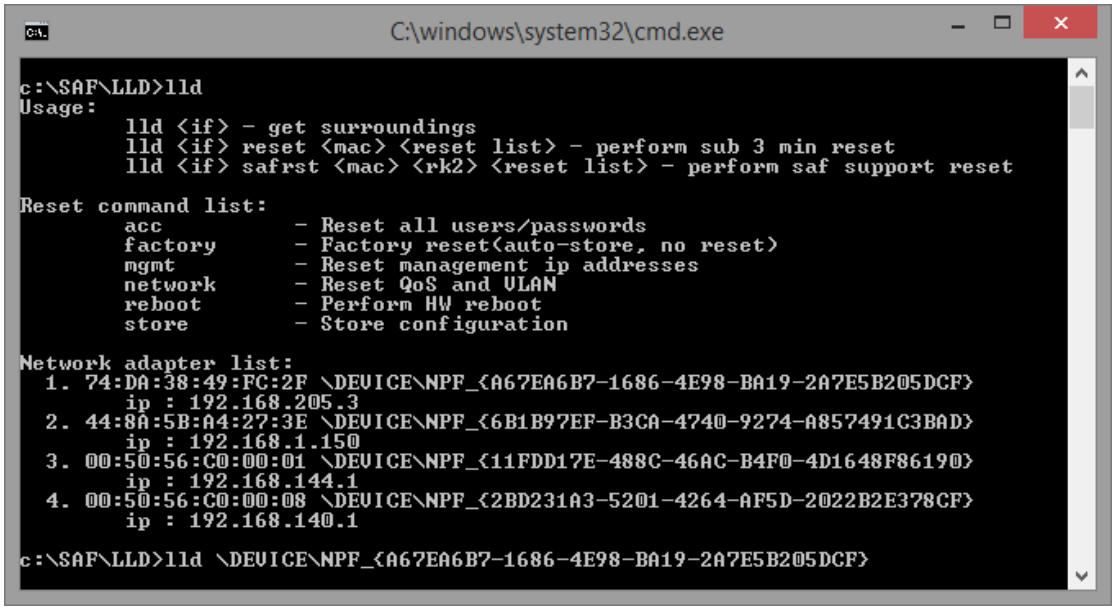


After selecting, release the left button and click the mouse right button anywhere on the console. The address should be copied.

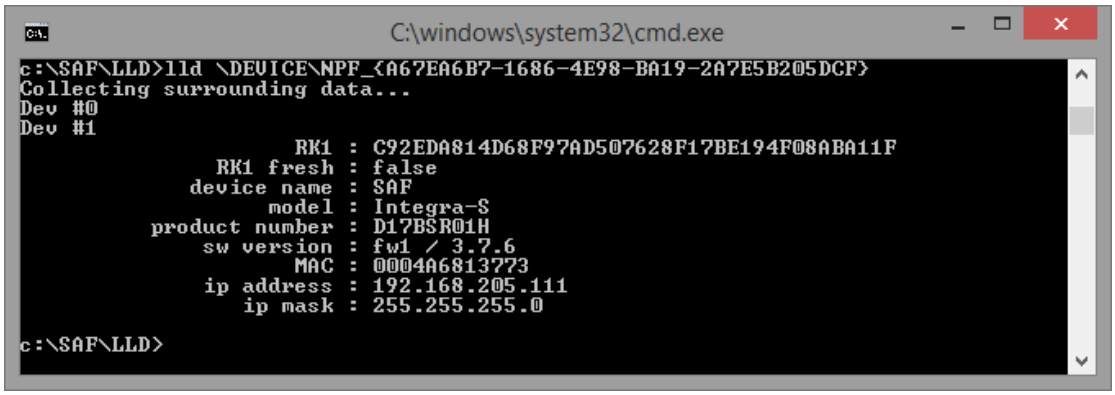
Type “lld “and paste the address by clicking the right button anywhere on the console:



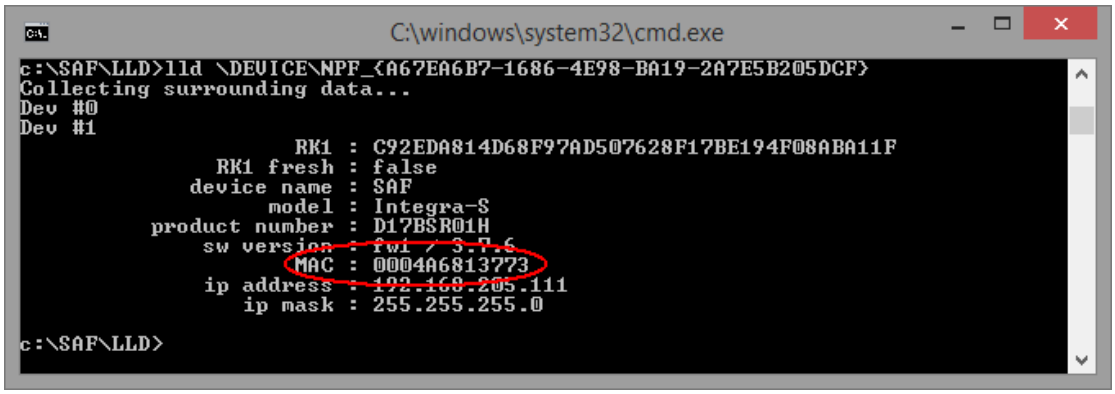
The result should be similar as shown in the image below:



6) Press ENTER and the recovery tool will now scan for Integra devices. Available devices and their information will appear in the console. Make sure that the device has finished booting up.



7) Use the MAC address of the device with the reset command to reset this specific device. The MAC address can be copied the same way as the interface 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 device address;

<reset command> – reset options.

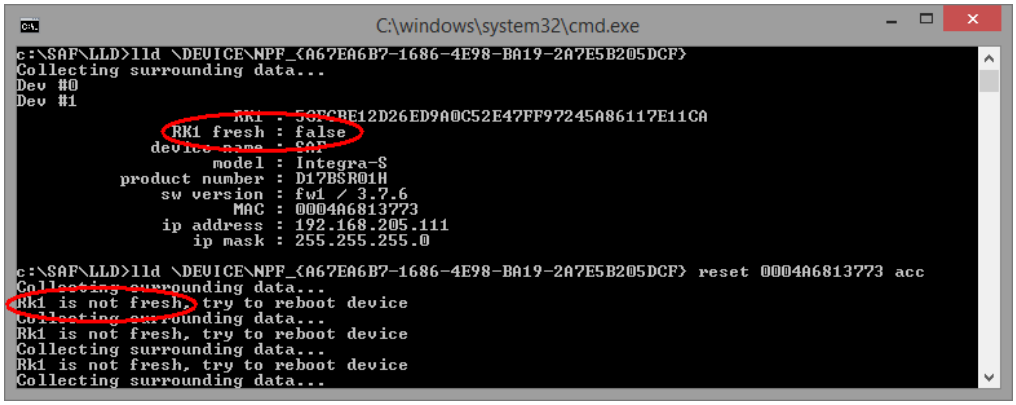
Different reset options are available depending on the reset requirement. Reboot and store options are also available. The store option saves the device's current configuration so it will be restored after the system reboot. The commands are available in the reset command list. Use the command after the MAC address of the device as shown in the previous reset command example.

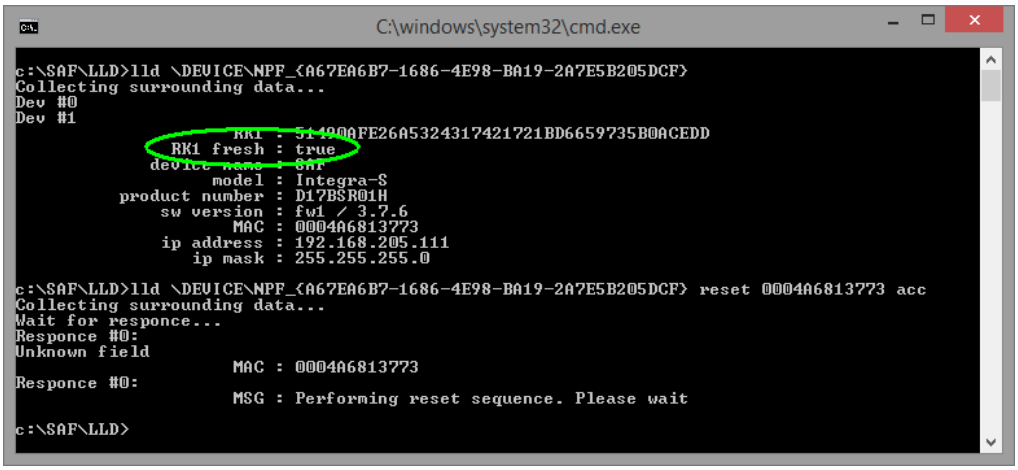
```
Reset command list:
        acc             - Reset all users/passwords
        factory         - Factory reset(auto-store, no reset)
        mgmt            - Reset management ip addresses
        network         - Reset QoS and VLAN
        reboot          - Perform HW reboot
        store           - Store configuration
```

For example, to reset users and passwords on Integra 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 reboot ("*RK1 fresh*" must be "*true*" in the console), otherwise the error shown in the screenshot below error 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.



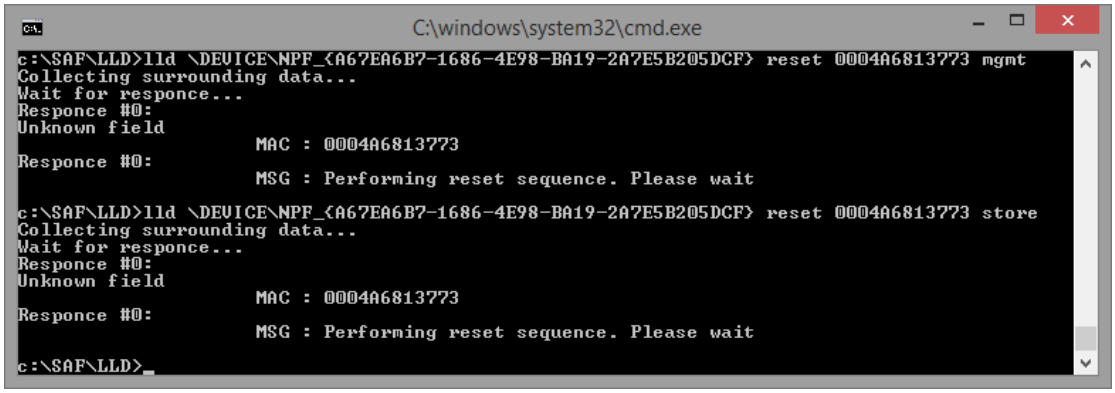


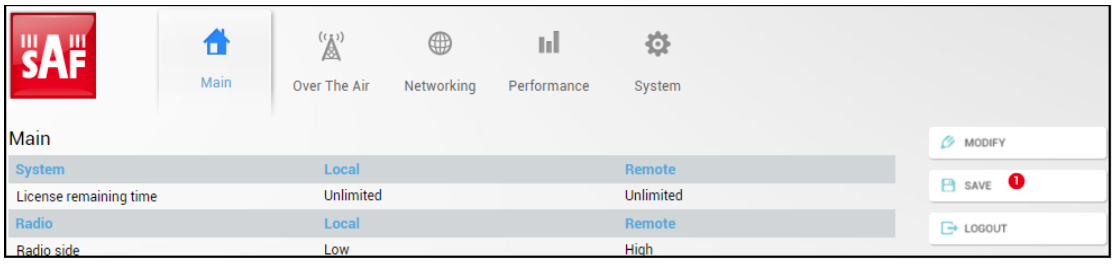
Power down the Integra device and power it up again, the reset should be completed soon.

If the reset cannot be completed, redo step 8).

9) Store changes by command (must be done within the time frame of 3 minutes after bootup) or by using WEB GUI (any time before the Integra device is powered off) “SAVE” button. For example:

lld \DEVICE\NPF_{A67EA6B7-1686-4E98-BA19-2A7E5B205DCF} reset 0004A6813773 store





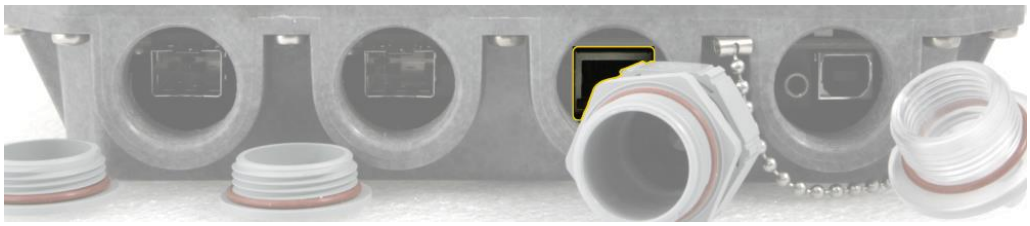
MIB files

Relevant MIB files can be downloaded directly from the Integra/Integra-S/Integra-G/Integra-GS Web GUI. See Chapter System → Configuration → SNMP configuration for further details.

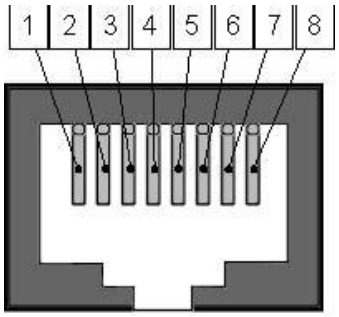
Chapter 8: INTERFACES

RJ-45 port

The RJ-45 port complies with IEEE 802.3-2005 1000Base-T, 100Base-T, and 10Base-T Ethernet and LTPoE++ Power over Ethernet standards.



The pinouts of that socket are as follows:



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-

PoE power polarity can be reversed.

In case an Ethernet cable is used for power & data (with PoE injector), the combined Ethernet cable length from the PoE injector to Integra/Integra-S/Integra-G/Integra-GS FODU and from PoE injector to CPE is limited to 100m / 328ft.

In case SFP interfaces on LAN2 / LAN3 ports are used as the data interface, it is possible to use the LAN1 port solely for the power supply. Two options are possible:

1) Ethernet cable with PoE injector.

   Please refer to the table below for the maximum Ethernet cable length from the PoE injector to Integra/Integra-S/Integra-G/Integra-GS FODU based on AWG wire size and Integra/Integra-S/Integra-G/Integra-GS FODU power consumption.

AWG	Lmax @ 75W	Lmax @ 55W	Lmax @ 35W
26	129m / 423ft	176m / 577ft	277m / 907ft
24	205m / 673ft	280m / 918ft	440m / 1442ft
22	326m / 1071ft	445m / 1460ft	699m / 2294ft

2) 2-wire power cable together with a DC power adapter cable for the Integra/Integra-S/Integra-G/Integra-GS (P/N D0ACPW01).

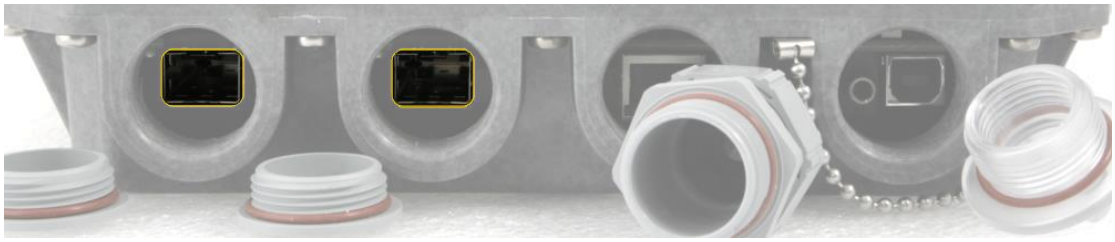
Please refer to the tables below for maximum power cable length based on AWG wire size or cross-section area and Integra/Integra-S/Integra-G/Integra-GS FODU power consumption.

AWG	Lmax @ 75W	Lmax @ 55W	Lmax @ 35W
24	51m / 168ft	70m / 229ft	110m / 361ft
22	82m / 268ft	111m / 365ft	175m / 574ft
20	132m / 423ft	180m / 589ft	282m / 926ft
18	206m / 675ft	281m / 920ft	441m / 1446ft
16	329m / 1080ft	449m / 1473ft	705m / 2314ft
14	527m / 1728ft	718m / 2356ft	1129m / 3703ft
Cross-section area	**Lmax @ 75W**	**Lmax @ 55W**	**Lmax @ 35W**
0.25mm^2	64m / 211ft	88m / 288ft	138m / 452ft
0.5mm^2	129m / 422ft	175m / 575ft	276m / 904ft
0.75mm^2	193m / 633ft	263m / 863ft	413m / 1356ft
1.0mm^2	251m / 824ft	342m / 1124ft	538m / 1766ft
1.5mm^2	376m / 1232ft	512m / 1681ft	805m / 2641ft

The maximum cable length calculation is done using copper resistance.

SFP ports

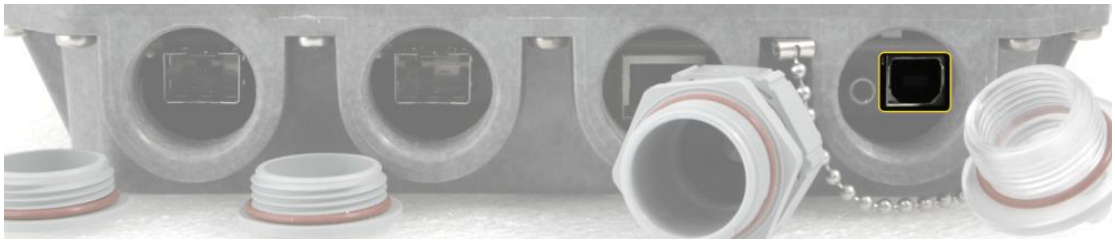
SFP ports provide SFP transceiver connectivity.
Both SFP ports comply with the following Gigabit Ethernet standards:
1000BASE-SX, 1000BASE-LX, 1000Base-T (note: 1000FDX only).

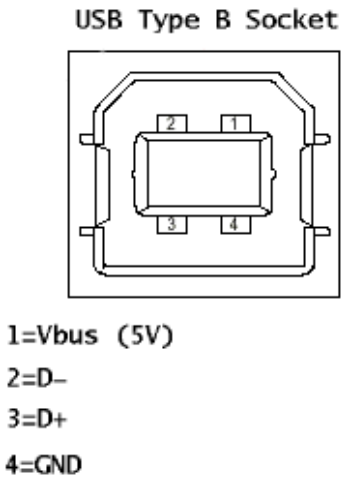


Inquire SAF representative about compatible SFP modules.
In the case of third-party modules, inquire SAF representative about the testing possibility.

USB port

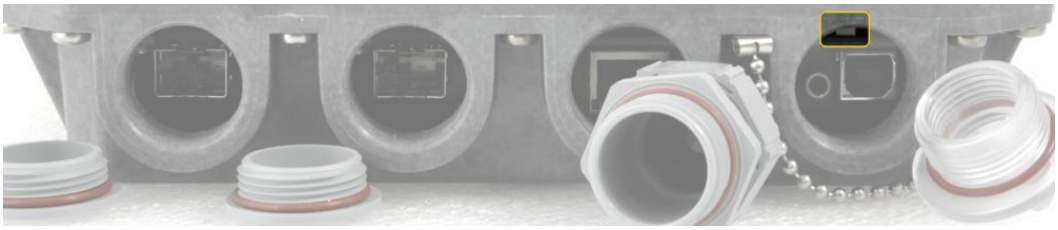
USB port provides serial terminal access to CLI. The socket is B type.



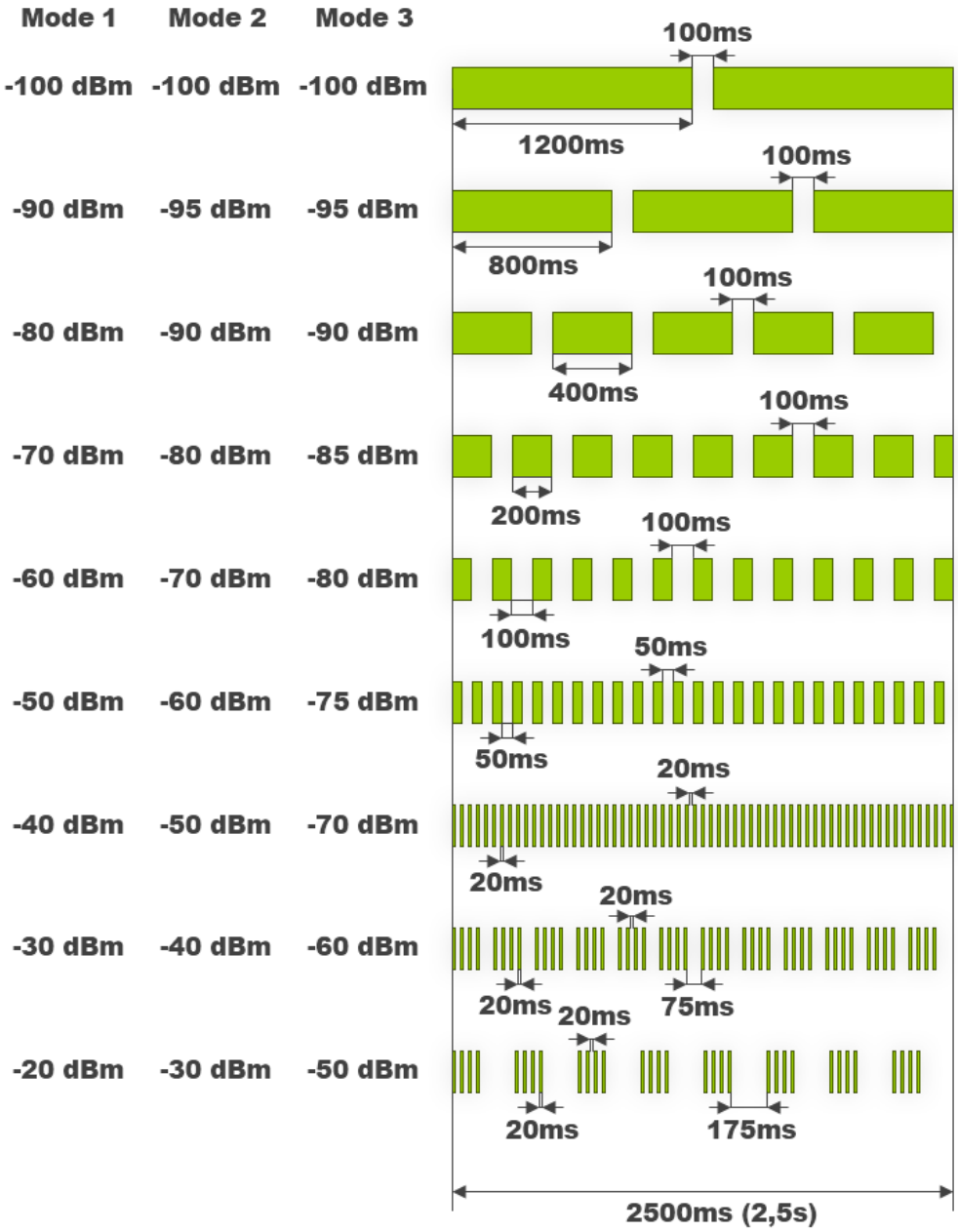


RSSI LED

The RSSI LED can be activated in three operational modes – Mode 1, Mode 2, and Mode 3. By default, RSSI LED is enabled in Mode 1. For further details please refer to the chapter Over The Air → Radio → Configuration.



Corresponding Rx signal levels and LED blinking pattern for each mode is represented in the figure below:



Integra-S/Integra-GS RSSI LED description

The 15-42 GHz Integra-S/Integra-GS FODUs have a dual-color RSSI LED. The RSSI LED can blink either in green or red color. The blinking pattern is as given in the figure above and is the same for both colors. (Functionality may not be available in older HW revisions.)

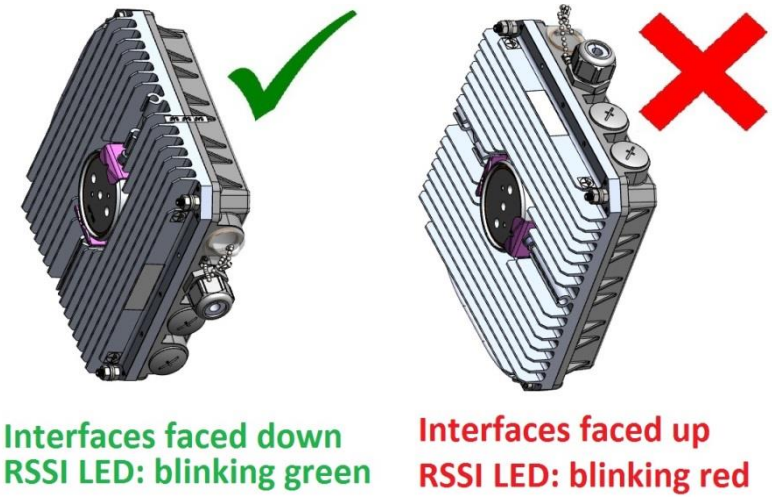
A red RSSI LED warns about mistakes in the FODU installation. It turns red in the following circumstances:

1) If the polarization offset from the vertical polarization axis (zero-degree level) is more than 3 degrees to both sides.

2) If the polarization offset from the horizontal polarization axis (zero-degree level) is more than 3 degrees to both sides.

3) If the elevation angle of the Integra-S/Integra-GS FODU will differ for more than +/-20 degrees from the zero-degree elevation angle

4) If the FODU will be installed with its interfaces upwards.



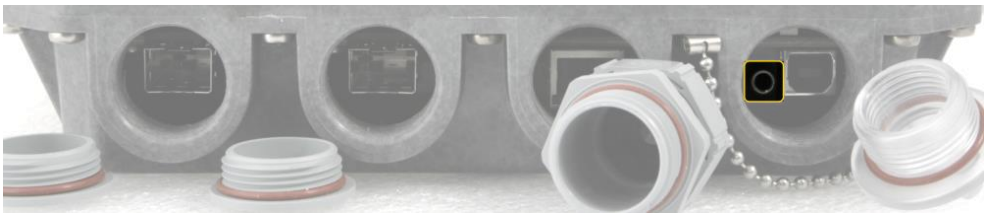
5) If the FODU will be placed on any surface horizontally.

Horizontal position
RSSI LED: blinking red

Note that 17&24 GHz Integra-S/Integra-GS FODUs must be installed in opposite polarizations.

RSSI/audio port

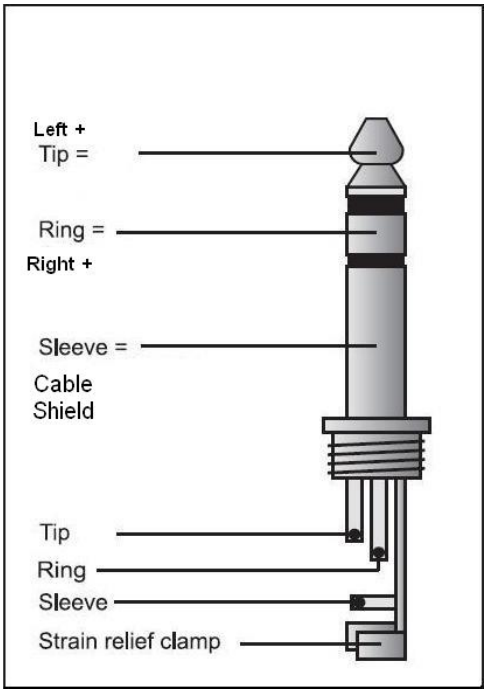
The RSSI (Received Signal Strength Indicator) port is used to adjust the alignment of the antenna for best performance (for both rough and fine adjustment); this can be done using a digital multimeter or headphones connected to the RSSI port. The RSSI port is a 3.5mm socket. The output of the RSSI port is DC voltage and audio frequency and varies depending on the received signal level. Both are linear curves.



Note that in the case of Integra-S/-GS 6-13GHz RSSI/audio port is separated from the USB port and is located in the last fifth socket:

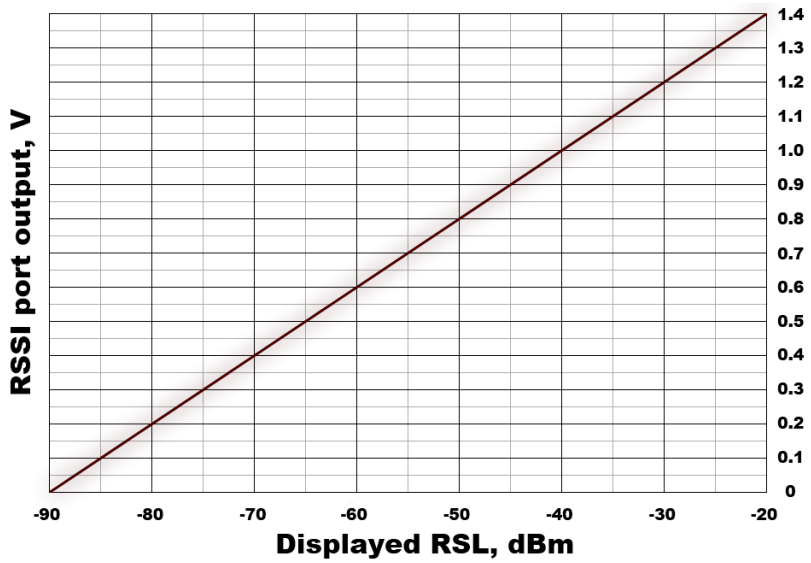
To connect a voltmeter, you will require the appropriate RSSI cable (P/N D0ACRS01):

RSSI cable has a 3.5mm RSSI/audio jack with the pinout shown below:



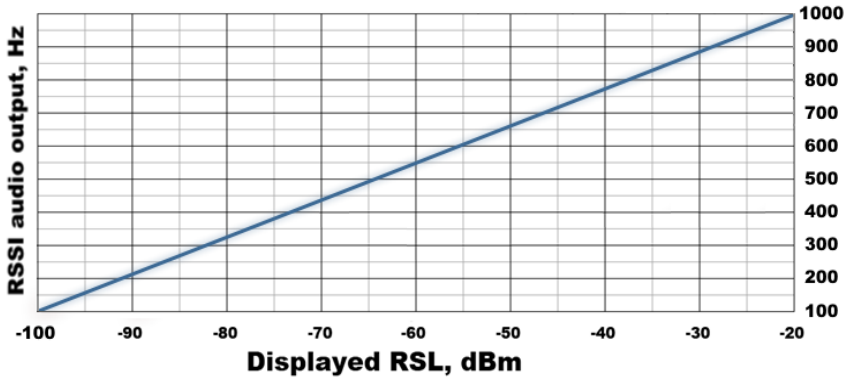
The following charts and tables show the typical relationship of the received signal level (Rx level) displayed by the Integra/Integra-S/Integra-G/Integra-GS vs. the RSSI port output voltage (RSSI – Received Signal Strength Indicator) and audio frequency. The RSSI port is located on the FODU. The evaluated Rx level has an error of +/-2 dB.

Output voltage



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

Output audio frequency



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

Grounding connection

Always provide a good connection from the FODU grounding screw to the tower/mast/building grounding circuit or body. You must choose one, the most convenient, of 2 screws for grounding connection.

Appendix A: TECHNICAL SPECIFICATION

Technical specification

		Integra-G		Integra-W	
General					
Concept / form factor		FODU (Full-outdoor unit), directly mounted to the antenna			
Frequency bands		5.8 GHz UL, 6GHz, 7GHz, *8GHz*, 11GHz, 13GHz, 15GHz, 17GHz UL, 18GHz, 23GHz, 24GHz UL, 25GHz, 26GHz, 28GHz, 38GHz, *and more**			
Radio standards		EN 302 217-2 v3.1.1, EN 300 t+40-2 v1.4.1, FCC CFR 47 Part 101, Industry Canada RSS-GEN and relevant SRSP Specifications			
Frequency stability		± 10 ppm			
Capacity		Up to 1Gbps* with HC at 1+0 or 2+0		883 Mbps at 112 MHz 1024QAM 643 Mbps at 80 MHz 1024QAM (for Integra-W 17GHz and 24GHz)	
		491 Mbps at 60 MHz 2048QAM			
Max modulation		2048QAM		1024QAM	
Configurations		1+0, 2+0 link bonding, 1+1 HSB		1+0	
ACM and ATPC		Yes		Yes	
Channel bandwidth		ETSI: from 1.75* MHz, up to 56 MHz FCC: from 5 MHz, up to 60 MHz		ETSI: from 56 MHz, up to 112 MHz FCC: from 40 MHz, up to 80 MHz	
Ports					
Gigabit Ethernet		1x RJ-45	Electrical with built-in PoE splitter and surge arrestor	2x RJ-45	Electrical with built-in PoE splitter and surge arrestor
		2x SFP	Fiber Optics	1x SFP	Alternative to 1xRJ-45
Service ports	3.5mm	Audible alignment and RSSI			
	USB B	RS232 serial over USB B-Type			
	LED	Power On, Link Synchronization, RSL, Polarization accuracy*			
Ethernet					
Ethernet		GbE Network Processor built-in		Unmanaged Gigabit Ethernet	
MAC Table size		32K entries		-	
VLAN		802.1Q 4096 VLANs, QinQ		Transparent	
Quality of Service		8 level 802.1p, 64 level DSCP, CoS, MPLS-TP exp bit		Transparent	
Spanning Tree Prot.		802.1d-2004 RSTP		Transparent	
Synchronization		SyncE		-	
Carrier Ethernet		MEF9&14, HC, Packet Fragmentation		Transparent	
Jumbo frames		Yes, 9600 bytes		Yes, 9600 bytes	
Encryption		AES 256-bit**, licensed feature		-	
Management		SNMP v1/2c/3, SSH, Telnet, HTTPS, Serial, RADIUS, Network Time Protocol			
		In-band MNG over same ETH port		Either Out-of-band or In-band MNG, depending on PN and firmware. In-band MNG supported only if PN has suffix "S1"	
Perf. monitoring		Performance graphs, constellation diagram, alarms, detailed counters			

		Integra-G	Integra-W
Electrical			
Power consumption		28...74 W depending on model and frequency band. See table below.	
Voltage range	Integra	36…57 V DC	
	PoE Injector[1]	27…57 V DC in injector's "Vout = 57V" mode, 36…57 V DC in "Vout = Vin" mode.	

** 5.8 GHz UL product is identical to L6 GHz in terms of specified parameters. For all bands, the maximum channel bandwidth of some radio modifications can be narrower than specified due to the limited tuning ranges. Inquire SAF representative for more information.*

*** Integra-G is FIPS 197 (Federal Information Processing Standards) validated and placed on validated product list, Validation No.: AES 5899: SAF AES-256 Encryption Engine*

[1] Voltage range using I0ATPI43 Power over Ethernet Injector. The voltage drop in Ethernet cable must also be considered.

Mechanical & environmental specification

Integra Model		Integra-G, Integra-W		
Antenna type		External antenna (default)	0.3m / 1ft, integrated	0.6m / 2ft, integrated
Antenna interface		SAF2R 6…13 GHz SAF2 15…38 GHz	Integrated antenna, factory assembled with radio *(discontinued solution, no more available)*	
Stationary use		Conforms to ETSI EN 300 019 Class 4.1, NEMA 4X		
IP class		IP66: Integra-G 6...13 GHz models and Integra-W. IP67: Integra-G 15…38 GHz		
Relative Humidity		15 to 90-100% @ 30°C		
Temperature range		-33...+55 °C / -28…+130 °F		
Size, 15GHz and higher, w/o mount		235 x 250 x 72 mm / 9.26" x 9.85" x 2.84"	378 x 378 x 227 mm / 14.9" x 14.9" x 9"	669 x 669 x 289 mm / 26.3" x 26.3" x 11.4"
Size, Integra -W 17/24 GHz UL		235 x 250 x 111 mm / 9.26" x 9.85" x 4.37"	N/A	N/A
Size, 6…13 GHz		280 x 437 x 100 mm / 11.02" x 17.2" x 3.9"	N/A	N/A
Weight, w/o mount		2.9 kg / 6.4 lbs	5 kg / 11 lbs	5 kg / 11 lbs
Weight, Integra -W 17/24 GHz UL		4.9 kg / 10.8 lbs	N/A	N/A
Weight, 6…13 GHz		6.5 kg / 14.3 lbs	N/A	N/A
Mount	Mount size	Mount on antenna	292 x 176 x 250 mm / 11.5" x 7" x 10" max	
	Pole size		Ø 40 – 120 mm / Ø 1.6" – 4.7"	
	Weight		2.55 kg / 5.6 lbs	

** Inquire SAF representative for more information*

Power consumption and rated current at 36 – 57 V DC[2]

Model		L6 GHz	U6, 7, 8 GHz	11, 13 GHz	15 GHz	17 GHz	18 GHz	23 GHz	24 GHz	25, 26, 28 GHz	38 GHz
Integra-G	Power [W] @ 36–57V DC	74	69	65	40	35	45 [3]	41	38	45	47
	Current [A] @ 36 V DC	2.1	1.9	1.8	1.1	1.0	1.3	1.1	1.1	1.3	1.3
	Current [A] @ 48 V DC	1.5	1.4	1.4	0.8	0.7	1.0	0.9	0.8	0.9	1.0
	Current [A] @ 57 V DC	1.3	1.2	1.1	0.7	0.6	0.8	0.7	0.7	0.8	0.8
Integra-W	Power [W] @ 36–57V DC	70	64	51	31	28	35	35	30	36	38
	Current [A] @ 36 V DC	1.9	1.8	1.4	0.9	0.8	1.0	1.0	0.8	1.0	1.1
	Current [A] @ 48 V DC	1.5	1.3	1.1	0.6	0.6	0.7	0.7	0.6	0.8	0.8
	Current [A] @ 57 V DC	1.2	1.1	0.9	0.5	0.5	0.6	0.6	0.5	0.6	0.7

[2] *Power consumption of Integra radio shown only. For power consumption of complete system add up to 8% (at 48V DC input) for PoE in DC/DC mode, around 4W for 100m cable (depends on cable) and approx. 1W for SFP transceiver, if used.*

[3] *Both Standard and HP product versions*

Exterior design of Integra-G and Integra-W models

5.8 GHz UL, 6 …13 GHz models

Integra-W 17GHz and 24GHz UL

15GHz and higher

FCC & IC IDs for Integra UL versions

Integra-G 5.8 GHz: FCC ID: W9Z-INTEGRA5G8 IC ID: 8855A-INTEGRA5G8	Integra-G 24 GHz: FCC ID: W9Z-INTEGRA24 IC ID: 8855A-INTEGRA24	Integra-W 24 GHz: FCC ID: W9Z-INTEGRA24W IC ID: 8855A-INTEGRA24W

Maximum Tx Power [dBm] for Integra-G

1) **For all ETSI channels, and FCC 60 MHz channel in fixed and variable Tx power modes:**
"**Fix**" – Fixed Tx power mode for all channels mentioned above, and Variable Tx power mode for ETSI ≤14 MHz channels.
"**Var**" - Variable Tx power mode for all ETSI channels, except 1.75, 3.5, 7 and 14 MHz, and for the FCC 60 MHz channel.

Modulation	L6, U6, 7, 8 GHz		11 GHz 13 GHz		15 GHz, 18 GHz HP[4]		18, 23, 26, 28 GHz		17 GHz[5], 24 GHz[5]		38 GHz		
	Fix	Var	Fix	Var	Fix	Var	Fix	Var	Fix	Var	Fixed	Variable ≤14 MHz	Var
4 QAM	+31		+26		+23		+20		-22 … +5		+15	+15	+15
16 QAM	+30		+25		+22		+19		-22 … +5		+14	+14	+14
32 QAM	+29		+24		+21		+18		-22 … +5		+14	+13	+13
64 QAM	+28		+23		+20		+17		-22 … +5		+13	+12	+12
128 QAM	+28	+27	+23	+22	+20	+19	+17	+16	-22 … +5		+13	+12	+11
256 QAM	+27	+25	+22	+20	+19	+17	+16	+14	-22 … +5		+12	+11	+9
512 QAM	+26	+24	+21	+19	+18	+16	+15	+13	-22 … +5		+11	+10	+8
1024 QAM	+23		+18		+15		+12		-22 … +5		+10	-	+7
2048 QAM[6]	+22		+17		+14		+11		-22 … +5		+9	-	+6

2) **For FCC 5 to 50 MHz channels in fixed Tx power mode:**

Frequency band	L6, U6, 7, 8 GHz			11 GHz			13 GHz			15 GHz, 18 GHz HP[4]			18, 23, 25, 26, 28 GHz			17 GHz[5], 24 GHz[5]	38 GHz
BW, MHz / Modulation	50 40 30	25 20	10 5	50 40 30	25 20	10 5	50 40 30	25 20	10 5	50 40 30	25 20	10 5	50 40 30	25 20	10 5	5 … 60	5 … 60
4 QAM	+30	+29	+27	+25	+24	+22	+25	+24	+22	+22	+21	+19	+19	+18	+16	-22 … +5	+15
16 QAM	+30	+29	+27	+25	+24	+22	+25	+24	+22	+22	+21	+19	+19	+18	+16	-22 … +5	+14
32 QAM	+29	+29	+27	+24	+24	+22	+24	+24	+22	+21	+21	+19	+18	+18	+16	-22 … +5	+14
64 QAM	+28	+28	+27	+23	+23	+22	+23	+23	+22	+20	+20	+19	+17	+17	+16	-22 … +5	+13
128 QAM	+28	+28	+27	+23	+23	+22	+23	+23	+22	+20	+20	+19	+17	+17	+16	-22 … +5	+13
256 QAM	+27	+27	+27 -	+22	+22	+22 -	+22	+22	+22 -	+19	+19	+19 -	+16	+16	+16 -	-22 … +5	+12
512 QAM	+26	+26	-	+21	+21	-	+21	+21	-	+18	+18	-	+15	+15	-	-22 … +5	+11
1024 QAM	+23	+23	-	+18	+18	-	+18	+18	-	+15	+15	-	+12	+12	-	-22 … +5	+10
2048 QAM[6]	+22	-	-	+17	-	-	+17	-	-	+14	-	-	+11	-	-	-22 … +5	+9

3) For FCC 5 to 60 MHz channels in variable Tx power mode:

Frequency band	L6, U6, 7, 8 GHz				11 GHz				13 GHz				15 GHz, 18 GHz HP[4]				18, 23, 25, 26, 28 GHz				38 GHz			
BW, MHz / Modulation	60	50 40 30	25 20	10 5	60	50 40 30	25 20	10 5	60	50 40 30	25 20	10 5	60	50 40 30	25 20	10 5	60	50 40 30	25 20	10 5	60	50 40 30	25 20	10 5
4 QAM	+31	+30	+29	+27	+26	+25	+24	+22	+26	+25	+24	+22	+23	+22	+21	+19	+20	+19	+18	+16	+15	+14	+13	+11
16 QAM	+30	+30	+29	+27	+25	+25	+24	+22	+25	+25	+24	+22	+22	+22	+21	+19	+19	+19	+18	+16	+14	+14	+13	+11
32 QAM	+29	+29	+29	+27	+24	+24	+24	+22	+24	+24	+24	+22	+21	+21	+21	+19	+18	+18	+18	+16	+13	+13	+13	+11
64 QAM	+28	+28	+28	+27	+23	+23	+23	+22	+23	+23	+23	+22	+20	+20	+20	+19	+17	+17	+17	+16	+12	+12	+12	+11
128 QAM	+27	+27	+27	+27	+22	+22	+22	+22	+22	+22	+22	+22	+19	+19	+19	+19	+16	+16	+16	+16	+11	+11	+11	+11
256 QAM	+25	+25	+25	+27 -	+20	+20	+20	+22 -	+20	+20	+20	+22 -	+17	+17	+17	+19 -	+14	+14	+14	+16 -	+9	+9	+9	+11 -
512 QAM	+24	+24	+24	-	+19	+19	+19	-	+19	+19	+19	-	+16	+16	+16	-	+13	+13	+13	-	+8	+8	+8	-
1024 QAM	+23	+23	+23	-	+18	+18	+18	-	+18	+18	+18	-	+15	+15	+15	-	+12	+12	+12	-	+7	+7	+7	-
2048 QAM[6]	+22	+22	-	-	+17	+17	-	-	+17	+17	-	-	+14	+14	-	-	+11	+11	-	-	+6	+6	-	-

[3] Preliminary data

[4] Integra-G 18 GHz HP version has 3dB higher Tx power than standard version

[5] Max Tx power settings depend on EIRP allowed by national regulatory and antenna size.

[6] 2048QAM modulation is available only for Integra-G. It is not supported by legacy models and 17 GHz radio.

Maximum Tx Power [dBm] for Integra-W

Tx Power, dBm						
Modulation	L6 GHz	U6 GHz	11 GHz	15, 18, 23, 25, 26, 28 GHz	17 GHz[5], 24 GHz[5]	38 GHz
4 QAM	+33	+31	+28	+22	-26 … +5	+17
8 QAM	+33	+31	+28	+22	-26 … +5	+17
16 QAM	+32	+30	+27	+21	-26 … +5	+16
32 QAM	+31	+29	+26	+21	-26 … +5	+16
64 QAM	+30	+28	+25	+20	-26 … +5	+15
128 QAM	+30	+28	+25	+20	-26 … +5	+15
256 QAM	+30	+28	+25	+19	-26 … +5	+14
512 QAM	+30	+28	+25	+19	-26 … +5	+14
1024 QAM	+28	+26	+23	+17	-26 … +5	+12

[5] Max Tx power settings depend on EIRP allowed by national regulatory and antenna size.

Integra-G RSL Thresholds at BER 10^{-6} and Total Payload Capacity (Mbps) for ETSI channels [6, 7, 8]

Band-width, MHz	Modulation	6GHz	7GHz	8GHz	11GHz	13GHz	15GHz	17GHz	18GHz	23GHz	24GHz	26GHz	28GHz	38 GHz	Capacity, Mbps	
		Guaranteed RSL Threshold, dBm													-G modes	Legacy modes
1.75[8]	4QAM StrongFEC	-100	-99	-100	-99	-99.5	-98.5	-97	-99	-99	-99.5	-98.5	-98	-95	1.9	
	16QAM StrongFEC	-93	-93.5	-93.5	-92	-93	-91.5	-90.5	-92.5	-92	-92.5	-92.5	-92	-89	3.9	
	32QAM StrongFEC	-89	-89.5	-89.5	-88	-89	-87	-86	-88.5	-87.5	-88.5	-87.5	-87	-85	4.9	
	64QAM StrongFEC	-86	-86.5	-86.5	-85.5	-86	-84.5	-83.5	-85.5	-84.5	-86	-85	-85	-82	6.6	

Band-width, MHz	Modulation	6GHz	7GHz	8GHz	11GHz	13GHz	15GHz	17GHz	18GHz	23GHz	24GHz	26GHz	28GHz	38 GHz	Capacity, Mbps	
		Guaranteed RSL Threshold, dBm													-G modes	Legacy modes
	128QAM StrongFEC	-84	-83.5	-83.5	-82	-83	-80.5	-79.5	-81.5	-80	-82.5	-81.5	-82	-79	7.9	
	128QAM WeakFEC	-82	-81	-79.5	-79	-81	-76.5	-78	-79.5	-78	-80.5	-79.5	-79	-77	8.6	
	4QAM StrongFEC	-97	-96	-97	-96	-96.5	-95.5	-94	-96	-96	-96.5	-95.5	-95	-92		4
	16QAM StrongFEC	-90	-90.5	-90.5	-89	-90	-88.5	-87.5	-89.5	-89	-89.5	-89.5	-89	-86		8
3.5	32QAM StrongFEC	-86	-86.5	-86.5	-85	-86	-84	-83	-85.5	-84.5	-85.5	-84.5	-84	-82		10
	64QAM StrongFEC	-83.5	-83.5	-83.5	-82.5	-83	-81.5	-80.5	-82.5	-81.5	-83	-82	-82	-79		13
	128QAM StrongFEC	-80	-80.5	-80.5	-79	-80	-77.5	-76.5	-78.5	-77	-79.5	-78.5	-79	-76		16
	128QAM WeakFEC	-77.5	-78	-76.5	-76	-78	-73.5	-75	-76.5	-75	-77.5	-76.5	-76	-74		17
	4QAM StrongFEC	-94	-94.5	-94	-93	-94	-93	-91	-94	-93	-93.5	-92.5	-93	-90.5		8
	16QAM StrongFEC	-87	-87.5	-88.5	-86.5	-88	-86	-84.5	-87.5	-86	-87	-86	-86	-84		16
	32QAM StrongFEC	-84	-84.5	-84.5	-83.5	-84	-82.5	-80.5	-83.5	-82	-83.5	-82.5	-83	-80		20
7	64QAM StrongFEC	-80.5	-81.5	-81.5	-80.5	-81	-80	-78	-80.5	-80	-80.5	-79	-80	-77.5		27
	128QAM StrongFEC	-77	-78	-78.5	-76.5	-77	-76	-75	-77.5	-77	-77.5	-76	-76.5	-74		33
	256QAM StrongFEC	-74	-74.5	-75	-73.5	-74.5	-73	-71	-74.5	-72	-73.5	-72.5	-73	-71		39
	256QAM WeakFEC	-72	-73	-67.5	-71.5	-72	-70	-69	-72.5	-71	-71.5	-69	-71	-69		41
	4QAM StrongFEC	-91	-91	-92	-90.5	-91	-90	-88	-91	-87.5	-91	-90	-90	-87		17
	16QAM StrongFEC	-85	-85	-85.5	-84	-85	-83.5	-81.5	-84.5	-82	-84	-83.5	-84	-81		33
	32QAM StrongFEC	-80	-81	-81.5	-80	-80.5	-79	-77	-80.5	-78	-80	-79	-79	-77		44
	64QAM StrongFEC	-78	-78.5	-78.5	-77	-78.5	-77	-75	-78.5	-76	-78	-77	-77	-74		56
14	128QAM StrongFEC	-75	-75.5	-74.5	-74	-71	-74	-72	-75.5	-73	-74.5	-73.5	-74	-71		67
	256QAM StrongFEC	-71.5	-72	-72.5	-71	-67	-71	-68.5	-71.5	-69.5	-71	-70.5	-70.5	-69		79
	512QAM StrongFEC	-68.5	-68	-69.5	-67	-63	-67	-65	-68.5	-67	-67.5	-67.5	-67	-65		90
	512QAM WeakFEC	-65.5	-66	-66.5	-64.5	-61	-64	-61.5	-65.5	-63	-65	-64	-64	-62		97
	4QAM StrongFEC	-89	-90	-91	-88,5	-88.5	-88.5	-87	-89.5	-86	-89	-89.5	-89	-86		25
	16QAM StrongFEC	-83	-84	-84.5	-83	-81	-82.5	-80	-83.5	-81	-83	-82.5	-82.5	-79.5		51
	32QAM StrongFEC	-80	-80	-80.5	-79	-78	-78	-76.5	-79.5	-77	-79	-78.5	-79	-75.5		64
	64QAM StrongFEC	-77	-77	-77.5	-76,5	-74.5	-76	-74	-77	-75	-77	-75.5	-76	-73		85
20	128QAM StrongFEC	-74	-74	-74.5	-73	-71.5	-73	-70.5	-74	-72	-73	-72.5	-73	-70		102
	256QAM StrongFEC	-70,5	-71	-71.5	-69,5	-67.5	-69.5	-68	-70.5	-68.5	-70	-70.5	-71	-67		119
	512QAM StrongFEC	-67,5	-68	-67.5	-67	-65	-66	-64.5	-67.5	-65.5	-67	-66	-66	-63.5		136
	1024QAM StrongFEC	-64	-64	-64.5	-62,5	-61	-63	-60.5	-64.5	-62	-63	-62.5	-62	-60		153
	1024QAM WeakFEC	-62	-62	-60.5	-61	-58	-60	-58	-62.5	-59.5	-61	-60.5	-60	-58		163
	4QAM StrongFEC	-88	-89	-89	-88	-87	-87	-85	-88	-84	-88	-86.5	-87	-85	34	35
	16QAM StrongFEC	-82	-83	-83	-81.5	-79.5	-81	-79	-82.5	-79.5	-82	-81.5	-81	-78	69	69
	32QAM StrongFEC	-79	-79	-80	-77.5	-77	-77	-75	-78.5	-75.5	-78	-77.5	-77	-74	87	88
	64QAM StrongFEC	-76	-76	-76.5	-75.5	-74	-75	-72	-75.5	-73.5	-75	-74.5	-74.5	-72	114	115
28	128QAM StrongFEC	-73	-73	-73.5	-71.5	-70.5	-72	-69	-72.5	-70.5	-72	-71.5	-71	-69	137	138
	256QAM StrongFEC	-70	-70	-70	-68.5	-66.5	-68	-66	-69.5	-67.5	-69	-68	-68	-65	160	161
	512QAM StrongFEC	-66.5	-66	-67	-65	-63.5	-65	-62.5	-66.5	-64	-65	-64.5	-64	-62	183	184
	1024QAM StrongFEC	-63	-63	-62.5	-62	-59.5	-61.5	-59	-63.5	-61	-62	-61.5	-61	-58	206	207
	1024QAM WeakFEC	-61			-59.5		-59	-57	-60.5	-59.5	-60	-58.5	-59	-56		220
	2048QAM StrongFEC	-59	-60	-60.5	-58	-56	-58		-59	-57	-59	-58	-57	-54	226	
	4QAM StrongFEC	-86.5	-87	-87	-85	-86	-85.5	-83	-86.5	-83	-85.5	-85	-85.5	-83	50	50
	16QAM StrongFEC	-81	-81	-82	-79.5	-78.5	-79.5	-77	-81	-78.5	-80	-79.5	-79	-76.5	98	98
	32QAM StrongFEC	-77	-77	-78	-76.5	-75.5	-75.5	-73	-77	-74.5	-76	-75.5	-75.5	-73	125	125
	64QAM StrongFEC	-74	-74	-75	-73.5	-71	-73	-71	-74	-72	-73	-73.5	-73.5	-70.5	165	165
40	128QAM StrongFEC	-71	-71	-72	-70.5	-70	-70.5	-67	-71	-69	-70	-69.5	-70	-67	198	198
	256QAM StrongFEC	-68	-68	-68	-67	-65	-66.5	-64	-68	-66	-67	-66.5	-65	-63.5	231	231
	512QAM StrongFEC	-65	-65	-65.5	-64	-62	-63.5	-61	-65	-63	-63.5	-63.5	-63	-60.5	264	264
	1024QAM StrongFEC	-61	-61	-61.5	-60.5	-59	-60	-57	-61.5	-59.5	-60.5	-59.5	-59	-56.5	298	298
	1024QAM WeakFEC	-59			-59		-57	-55	-59	-57.5	-58.5	-58	-57.5	-55		314
	2048QAM StrongFEC	-58	-58	-58.5	-56.5	-54	-56		-57.5	-55.5	-56.5	-56	-56	-52.5	327	

Band-width, MHz	Modulation	6GHz	7GHz	8GHz	11GHz	13GHz	15GHz	17GHz	18GHz	23GHz	24GHz	26GHz	28GHz	38 GHz	Capacity, Mbps	
		Guaranteed RSL Threshold, dBm													-G modes	Legacy modes
56	4QAM StrongFEC	-85	-85	-86	-84	-84.5	-84	-81	-85	-82	-84	-83.5	-84	-81	71	72
	16QAM StrongFEC	-79	-79.5	-80	-78.5	-78	-78	-75	-79	-77	-78.5	-78	-78	-75	144	145
	32QAM StrongFEC	-75	-75.5	-76	-74.5	-74	-74	-71.5	-75	-73	-74.5	-73.5	-74	-72	183	183
	64QAM StrongFEC	-72	-73	-74	-72	-71	-71	-69	-72	-70	-72.5	-71	-71	-69	238	241
	128QAM StrongFEC	-70	-69.5	-70	-68.5	-68	-69	-66	-69	-67.5	-69.5	-68	-68	-65	286	289
	256QAM StrongFEC	-67	-66	-67	-65.5	-64	-65	-62	-66	-64.5	-65.5	-64.5	-65	-62	334	337
	512QAM StrongFEC	-63	-63.5	-64	-62	-61	-62	-59	-63	-61.5	-62.5	-61	-62	-59	382	385
	1024QAM StrongFEC	-60	-60	-60	-58.5	-58	-58	-56	-59	-57.5	-59.5	-57.5	-58	-55	430	433
	1024QAM WeakFEC	-58			-57		-55	-54	-57.5	-55.5		-55.5	-55.5	-54		456
	2048QAM StrongFEC	-56	-57	-57	-54.5	--55	-54		-55	-53.5	-55.5	-54	-54.5	-52	472	

[6] *2048QAM modulation is available only for Integra-G. It is not supported by legacy models and 17 GHz radio.*

[7] *1024QAM modulation with Weak FEC setting is available for legacy models or in legacy modes only.*

[8] *1.75 MHz bandwidth is available on all Integra-G models but is being tested on customized products only. RSL values are preliminary for all bands except 6 and 13 GHz. Please ask SAF representative for more information.*

Integra-G RSL Thresholds at BER 10^{-6} and Total Payload Capacity (Mbps) for FCC channels [6, 7]

BW, MHz	Modulation	6GHz	7GHz	8GHz	11GHz	13GHz	15GHz	17GHz	18GHz	23GHz	24GHz	26GHz	28GHz	38 GHz	Capacity, Mbps	
		Guaranteed RSL Threshold, dBm													-G modes	Legacy modes
5	4QAM StrongFEC	-96	-96	-96.5	-95	-95.5	-94	-92.5	-95	-94	-95.5	-94.5	-95	-91		5
	16QAM StrongFEC	-89	-89.5	-86.5	-88	-89	-87	-86.5	-88.5	-88	-89	-87.5	-88	-85		10
	32QAM StrongFEC	-85	-85.5	-85.5	-84	-85	-83.5	-82.5	-84.5	-84	-85	-83.5	-84	-81		12
	64QAM StrongFEC	-82.5	-82.5	-80.5	-81.5	-82	-80.5	-79.5	-81.5	-81	-82	-81	-81	-79		17
	128QAM StrongFEC	-79	-79.5	-79.5	-78.5	-79	-77.5	-76.5	-78.5	-77.5	-79	-78	-78	-75		20
	128QAM WeakFEC	-77	-77	-77	-76.5	-77	-74	-73.5	-76.5	-75.5	-76.5	-75.5	-75.5	-73		22
10	4QAM StrongFEC	-92	-92.5	-94	-91	-92.5	-91	-89	-92	-90	-92	-91.5	-91.5	-89		12
	16QAM StrongFEC	-86	-86.5	-86.5	-85	-86	-84.5	-82.5	-85.5	-84	-85.5	-84.5	-85	-82		24
	32QAM StrongFEC	-82	-82.5	-82.5	-81.5	-82	-81	-79	-82.5	-80	-82	-81	-81	-78		30
	64QAM StrongFEC	-79.5	-80	-80	-79	-79.5	-78	-76	-79.5	-78	-79	-78	-78	-76		40
	128QAM StrongFEC	-76	-76.5	-76.5	-75.5	-76	-75	-73	-76.5	-75	-76	-75	-75	-73		48
	256QAM StrongFEC	-73	-73.5	-73.5	-72	-73	-72	-69	-72.5	-71	-72.5	-71.5	-71	-70		56
	256QAM WeakFEC	-70	-70.5	-70.5	-69	-70	-69	-66.5	-70.5	-68	-69.5	-68.5	-68.5	-66		60
20	4QAM StrongFEC	-89	-90	-91	-88.5	-88.5	-88.5	-86	-89	-86.5	-89	-88.5	-88	-86		24
	16QAM StrongFEC	-83	-84	-84.5	-83	-81	-83	-80	-83.5	-81	-83	-82.5	-82.5	-80		49
	32QAM StrongFEC	-80	-80	-80.5	-79	-78	-79	-76.5	-79.5	-77	-79	-78.5	-79	-77		62
	64QAM StrongFEC	-77	-77	-77.5	-76.5	-74.5	-76	-74	-76.5	-74.5	-77	-75.5	-76	-73		82
	128QAM StrongFEC	-74	-74	-74.5	-73	-71.5	-73	-70.5	-73.5	-71.5	-73	-72.5	-73	-71		99
	256QAM StrongFEC	-70.5	-71	-71.5	-69.5	-67.5	-70	-67	-70.5	-68.5	-70	-69.5	-70	-67.5		115
	512QAM StrongFEC	-67.5	-68	-67.5	-67	-65	-66	-64.5	-67.5	-65.5	-67	-66	-66	-64		132
	1024QAM StrongFEC	-64	-64	-64.5	-62.5	-61	-63	-60.5	-64.5	-62.5	-63	-62.5	-62	-61		148
	1024QAM WeakFEC	-62	-62	-60.5	-61	-58	-60	-58	-62.5	-59.5	-61	-60.5	-60	-58		157
25	4QAM StrongFEC	-88	-88.5	-89.5	-88	-88	-88	-85	-88	-85	-88	-87.5	-87	-85		31
	16QAM StrongFEC	-82	-83	-83.5	-82.5	-81	-82	-79	-82.5	-80	-82	-81.5	-81.5	-79		62
	32QAM StrongFEC	-79	-79	-79.5	-78.5	-76.5	-78	-75.5	-78.5	-77	-78.5	-77.5	-78	-75		78
	64QAM StrongFEC	-76	-76	-76.5	-75.5	-74	-75	-73	-76.5	-73.5	-75.5	-74.5	-75	-72		104
	128QAM StrongFEC	-73	-73	-73.5	-72.5	-70.5	-72	-70	-72.5	-70.5	-72.5	-71.5	-72	-69		124
	256QAM StrongFEC	-70	-70	-69.5	-69.5	-65.5	-69	-66	-69.5	-68	-69	-68.5	-68	-66		145
	512QAM StrongFEC	-66.5	-67	-66.5	-65.5	-63	-66	-63	-66.5	-65	-66	-65.5	-64.5	-63		166
	1024QAM StrongFEC	-63	-63	-63.5	-61.5	-59	-62	-59	-63.5	-61.5	-62.5	-61.5	-61	-60		187
	1024QAM WeakFEC	-61	-61	-61.5	-59.5	-58	-58	-57	-60.5	-59.5	-60	-59.5	-59	-57		198

BW, MHz	Modulation	6GHz	7GHz	8GHz	11GHz	13GHz	15GHz	17GHz	18GHz	23GHz	24GHz	26GHz	28GHz	38 GHz	Capacity, Mbps	
		Guaranteed RSL Threshold, dBm													-G modes	Legacy modes
30	4QAM StrongFEC	-88	-88	-89	-87	-87	-87	-85	-88	-84.5	-87	-86.5	-86.5	-84		37
	16QAM StrongFEC	-82	-82	-83	-81.5	-79.5	-81	-78.5	-81.5	-79	-81.5	-80.5	-81	-78		73
	32QAM StrongFEC	-78	-79	-79	-77.5	-76.5	-77	-75	-78.5	-75	-77.5	-76.5	-77	-74		93
	64QAM StrongFEC	-76	-76	-76.5	-74.5	-74	-74	-72	-75.5	-73	-75	-74.5	-74	-71.5		123
	128QAM StrongFEC	-72	-73	-73	-71.5	-70	-71	-69	-72.5	-70	-71.5	-71.5	-71	-69		148
	256QAM StrongFEC	-69	-69	-69.5	-68.5	-67	-68	-66	-69	-67.5	-68.5	-67.5	-68	-65		173
	512QAM StrongFEC	-66	-66	-66.5	-65.5	-62.5	-65	-62	-66.5	-64.5	-65	-64.5	-64	-62		197
	1024QAM StrongFEC	-63	-62	-62.5	-61.5	-60	-61	-59	-62.5	-61.5	-61.5	-61	-60	-58		222
	1024QAM WeakFEC	-61			-60		-58	-57	-60.5	-59.5	-60.5	-59	-58.5	-56		235
	2048QAM StrongFEC	-59	-60	-60.5	-58	-56.5	-56		-58	-57	-58.5	-57	-57.5	-54	244	
40	4QAM StrongFEC	-86.5	-87	-87	-85	-86	-85.5	-83	-86	-83	-85.5	-85	-85.5	-82		51
	16QAM StrongFEC	-81	-81	-82	-79.5	-78.5	-79	-77	-80.5	-78	-80	-79.5	-79	-77		101
	32QAM StrongFEC	-77	-77	-78	-76.5	-75.5	-76	-73	-77	-74	-76	-75.5	-75.5	-73		129
	64QAM StrongFEC	-74	-74	-75	-73.5	-71	-73	-70	-74	-72	-73	-72.5	-72.5	-70		170
	128QAM StrongFEC	-71	-71	-72	-70.5	-70	-70	-67	-71	-69	-70	-69.5	-70	-67		204
	256QAM StrongFEC	-68	-68	-68	-67	-65	-66.5	-64.5	-67	-66	-67	-66.5	-65.5	-64		238
	512QAM StrongFEC	-65	-65	-65.5	-64	-62	-64	-61	-64.5	-63	-63.5	-63.5	-63	-61		272
	1024QAM StrongFEC	-61	-61	-61.5	-60.5	-59	-58	-57.5	-61.5	-59	-60.5	-59.5	-59.5	-56.5		306
	1024QAM WeakFEC	-60			-59		-55	-55	-59.5	-57.5	-58.5	-58	-57.5	-55.5		323
	2048QAM StrongFEC	-58	-58	-58.5	-57	-54	-53		-57.5	-55	-56.5	-55.5	-56	-53	336	
50	4QAM StrongFEC	-85	-86	-86	-84.5	-85.5	-85	-82	-85	-82.5	-85.5	-84	-84	-81.5	63	63
	16QAM StrongFEC	-80	-80	-80	-78.5	-78	-78	-76	-79.5	-77	-79.5	-78	-78	-76	128	130
	32QAM StrongFEC	-76	-76	-76	-74.5	-74.5	-75	-72	-75.5	-73	-75.5	-74.5	-74.5	-72.5	163	163
	64QAM StrongFEC	-73	-73.5	-74	-72.5	-71	-72	-69	-72	-71	-72.5	-71.5	-72	-69.5	212	216
	128QAM StrongFEC	-70	-70	-71	-69	-68	-69	-66	-70	-68	-69.5	-68	-69	-66.5	254	258
	256QAM StrongFEC	-67	-67	-67	-65.5	-64	-66	-63	-66	-64.5	-66.5	-65	-65	-63	297	301
	512QAM StrongFEC	-64	-63.5	-64	-63	-61	-63	-59	-63.5	-62	-63	-62	-62	-60	339	344
	1024QAM StrongFEC	-61	-61	-60	-60	-57	-58	-56	-60	-58.5	-59.5	-58.5	-58	-56	382	385
	1024QAM WeakFEC	-59			-57		-55	-54	-57.5	-55.5	-57.5	-56	-56	-54		410
	2048QAM StrongFEC	-57	-57	-57.5	-56	-55	-53	-	-56	-54	-56.5	-55.5	-55	-52	420	
60	4QAM StrongFEC	-84	-85	-85.5	-83.5	-84.5	-84	-81	-85	-82	-84	-83.5	-83.5	-81	74	74
	16QAM StrongFEC	-79	-79.5	-80	-78	-77	-78	-75	-78.5	-76	-78.5	-77	-77.5	-75	149	151
	32QAM StrongFEC	-75	-75.5	-76	-74.5	-73	-74	-71	-75	-73	-74.5	-73.5	-74	-71	190	190
	64QAM StrongFEC	-72	-73	-73	-71.5	-71	-71	-69	-72	-70	-71.5	-71	-71	-69	247	251
	128QAM StrongFEC	-70	-69.5	-70	-68.5	-68	-68	-66	-69	-67	-69	-67.5	-68	-65	297	301
	256QAM StrongFEC	-66	-66	-67	-65	-64	-65	-62	-66	-64.5	-65.5	-64.5	-65	-62	347	351
	512QAM StrongFEC	-63	-63	-63	-62.5	-61	-62	-59	-62.5	-61.5	-62.5	-61	-61	-59	397	401
	1024QAM StrongFEC	-60	-59	-60	-58.5	-58	-58	-55	-59	-57.5	-58.5	-57.5	-57	-54.5	447	451
	1024QAM WeakFEC	-58			-57		-55	-53	-57	-55.5	-56.5	-55.5	-55.5	-53		474
	2048QAM StrongFEC	-56	-56	-57	-54	-54	-54		-55	-53	-55.5	-54.5	-54	-51.5	491	

[6] 2048QAM modulation is available only for Integra-G. It is not supported by legacy models and 17 GHz radio

[7] 1024QAM modulation with Weak FEC setting is available for legacy models or in legacy modes only

Integra-W RSL Thresholds at BER 10^{-6} and Total Payload Capacity (Mbps) [9]

		6L GHz	6U GHz	11GHz	15GHz	17GHz[10]	18GHz	23GHz	24GHz[10]	26GHz	28GHz	38 GHz	Capacity, Mbps
BW, MHz	Modulation, Strong FEC	Guaranteed RSL Threshold, dBm											Integra -W
40 FCC	4QAM	-82.5	-82.5	-82.5	-82	-79	-83.5	-80.5	-80	-82	-82.5	-79	63
	8QAM	-79	-79	-78	-77.5	-76	-80.5	-76.5	-75.5	-78	-78.5	-75	94
	16QAM	-76	-76	-75.5	-75	-73	-76.5	-74.5	-72.5	-75	-74.5	-72.5	126
	32QAM	-73	-73	-73	-72.5	-70	-74	-71.5	-70	-72	-72	-69.5	157
	64QAM	-70	-70	-70	-69.5	-67.5	-71.5	-69.5	-66.5	-69	-69	-66.5	189
	128QAM	-67	-67	-67	-66.5	-64.5	-68	-65.5	-64	-66	-66.5	-63.5	220
	256QAM	-64	-64	-64	-63.5	-61	-63.5	-62.5	-60.5	-63	-61.5	-60.5	252
	512QAM	-61	-61	-60	-59.5	-58	-59.5	-59.5	-57.5	-60	-59.5	-57.5	284
	1024QAM	-57	-57	-56.5	-56	-55	-55.5	-57	-54	-56	-55.5	-53	315
50 FCC	4QAM	-82	-82	-82	-81.5	-79	-82.5	-79.5	-79	-81	-81	-78.5	78
	8QAM	-78	-78	-77	-76.5	-75	-79	-75.5	-75	-77	-77	-74.5	118
	16QAM	-75	-75	-75	-74.5	-72	-76.5	-74.5	-72	-74	-74	-72	157
	32QAM	-72	-72	-72	-71.5	-69.5	-73.5	-71.5	-69	-71	-71	-69	197
	64QAM	-69	-69	-69	-68.5	-66.5	-70.5	-68.5	-66	-68	-68.5	-66	236
	128QAM	-66	-66	-66	-65.5	-63.5	-65.5	-65.5	-62.5	-65.5	-66.5	-64	276
	256QAM	-63	-63	-63	-62.5	-60	-62.5	-61.5	-60	-62	-62	-60	315
	512QAM	-60	-60	-60	-59.5	-57.5	-58.5	-58.5	-57	-59	-59	-57	355
	1024QAM	-56	-56	-56	-55.5	-54	-55.5	-55.5	-53	-55	-54.5	-52.5	394
56 ETSI	4QAM	-81.5	-81.5	-81	-80.5	-78.5	-82.5	-80	-78	-80	-80.5	-77.5	89
	8QAM	-77	-77	-76	-75.5	-74.5	-78	-75.5	-73	-76	-76.5	-73.5	134
	16QAM	-74.5	-74.5	-74	-73.5	-72	-75.5	-74	-71	-74	-74	-71	178
	32QAM	-71.5	-71.5	-71	-70.5	-69	-72.5	-70.5	-68.5	-71	-71.5	-69.5	224
	64QAM	-68.5	-68.5	-68.5	-68	-66	-68.5	-67.5	-65	-68	-68	-66	269
	128QAM	-65	-65	-65	-64.5	-63	-65.5	-65	-62	-65	-65	-62	314
	256QAM	-62.5	-62.5	-62.5	-62	-60	-61.5	-61.5	-59	-62	-62.5	-59.5	359
	512QAM	-59.5	-59.5	-59	-58.5	-57	-58.5	-58.5	-56	-58	-59	-56	404
	1024QAM	-55	-55	-55.5	-55	-53	-54.5	-55	-52.5	-55	-55.5	-52.5	449
60 FCC	4QAM	-81	-81	-81	-80.5	-78.5	-81.5	-80.5	-78	-80	-80	-77.5	96
	8QAM	-76.5	-76.5	-76	-75.5	-74	-78	-75.5	-74	-76	-76	-73.5	144
	16QAM	-74.5	-74.5	-74	-73.5	-71.5	-75.5	-73.5	-71	-74	-74.5	-72	192
	32QAM	-71.5	-71.5	-71	-70.5	-68.5	-72.5	-70.5	-68	-71	-71.5	-68.5	240
	64QAM	-68.5	-68.5	-67.5	-67	-64.5	-67.5	-67.5	-65	-67	-67	-65	288
	128QAM	-65	-65	-65	-64.5	-62.5	-65.5	-64.5	-62	-65	-65.5	-62.5	336
	256QAM	-62.5	-62.5	-62	-61.5	-59.5	-61.5	-61.5	-59	-61	-61.5	-58.5	385
	512QAM	-59	-59	-58	-57.5	-56.5	-58.5	-58.5	-55.5	-58	-58	-56	433
	1024QAM	-55	-55	-55	-54.5	-53	-54.5	-55	-52	-55	-54.5	-52	481
80 FCC	4QAM	-79.5	-79.5	-79.5	-79	-77.5	-81	-78.5	-76	-79	-79	-76.5	128
	8QAM	-75.5	-75.5	-74	-73.5	-72.5	-77	-75	-73	-75	-75	-72.5	192
	16QAM	-72.5	-72.5	-72	-71.5	-70	-74.5	-71.5	-70	-72	-72	-69.5	257
	32QAM	-69.5	-69.5	-69	-68.5	-67.5	-71.5	-68.5	-67	-69	-69	-66.5	321
	64QAM	-66.5	-66.5	-66.5	-66	-64.5	-67.5	-65.5	-64	-66	-66	-63.5	385
	128QAM	-63.5	-63.5	-63.5	-63	-61	-64	-62.5	-61	-63	-63	-60.5	450
	256QAM	-60.5	-60.5	-60.5	-60	-58	-60.5	-59.5	-58	-60	-60	-57.5	514
	512QAM	-57.5	-57.5	-57	-56.5	-55	-57	-56.5	-54	-56.5	-56.5	-54	578
	1024QAM	-53.5	-53.5	-53.5	-53	-51.5	-53.5	-53	-51	-53.5	-53.5	-51	643

		6L GHz	6U GHz	11GHz	15GHz	17GHz[10]	18GHz	23GHz	24GHz[10]	26GHz	28GHz	38 GHz	Capacity, Mbps
BW, MHz	Modulation, Strong FEC	Guaranteed RSL Threshold, dBm											Integra -W
100[9] FCC	4QAM	-78.5	-78.5	-79	-78.5	-	-80	-77.5	-	-78.5	-78.5	-76	168
	8QAM	-74.5	-74.5	-74	-73.5	-	-76	-73.5	-	-73.5	-73.5	-71	252
	16QAM	-71.5	-71.5	-71	-70.5	-	-73	-70.5	-	-71.5	-71.5	-69	336
	32QAM	-68.5	-68.5	-69	-68.5	-	-70	-67.5	-	-68.5	-68.5	-66	420
	64QAM	-65.5	-65.5	-65.5	-65	-	-66	-64.5	-	-65.5	-65.5	-63	504
	128QAM	-63	-63	-63	-62.5	-	-63	-61.5	-	-62.5	-62.5	-60	588
	256QAM	-59.5	-59.5	-59.5	-59	-	-60	-58.5	-	-58.5	-58.5	-56	672
	512QAM	-56	-56	-56	-55.5	-	-56	-55.5	-	-56.5	-56.5	-54	756
	1024QAM	-52	-52	-51	-50.5	-	-51.5	-52	-	-51.5	-51.5	-49	840
112[9] ETSI	4QAM	-78.5	-78.5	-77.5	-77	-	-79.5	-77.5	-	-77.5	-77.5	-75	176
	8QAM	-73.5	-73.5	-73.5	-73	-	-76	-73	-	-73	-73	-70.5	265
	16QAM	-71.5	-71.5	-71	-70.5	-	-73	-70.5	-	-70.5	-70.5	-68	353
	32QAM	-68.5	-68.5	-68	-67.5	-	-70	-67.5	-	-67.5	-67.5	-65	441
	64QAM	-65	-65	-65	-64.5	-	-66	-64.5	-	-64.5	-64.5	-62	530
	128QAM	-62.5	-62.5	-62	-61.5	-	-63	-61.5	-	-61.5	-61.5	-59	618
	256QAM	-59.5	-59.5	-59	-58.5	-	-59	-58.5	-	-58.5	-58.5	-56	707
	512QAM	-54.5	-54.5	-56	-55.5	-	-56	-54.5	-	-54.5	-54.5	-52	795
	1024QAM	-52	-52	-51.5	-51	-	-51.5	-51	-	-51.5	-51.5	-49	883

[9] 100 MHz and 112 MHz channel bandwidths are available for all Integra-W models except 17GHz and 24GHz UL.

[10] Please check the availability of 17GHz and 24GHz UL Integra-W models at SAF representative before planning your network

ABBREVIATIONS

ACI – Adjacent-Channel Interference
ACM – Adaptive Coding and Modulation
ATPC – Automatic Transmit Power Control
BER – Bit-Error Ratio
CCI – Co-Channel Interference
CLI – Command-Line Interface
CPU – Central Processing Unit
CRC – Cyclic Redundancy Check
DC – Direct Current
DiffServ – Differentiated Services
DSCP - Differentiated Services Code Point
ETSI – European Telecommunications Standards Institute
FCC - The Federal Communications Commission
FCS - Frame check sequence
FEC – Forward Error Correction
FO – Fiber Optics
FODU – Full Outdoor Unit
FTP – File Transfer Protocol
GUI – Graphical User Interface
IEEE - Institute of Electrical and Electronics Engineers
IF – Intermediate Frequency
ISP – Internet Service Provider
ITU-T – International Telecommunication Union – Telecommunication Standardization Sector
LAN – Local Area Network
LED – Light-Emitting Diode
MAC – Media Access Control
MSE – Mean Square Error
NMS – Network Management System
PC – Personal Computer
MAC – Media Access Control
MSE – Mean Square Error
NMS – Network Management System
PC – Personal Computer
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
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

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