


SIRIUS: Teko Telecom Modular Coverage and Capacity System



TECHNICAL HANDBOOK

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SIRIUS: Teko Telecom Modular Coverage and Capacity System



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Safety Rules

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Initial Notes

Declaration of Conformity (*)

According to Directive 1999/5/EC (R&TTE)

We TEKOTELECOM hereby declare that the products described in this technical handbook are manufactured by TEKOTELECOM S.p.A. Via Meucci, 24/a 40024 Castel S. Pietro Terme (Bologna) – ITALY. All the above cited products are compliant with the essential requirements of article 3 and other relevant provisions of the Radio & Telecommunications Terminal Equipment Directive, n.1999/5/EC, when used for their intended purpose: improving coverage of mobile communication networks.

Castel S. Pietro Terme (Bologna) – ITALY

Legal representative

Teko Telecom S.p.A.

a Socio Unico

(*) A signed copy of the conformity declaration is available upon request. Please get in touch with our after sale service, filling in the form on line at the following Internet address: www.tekotelecom.it

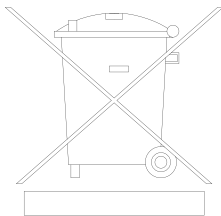
Note relevant to product utilization within the European Union (EU)

It's under user's own responsibility to verify to be compliant to the National provisions or authorisations required.

For further information refer to: http://ec.europa.eu/enterprise/sectors/rtte/index_en.htm

EU directive 2002/96/EC – WEEE (Waste Electrical and Electronic Equipment)

This product complies with the EU directive 2002/96/EC – WEEE (Waste Electrical and Electronic Equipment)



The symbol of the crossed container marked on the equipment shows that the product, at the end of its useful life, must be collected separately from other refuse. Therefore the user must deliver the equipment that has reached the end of its life to the special differentiated electronic and electrotechnical refuse collection centres, for subsequent dispatch of the discarded equipment for recycling, treatment and environmentally compatible disposal, thus contributing in preventing possible negative effects on the environment and on health and favouring the recycling of the materials from which the equipment is made.

Illicit disposal of the product by the user will lead to the application of the penalties provided for by the national legislations of the various Member States on receipt of directive 2002/96/EC.

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Packaging and Packaging Waste Directive 94/62/EC

The packaging of the product complies with the Directive 94/62/EC, concerning packaging and packaging waste. Environmentally harmful materials are not used for packaging.

Packaging is made from materials that can easily be recycled after use. Depending on the means of transportation, the equipment is packed in a cardboard or wooden box, protected with expanded polystyrene or barrier bags.

The packaging materials are marked according to ISO 11 469.

Please do not throw packaging materials into unsorted waste but separate them according to local regulations waste disposal options.

Compliance with the Maximum Permissible Exposure (MPE) limits - Examples of minimum separation distance calculation, based on the EN 50385

The following table summarizes the results of the calculations carried out assuming:

- zero losses between the output connector of Teko Telecom equipment and the input connector of the antenna
- maximum gain estimated for outdoor Antenna $G_i = 19\text{dBi}$ (for each band)
- maximum gain estimated for indoor Antenna $G_i = 7\text{dBi}$ (for each band)
- no co-location or operation in conjunction with any other antenna or transmitter.

Please note

The following table is **not** meant to represent the actual compliance distance from a particular Teko Telecom Optical System or Modular Repeater, being antennas, cables, and other RF components not provided with Teko Telecom equipment.

The actual compliance distance from a particular equipment can be calculated in the final installation phase only - when antenna, cables and other RF components specifications are available.

Equipment	Type	Maximum Output Power	Minimum separation distance between a person and the antenna in order to comply with MPE limits [m]				
			Indoor installation		Outdoor installation		
			E=6 [V/m]	E=20 [V/m]	E=6 [V/m]	E=20 [V/m]	
Remote Unit and Service Front End (TSFE)	• Low Power Single band Remote Units • Medium Power EGSM band Remote Unit	29dBm	1.8	0.6	7.1	2.3	
	Medium Power DCS band Remote Unit	31dBm	2.2	0.7	8.9	2.8	
	• Low Power Dual band Remote Units • Medium Power UMTS band Remote Unit	32dBm	2.5	0.8	10.1	3.2	
	Triband Low Power Remote Units	33.8dBm	3.1	1.0	12.3	3.9	
	Dual band Medium Power Remote Units	34.6dBm	3.4	1.1	13.4	4.2	
	Medium Power Triband Remote Units	35.6dBm	3.8	1.5	15.2	4.8	
	• Low Power 5-band Remote Unit • High Power TETRA Remote Unit • High Power TETRA Service Front End	36dBm	4.0	1.3	15.9	5.0	
	• High Power Single band Remote Units (LTE800 or EGSM or DCS or UMTS) • High Power Service Front End (LTE800 or EGSM or DCS or UMTS or LTE2600)	40dBm	6.3	2.0	25.1	8.0	
	High Power Single band Remote Unit (LTE2600)	41dBm	7.1	2.2	28.1	8.9	
	• High Power Dual band Remote Units (LTE800 and/or EGSM and/or DCS and/or UMTS) • Very High Power Single band Remote Units • Very High Power Service Front End (LTE800 or EGSM or DCS or UMTS)	43dBm	8.9	2.8	35.6	11.2	
	High Power Dual Band Remote Units (LTE800 or EGSM or DCS or UMTS with LTE2600)	43.5dBm	9.5	3.0	37.7	11.9	
	High Power Tri Band Remote Units (LTE800 and/or EGSM and/or DCS and/or UMTS)	44.7dBm	10.9	3.5	43.6	13.8	
	High Power Tri Band Remote Units (LTE800 or EGSM or DCS or UMTS with LTE2600)	45.1dBm	11.4	3.6	45.3	14.3	
	Very High Power Dual Band Remote Units	46dBm	12.6	4.0	50.3	15.9	
	Very High Power Tri Band Remote Units	47.8dBm	15.5	4.9	61.6	19.5	
	Donor Front End (TDFE)	Single Band TETRA Donor Front End	21dBm	0.7	0.2	2.8	0.9
		Single Band EGSM Donor Front End	23dBm	0.9	0.3	3.6	1.1
Single Band DCS Donor Front End		25dBm	1.1	0.4	4.5	1.4	
Single Band LTE 800 or LTE2600 Donor Front End		26dBm	1.3	0.4	5.0	1.6	
Single Band UMTS Donor Front End		27dBm	1.4	0.5	5.6	1.8	



Operation is subject to the following 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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The antenna(s) used for this transmitter must be installed to provide a separation distance of:

- at least 50cm for Low Power Remote Units family in Tri-Band system (with 8dB of maximum antenna gain for operating bands lower than 1.5GHz and 11dB for operating bands higher than 1.5GHz),
- at least 50cm for Low Power Remote Units family in Six-Band system (with 4.5dB of maximum antenna gain for operating bands lower than 1.5GHz and 6.5dB for operating bands higher than 1.5GHz),
- at least 150cm for Very High Power Remote Units family in Tri-Band System (with 3.5dB of maximum antenna gain for operating bands lower than 1.5GHz and 6.5dB for operating bands higher than 1.5GHz)
- at least 50cm for Donor Front End family (with 15.5dB of maximum antenna gain for operating bands lower than 1.5GHz and 19dB for operating bands higher than 1.5GHz),
- at least 150cm for Very High Power Amplifier radio module, equipped inside Service Front End family and Very High Power Remote Units family (with 8dB of maximum antenna gain for operating bands lower than 1.5GHz and 11.5dB for operating bands higher than 1.5GHz)

from all persons assuming no co-location or operating in conjunction with any other antenna or transmitter.

Specifications of antennas, cables, RF components, etc will be provided only in the final installation phase, being the external antenna not provided with equipment.

Equipment will be accessible only to maintenance men, that must switch it off before any maintenance operation.

Teko Telecom Coverage and Capacity Systems Technical Handbook

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SIRIUS: Teko Telecom Modular Coverage and Capacity System



1. General Description

1. Teko Telecom Modular Coverage and Capacity System - General Description

Teko Telecom Coverage and Capacity Systems are flexible multi-band multi-operator Systems that provide a wide range of solutions to extend both indoor and outdoor cellular coverage in shadow areas -where the RF signal is not available- and to increase capacity in indoor and outdoor hot spots -where the operators need dedicated coverage.

Modular design is a key feature of Teko Telecom Systems: it offers flexible configuration options to build the most suitable solution for any coverage need.

SIRIUS

Stand-alone Modular Repeaters, Optical Systems as well as integrated solutions share a unique common platform: SIRIUS.

SIRIUS includes a wide range of active and passive components that can be assembled in a variety of ways in order to provide easy to set-up, maintain, and upgrade products operating in the 380 to 2700MHz frequency range.

SIRIUS components can be used in different Systems with different functionalities to meet present needs and to allow system adaptation to changing conditions, always assuring optimized performances.

Teko Telecom Master Unit is the core of SIRIUS modular design: it is a versatile modular rack-based platform that controls the whole Coverage System and, depending on its components configuration, is able to provide:

- the RF interface towards the signal source (BTS, Node B, Repeater),
- the RF interface towards Service Antennas/leaky cable,
- the optical interface towards up to 144 Remote Units.

This technical handbook describes the components of SIRIUS and how these components can be assembled to provide Optical Systems and Modular Off-air Repeaters to improve coverage in different environments.

1.1 Components

The components of SIRIUS can be grouped in the following categories:

1. Modules providing the RF interface towards the signal source

- **Point of Interface (POI) module:** is the single-band/single-operator interface towards a BTS or NodeB. The Point of Interface module is connected to the signal source via coaxial cable.
- **Digital Donor Front End Module:** is the single-band/single-operator interface towards a Donor Antenna, providing a connection to a BTS or NodeB over an air link.

2. Equipment extending coverage / distributing capacity

- **Service Front End:** is the single-band/multi-operator interface towards a Service Antenna. It provides wireless signal to the area to be covered (Modular Repeaters). In Optical Systems the Service Front End can be used to extend coverage to the area close to the Master Unit site.
- **Remote Unit:** is the multi-band/multi-operator equipment used in Optical Systems to distribute wireless signal throughout the area to be covered (extensive areas coverage/ active DAS).

3. Modules providing the optical interface towards Remote Units

- **Fiber Optic Transmitter/Receiver Modules** are the optical interface between Master Unit and Remote Units: they provide RF-to-Optical/Optical-to-RF conversion.
- **Master and Slave Point to Point Modules** perform the RF-to-Optical/Optical-to-RF conversion required by the optical point to point link connecting RF Interface modules to distant Fiber Optic Transmitter/Receiver Modules. The optical point to point link allows a separation distance -up to 20km- between RF Interface modules and Fiber Optic Transmitter/Receiver Modules.

4. Passive Modules providing distribution and filtering

Our passive components provide RF distribution and filtering.

The 4-way Combiner/Splitter can be used to manage up to 4 RF interface modules operating in the same band; several models of Triplexers with built-in 1:4 Splitter/Combiner are available to distribute signals operating over up to 3 different bands. The multiplexers distribute signals operating over multiple different bands - up to 5 (pentaplexer); up to 6 (esaplexer).

Due to the flexible configuration options of Teko Telecom Coverage and Capacity Systems, the same passive components can be used for different purposes.

- The **4-way Combiner/Splitter** can be used to manage either up to 4 RF interface

modules, operating in the same band (Multi-Operator Systems) or up to 4 Fiber Optic Modules (Fiber Optic Transmitter/Receiver Modules or Master Point to Point Modules).

- The **Band Splitter/Combiner (Triplexer) with built-in 1:4 Splitter/Combiner** can be used to manage up to 3 RF interface modules or Service Front End subracks, operating in different bands, and up to 4 Fiber Optic Modules. It can also manage up to 3 four-way splitter/combiner modules each connected to multiple RF interface modules, operating in the same band, and up to 4 Fiber Optic Modules.

5. Modules for the management of the System

- The **Supervision Module** allows the management of the whole Coverage System.
- The **Alarm Module** is an optional module that can be equipped to increase the number of supported external alarms.

6. Power Supply Modules

The Coverage and Capacity Systems can be equipped with either AC (Universal mains, 85÷264Vac, 50-60Hz) or DC (-72÷-36Vdc) Power Supply modules.

7. Subracks hosting the System modules

Both active and passive subracks are available.

- **Active subracks** are provided with a backplane that allows the management and power supply of active modules.
- **Passive subracks** are used to host passive modules that do not require power nor management to function. Passive Subracks allow a reduction in the cost of the whole system.

8. Forced-air cooling Subrack

A forced-air cooling subrack is available to ensure the air flow required for proper cabinet installed equipment operation.

Rack cabinets for hosting the System Subracks (indoor installation) and cabinets for Outdoor installation are also available.

A detailed description of each Component of Teko Telecom Modular Coverage and Capacity System is provided in the following paragraphs.

1.1.1 Modules providing the RF interface towards the signal source

- **Point Of Interface Modules**

Point of Interface modules are used in Optical Systems to interface any kind of operator signal source -pico/micro/macro BTS or NodeB: each Point of Interface module is connected to a single mobile operator/ mobile band signal source via coaxial cable.

Optical Systems can be equipped with one Point of Interface or more Point of Interface modules to make multiple configurations available: single operator (single band / multi-band) and multi-operator (single-band / multi-band).



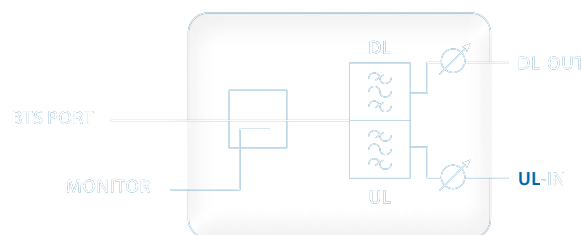
Passive Point Of Interface module (POI) with rotary adjustable attenuators



Point Of Interface module (TAPOI) with remote-controlled variable attenuators

Each Point of Interface module includes the duplexer, to separate/combine Downlink and Uplink paths and two variable attenuators to make both Downlink and Uplink RF levels separately adjustable.

A monitor port is available either for measurements or for external wireless modem coupling.



Point Of Interface module block diagram

Point of Interface modules with separate Downlink and Uplink ports (without built-in duplexer) are available as option.

Teko Telecom Point of Interface modules can be equipped either with manually adjustable attenuators (POI-x models) or with remote-controlled attenuators (TAPOI-x models).

POI modules

POI modules include two rotary adjustable attenuators to make Downlink and Uplink RF levels manually adjustable within a range of either 30dB, with 1dB step, or 10dB, with 1dB step (POI-A10 models).

TAPOI modules

TAPOI modules include two automated variable attenuators to adjust Downlink and Uplink RF levels via the Coverage System Supervision Module (TSPV) and Management Tools (OMT webpages, OMC software).

• **POI Modules Access Points**

Adjustable attenuators



Passive POI with built-in duplexer

Adjustable attenuators



Passive POI without built-in duplexer

Label (Connectors)	Description
DL-OUT	Downlink path RF output (SMA connector)
UL-IN	Uplink path RF input (SMA connector)
BTS PORT	RF connector (N type) towards the signal source (BTS, Node B or repeater)
MONITOR	Monitor port for measurements or for external wireless modem coupling

Label (Connectors)	Description
DL-OUT	Downlink path RF output SMA connector
UL-IN	Uplink path RF input SMA connector
BTS PORT DL	Input RF connector from the signal source - BTS, Node B or repeater (N type)
BTS PORT UL	Output RF connector to the signal source - BTS, Node B or repeater (N type)

Adjustable attenuators	Description
DL OUT	Downlink path RF level adjustable attenuator (0÷30dB or 0÷10dB - 1 dB step)
UL IN	Uplink path RF level adjustable attenuator (0÷30dB or 0÷10dB - 1 dB step)

- TAPOI Module Access Points



TAPOI with built-in duplexer

Label (Connectors)	Description
DL OUT	Downlink path RF output (SMA connector)
UL IN	Uplink path RF input (SMA connector)
BTS PORT	RF connector (N type) towards the signal source (BTS, Node B or repeater)
MONITOR	Monitor port for measurements or for external wireless modem coupling

Label (LEDs)	Description
ON	TAPOI Module operating status green LED ON when power supply is present
ALM	TAPOI Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)

- **Teko Telecom Digital Donor Front End**

The Digital Donor Front End Module is the single-band/single-operator System RF interface towards a Donor Antenna. No physical connections are required between the DFE and the cellular network: the Donor Antenna provides the connection to a BTS or NodeB over an air link.

Coverage Systems can be equipped with one or more Donor Front End modules to make multiple configurations available: single operator (single band / multi-band) and multi-operator (single-band / multi-band).



TEKO TELECOM CODE	UPLINK OPERATING FREQUENCY BAND	DOWNLINK OPERATING FREQUENCY BAND	Modulation
TDFE-7SL	698 ÷ 716MHz	728 ÷ 746 MHz	LTE (QAM, QPSK)
TDFE-7SH	776 ÷ 787MHz	746 ÷ 757 MHz	LTE (QAM, QPSK)
TDFE-8S	806 ÷ 824 MHz	851 ÷ 869 MHz	iDEN
TDFE-8A	824 ÷ 849 MHz	869 ÷ 894 MHz	GSM-EDGE-TDMA-CDMA-WCDMA-LTE (QAM, QPSK)
TDFE-9S	896 ÷ 902 MHz	935 ÷ 941 MHz	iDEN
TDFE-19	1850 ÷ 1915 MHz	1930 ÷ 1995 MHz	GSM-EDGE-TDMA-CDMA-WCDMA-LTE (QAM, QPSK)
TDFE-AW	1710 ÷ 1755 MHz	2110 ÷ 2155 MHz	CDMA-WCDMA-LTE (QAM, QPSK)

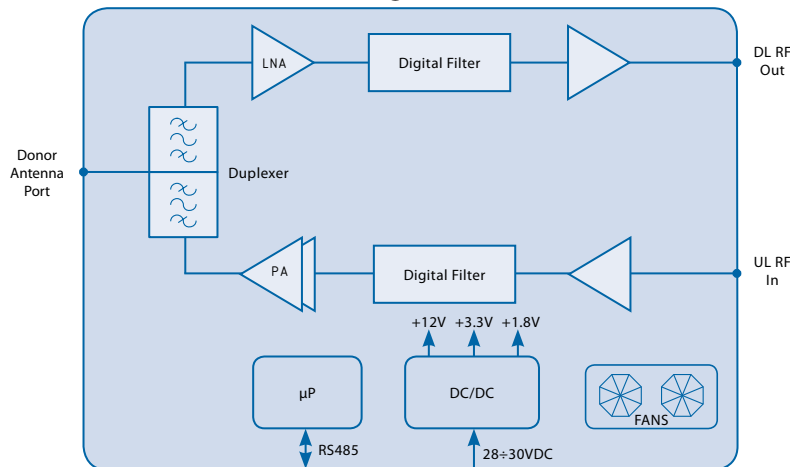
Digital Donor Front End Module operating frequency bands summary table

A single-band single-operator modular Off-air Repeater can be set up combining a Digital Donor Front End Module and a Service Front End (Teko Telecom single-band/multi-operator interface towards a Service Antenna). Up to 4 Donor Front End Modules can be connected to a single Service Front End to provide a single-band 4-operator modular Off-air Repeater.

Digital Donor Front End Modules can also be used to drive Optical Systems: the Digital Donor Front End Module allows Optical Systems to be driven without the need of a dedicated BTS or Node B. A donor antenna picks-up the signal and the Optical System acts as a repeater with distributed Service antennas connected to the Remote Units. Service Front End subracks can

be connected to DFE modules to provide coverage to the area next to the Master Unit site. Each DFE module hosts the duplexer, to be connected to the Donor Antenna to separate/combine downlink and uplink paths.

In downlink the signal from the Donor Antenna is preamplified by a Low Noise Amplifier and converted into an IF signal by a down converter. The selection of the band of frequencies or channels to be extended is handled by a digital filter. The digital filter can manage 1 variable band or 2 variable sub-bands. An up converter converts the IF signal into the RF output signal. In uplink the signal from the Service Front End Subrack or from the Optical System is converted into an IF signal by a down converter, filtered and re-converted into an RF signal, amplified by a power amplifier and re-transmitted to the signal source.



Digital Donor Front End Module block diagram

COMMERCIAL CODES (TDFE- Teko Telecom band code) For UL/DL Operating bands please refer to the Operating frequency bands Summary Table	TDFE-7SL; TDFE-7SH TDFE-8S; TDFE-8A; TDFE-9S TDFE-19; TDFE-AW
Down-Link	Output Power: 10 dBm Gain: 63 dBm
Up-Link	Output Power: 26 dBm Gain: 64 dBm
Number of variable sub-bands	Up to 2
Variable sub-band bandwidth	200kHz to 25MHz (100kHz step) - 1 sub-band 200kHz to 14.2MHz (100kHz step) - 2 sub-bands
Processed Band	up to 35MHz
Attenuation range on each sub-band (relative to set RF gain)	0 ÷ 30dB (0.5dB step) independent on each sub-band
Connector to the Donor Antenna	N (f)
Cooling	Active (with fans)
Power supply	28 ÷ 30 Vdc
Power Consumption	37 W
Operating temperature range	- 5°C up to +55°C (+23°F up to + 131°F)
Weight	~ 3,5 Kg (7.7lb)
Dimensions	3HE / 21TE

Digital Donor Front End Modules technical specifications

Digital Donor Front End Module Access Points



Label (Connectors)	Description
DL	Downlink path RF output (SMA connector) to Service Front End or Fiber Optic Modules
UL	Uplink path RF input (SMA connector) from Service Front End or Fiber Optic Modules
DONOR ANT	Donor Antenna Port (N type connector)

Label (LEDs)	Description
ON	Digital Donor Front End Module operating status green LED: ON when power supply is present
ALM	Digital Donor Front End Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)

1.1.2 Equipment extending coverage / distributing capacity

• Teko Telecom Service Front End

Teko Telecom Service Front End Subrack is a single-band/multi operator equipment, driven by Digital Donor Front End Modules and connected to a Service Antenna to provide wireless signal to the area to be covered. The equipment is available in four different power classes: Very High, High, Medium and Low.

A single-band single-operator modular Off-air Repeater can be set-up combining a Digital Donor Front End Module and a Service Front End. Up to 4 Donor Front End Modules can be connected to a single Service Front End subrack to provide a single-band 4-operator Repeater.

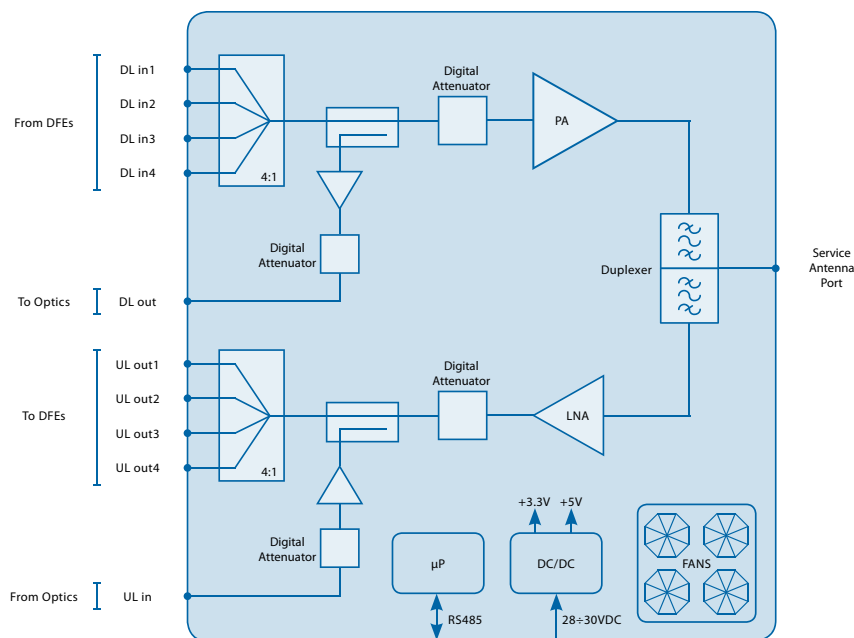
The Service Front End subrack can also be used in Optical Systems to provide coverage to the area adjoining the Master Unit site.

The SFE 19"/2U subrack hosts the duplexer, to be connected to the Service Antenna to separate/combine Downlink and Uplink paths.

In Downlink the signals from the Donor Front-End Modules are combined and amplified by a Power Amplifier.

In Uplink, the RF signal from the Service antenna is amplified by a Low Noise Amplifier (LNA) and split to feed up to 4 Donor Front-End Modules.

Auxiliary ports are available to drive an Optical System.



Service Front End block diagram

Service Front End Access Points



Label (Connectors)		Description
DL TO OPT		Downlink path RF output (SMA connector) - to Optics
UL FROM OPT		Uplink path RF input (SMA connector) - from Optics
SERVICE ANT		Service Antenna Port (N type)
DFE1	DL	Downlink path RF input (SMA connector) - from Digital Donor Front End 1
	UL	Uplink path RF output (SMA connector) - to Digital Donor Front End 1
DFE2	DL	Downlink path RF input (SMA connector) - from Digital Donor Front End 2
	UL	Uplink path RF output (SMA connector) - to Digital Donor Front End 2
DFE3	DL	Downlink path RF input (SMA connector) - from Digital Donor Front End 3
	UL	Uplink path RF output (SMA connector) - to Digital Donor Front End 3
DFE4	DL	Downlink path RF input (SMA connector) - from Digital Donor Front End 4
	UL	Uplink path RF output (SMA connector) - to Digital Donor Front End 4

Label (LEDs)		Description
LED		Service Front End subrack general operating status LED Green: no alarm Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)

- **Teko Telecom Remote Units**

Remote Units are used in Optical Systems to distribute wireless signals throughout the area to be covered. They are connected to the Fiber Optic Transmitter/Receiver Modules equipped in the Master Unit.

Remote Units are equipped with the Fiber Optic Receiver and Transmitter module (for Optical to RF and RF to Optical conversion), power amplifiers and filtering.

They can be Single or Multi-band with four different RF power classes: Very High, High, Medium and Low.

Remote Units with different power classes can be driven simultaneously by the same Master Unit to distribute capacity or extend coverage into different locations at the same time.

Very High, High and Medium Power Remote Units are equipped in a weatherproof IP66 case. Low Power Remote Units are equipped in an IP32 case; a protection kit, providing IP66 protection degree, is available as option for installation in harsh environments.



Single, Dual or Tri-band Very High, High and Medium Power Remote Unit



Single band / Multi-band Low Power Remote Unit

Please refer to Paragraph 1.2.2 for a detailed description of Remote Units.

1.1.3 Modules providing the optical interface towards Remote Units

- **Fiber Optic Transmitter/Receiver Modules**

Fiber Optic Transmitter/Receiver Modules are the optical interface between Master Unit and Remote Units: they provide RF-to-Optical/Optical-to-RF conversion. They are connected to Remote Units via single mode optical fibers, with Uplink and Downlink signals transmitted over the same fibre (Wavelength Division Multiplexing -WDM technology).

Different configurations are available: a single Fiber Optic Transmitter/Receiver Module can be equipped with 1 Optical Transmitter and 1 Optical Receiver (10dB optical link budget, up to 20km distance - 12.4 miles), or 1 Optical Transmitter split by 2 and 2 combined Optical Receivers (10dB optical link budget, up to 20km distance- 12.4 miles), or 1 Optical Transmitter split by 4 and 4 combined Optical Receivers (6dB optical link budget, up to 12km distance - 7.5 miles).

The Fiber Optic Transmitter/Receiver Module in 1:4 configuration can manage up to 4 Remote Units.

The Fiber Optic Transmitter/Receiver Module in 1:1 configuration is able to drive up to 5 cascaded Remote Units with different wavelengths in Up-link.



Fiber Optic Transmitter/Receiver Module in 1:4 configuration



Fiber Optic Transmitter/Receiver Module (1:4 configuration) with monitor for E9-1-1 service

The Fiber Optic Transmitter provides the RF to optical conversion (Downlink side): the module RF section covers the 380 to 2200MHz band (TTRC models) or the 380 to 2700MHz band

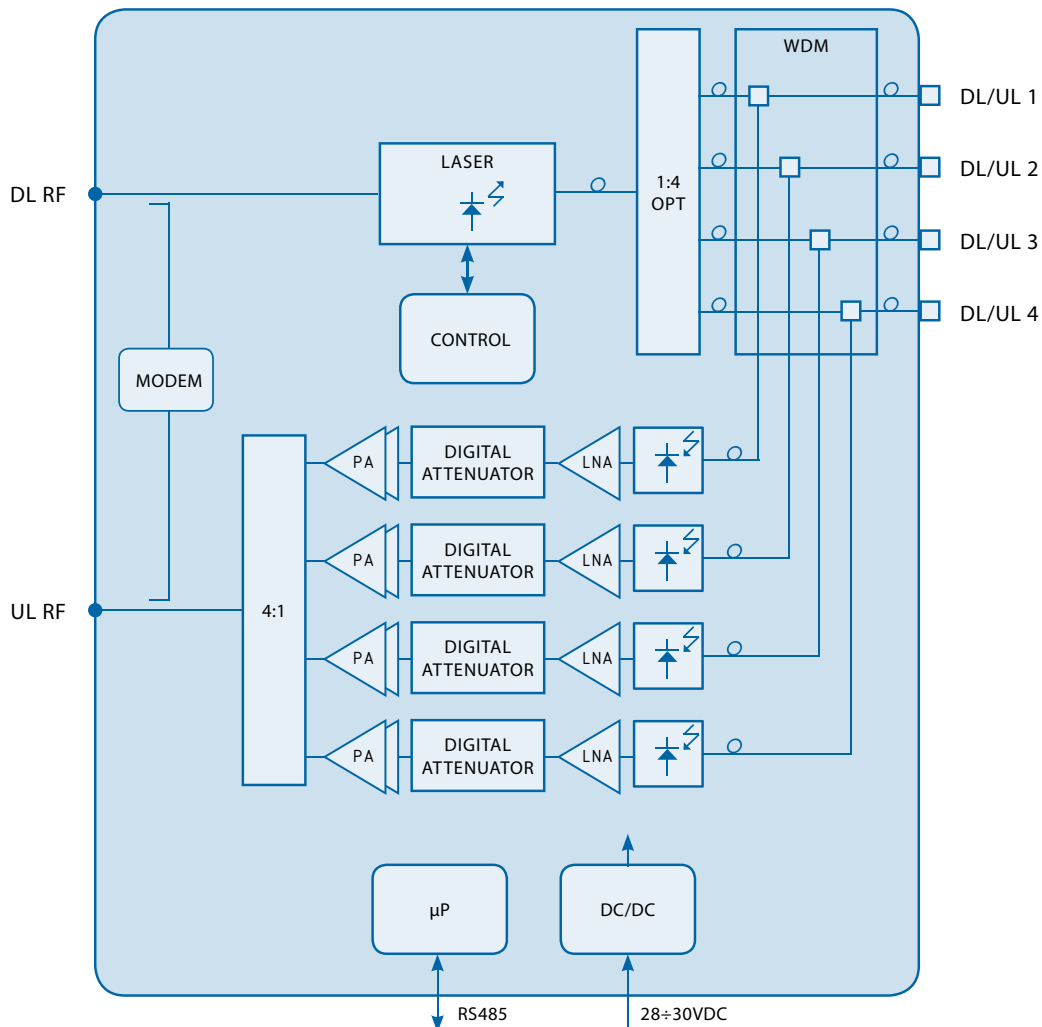
(TTRU models).

Fiber Optic Receivers convert uplink optical signals from Remote Units into RF. They operate in the third window (Optical wavelength 1490 ÷ 1570 nm).

Each Fiber Optic module is controlled by a microprocessor which provides the following data to the Supervision Module:

- optical power received by each optical receiver,
- Downlink attenuator and Uplink attenuator attenuation setting (0 ÷ 15dB),
- received optical power alarms.

An auto-levelling functionality (AGC) compensates up to 10dB optical link loss in order to guarantee constant gain over different optical budgets. This feature simplifies system installation, makes commissioning quick and easy and avoids field adjustments.



Block diagram: Fiber Optic Transmitter/Receiver Module equipped with 1 Optical Transmitter split by 4 and 4 combined Optical Receivers (WDM technology)

Fiber Optic Transmitter/Receiver Module Access Points



Fiber Optic Module 1:4 configuration - WDM



Fiber Optic Module 1:4 configuration - WDM with Monitor for E9-1-1 service



Fiber Optic Module 1:4 configuration

Label (Connectors)	Description
DL	Fiber Optic Transmitters (1 to 4) optical output connectors (SC-APC)
UL	Fiber Optic Receivers (1 to 4) optical input connectors (SC-APC)
DL RF	Fiber Optic Transmitter RF input SMA connector
UL RF	Fiber Optic Receiver RF output SMA connector
Monitor RXn	Monitor ports (RX1 to RX4) for E 9-1-1 service
Label (LEDs)	Description
ON	Fiber Optic Module operating status green LED ON when power supply is present
ALM	Fiber Optic Module alarm status LED: OFF: regular operation; BLINKING ORANGE/ORANGE: warning/minor; BLINKING RED/RED: major/critical
DL UL	These LEDs describe the general operating status of Remote Units (1 to 4) connected to Fiber Optic Transmitters (DL) and Repeaters (UL) . Each pair of DL/UL leds takes the same color as the general operating status led of the Remote Unit connected to the optical connector, except when <ul style="list-style-type: none"> • a Laser Fault occurs in the Fiber Optic transmitter. If this fault occurs, all DL leds turn RED and the ALM Led switches on (RED). • a Low Optical Power alarm arises in the Fiber Optic receiver. If this alarm arises, the UL led turns RED and the ALM Led switches on (RED). Each pair of DL/UL LEDs can be: Green: Remote Unit status OK Blinking Orange: presence of RU active alarms with warning severity level (4) Orange: presence of RU active alarms with minor severity level (3) Blinking Red: presence of RU active alarms with major severity level (2) Red: presence of RU active alarms with critical severity level (1)

- **Master and Slave Point to Point Modules**

Master and Slave Point to Point Modules provide an optical point to point link allowing a separation distance -up to 20km- between RF interface subracks and optical subracks.

The point to point link is suitable when the signal source (BTS, Node B, Repeater) is located far from the area to be covered or when the same optical system provides coverage to several separate buildings; in these applications the point to point link allows the transmission of signals from/to a group of remote units over a single optical fibre, thus providing a significant reduction in the number of fiber optics running long distances.

The point to point link requires the RF interface subracks to be equipped with Master Point to Point modules and the remote optical subracks to be equipped with Slave Point to Point modules. The RF Interface subracks can be equipped with up to 4 Master Point to Point modules for the management of up to 4 optical subracks, installed in different remote locations.



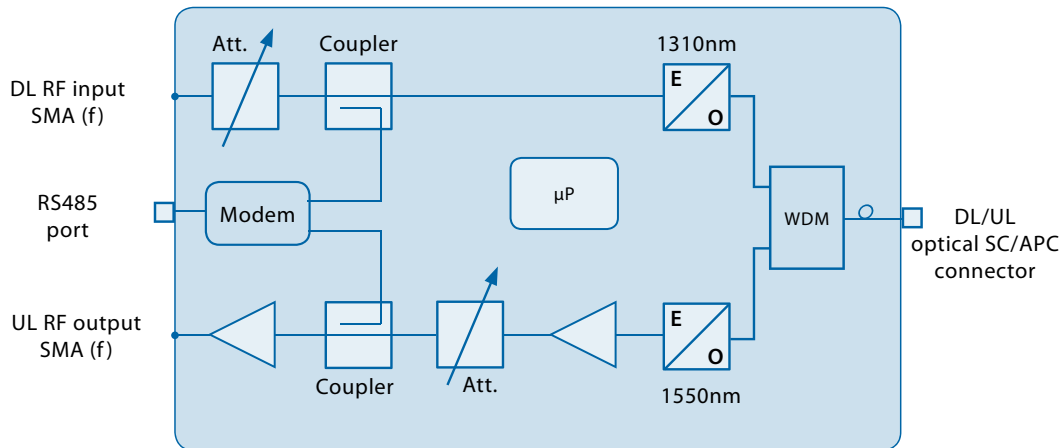
Master Point to Point Module



Slave Point to Point Module

Each Master Point to Point Module is connected to a Slave Point to Point Module, equipped in a remote optical subrack, via a single optical fibre (single-mode SMR 9/125).

Point to Point Modules (Master and Slave) perform the electrical-to-optical/optical-to-electrical conversion required for the transmission of downlink and uplink signals over the connecting optical fibre.

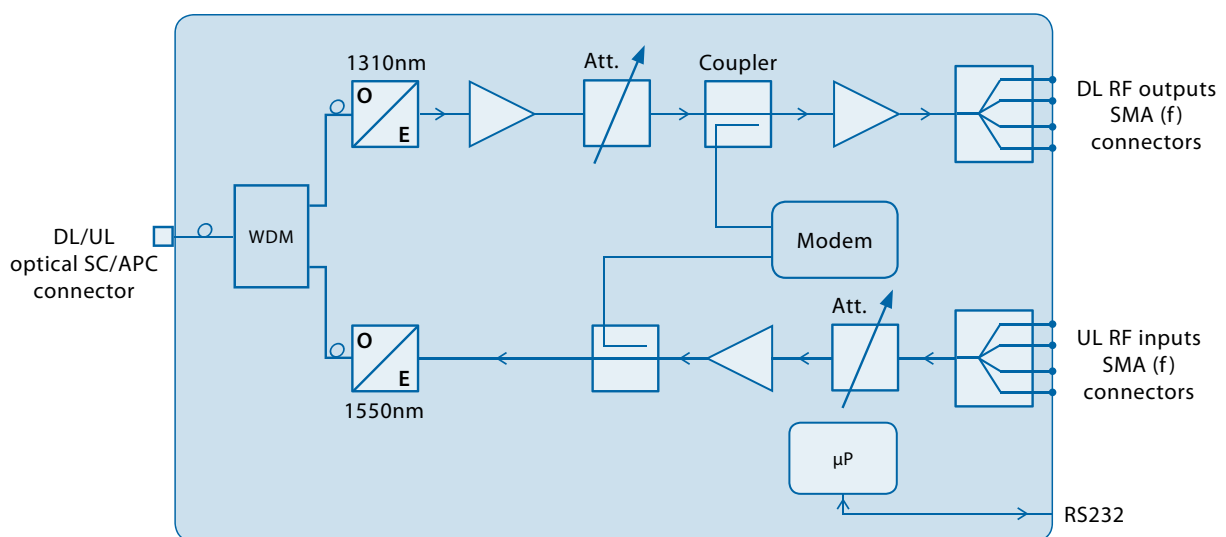


Master Point to Point Module block diagram

The Slave Point to Point module includes the 4-way splitter/combiner to manage up to 4 Fiber Optic Transmitter/Receiver Modules. A built-in Supervision unit controls the remote optical subrack, hosting the Slave Point to Point module, and all connected Remote Units.

The Coverage System Supervision Module communicates with the Slave Point to Point module built-in Supervision unit via the single-mode optical fiber connecting Master and Slave Point to Point modules.

An RS232 port on the Slave Point to Point Module front panel allows local communication with the built-in supervision.



Slave Point to Point Module block diagram

Master Point to Point Module Access Points



Master Point to Point Module

Label (Connectors)	Description
DL UL	Optical power input/output SC-APC connector (from/to Slave Point to Point Module)
RS485	RJ45 connector for RS485 connection to the Supervision Module
DL	RF input SMA connector (from the System RF Interface modules)
UL	RF output SMA connector (to the System RF Interface modules)

Label (LEDs)	Description
ON	Master Point to Point Module operating status green LED: ON when power supply is present
ALM	Point to Point Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)
DL	Fiber Optic Transmitter operating status LED: BLINKING GREEN: the module is reaching its operating temperature GREEN optical output power is available ORANGE: warning: optical output power is degraded RED: Laser Fault: no optical output power
UL	Fiber Optic Receiver operating status LED: GREEN: +6dBm to -4dBm optical input power YELLOW: -4dBm to -5dBm optical input power RED: optical input power is >+6dBm or <-5dBm

Slave Point to Point Module Access Points



Slave Point to Point Module

Label (Connectors)	Description
DL UL	Optical power input/output SC-APC connector (from/to Master Point to Point Module)
RS232	9-pole D-Sub RS232 connector for connection to an external modem (Local Management)
DL	RF output SMA connectors (to Fiber Optic Modules)
UL	RF input SMA connectors (from Fiber Optic Modules)

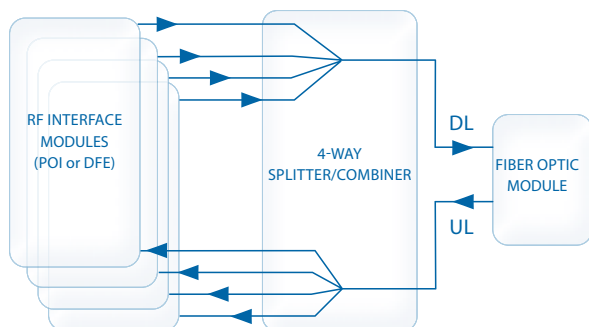
Label (LEDs)	Description
ON	Master Point to Point Module operating status green LED: ON when power supply is present
ALM	Point to Point Module alarm status LED: OFF: regular operation Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)
DL	Fiber Optic Receiver operating status LED: GREEN: +6dBm to -4dBm optical input power YELLOW: warning: -4dBm to -5dBm optical input power RED: alarm: optical input power is >+6dBm or <-5dBm
UL	Fiber Optic Transmitter operating status LED: BLINKING GREEN: the module is reaching its operating temperature GREEN optical output power is available ORANGE: warning: optical output power is degraded RED: : Laser Fault: no optical output power

1.1.4 Passive Modules providing distribution and filtering

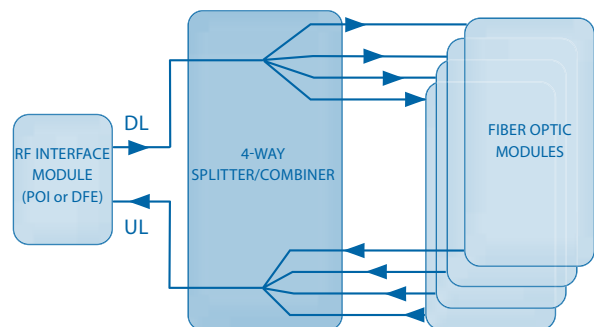
- 4-way Combiner/Splitter Module



The 4-way Combiner/Splitter can be used to manage either up to 4 RF interface modules (POI modules or DFE modules), operating in the same band (Multi-Operator Systems) or up to 4 Fiber Optic Transmitter/Receiver Modules.



4-way combiner (DL side) / 4-way splitter (UL side) to manage up to 4 RF interface modules operating in the same band



4-way splitter (DL side) / 4-way combiner (UL side) to manage up to 4 Fiber Optic Transmitter/Receiver Modules

4-way Combiner/Splitter module block diagrams

4-way Combiner/Splitter Module Access Points



Label (Connectors)	Description			
UL	WHEN USED TO MANAGE MULTIPLE RF INTERFACE MODULES	Up-link path output SMAconnectors (to RF interface modules)	WHEN USED TO MANAGE MULTIPLE FIBER OPTIC MODULES	Up-link path input SMAconnectors (from optical sub-racks)
UL COMMON		Up-link path input SMA connector		Up-link path output SMA connector
DL		Down-link path input connectors (from RF interface modules)		Down-link path output connectors (to optical sub-racks)
DL COMMON		Down-link path output		Down-link path input

- **Triplexer (Band Splitter/Combiner) with built-in 4-way Combiner/Splitter**

The Triplexer is used in multi-band configurations to distribute signals operating in different bands.

The module also includes a 4-way Splitter/Combiner to drive up to 4 Fiber Optic Transmitter/Receiver Modules.

Several models of Triplexers, operating over different Uplink/Downlink frequency bands, are available.



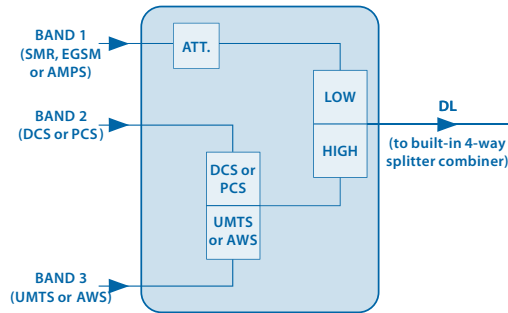
Example: EGSM, DCS, UMTS Triplexer with built-in 4-way Combiner/Splitter



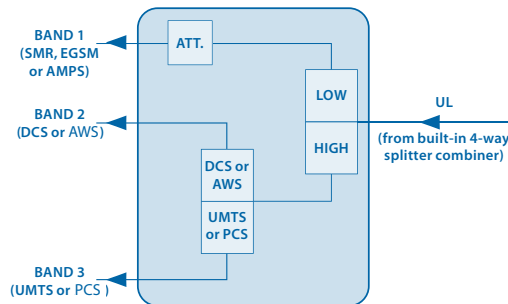
Example: AMPS, PCS, AWS Triplexer with built-in 4-way Combiner/Splitter

The triplexer can be used in Optical Systems to manage:

- up to 3 RF interface modules operating in different bands and up to 4 Fiber Optic Transmitter/Receiver Modules, or
- up to 3 Service Front End modules operating in different bands and up to 4 Fiber Optic Transmitter/Receiver Modules, or
- up to 3 four-way splitter/combiner - used to manage multiple RF interface modules (up to 4 for each band) - and up to 4 Fiber Optic Transmitter/Receiver Modules.

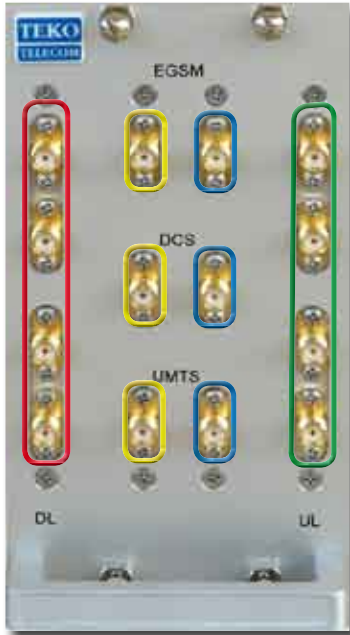


Example: EGSM, DCS, UMTS Triplexer block diagram - Downlink path



Example: Low band, PCS, AWS Triplexer block diagram - Uplink path

Triplexer Module Access Points -Example



Example: EGSM, DCS, UMTS Triplexer with built-in 4-way Combiner/Splitter



Example: AMPS, PCS, AWS Triplexer with built-in 4-way Combiner/Splitter

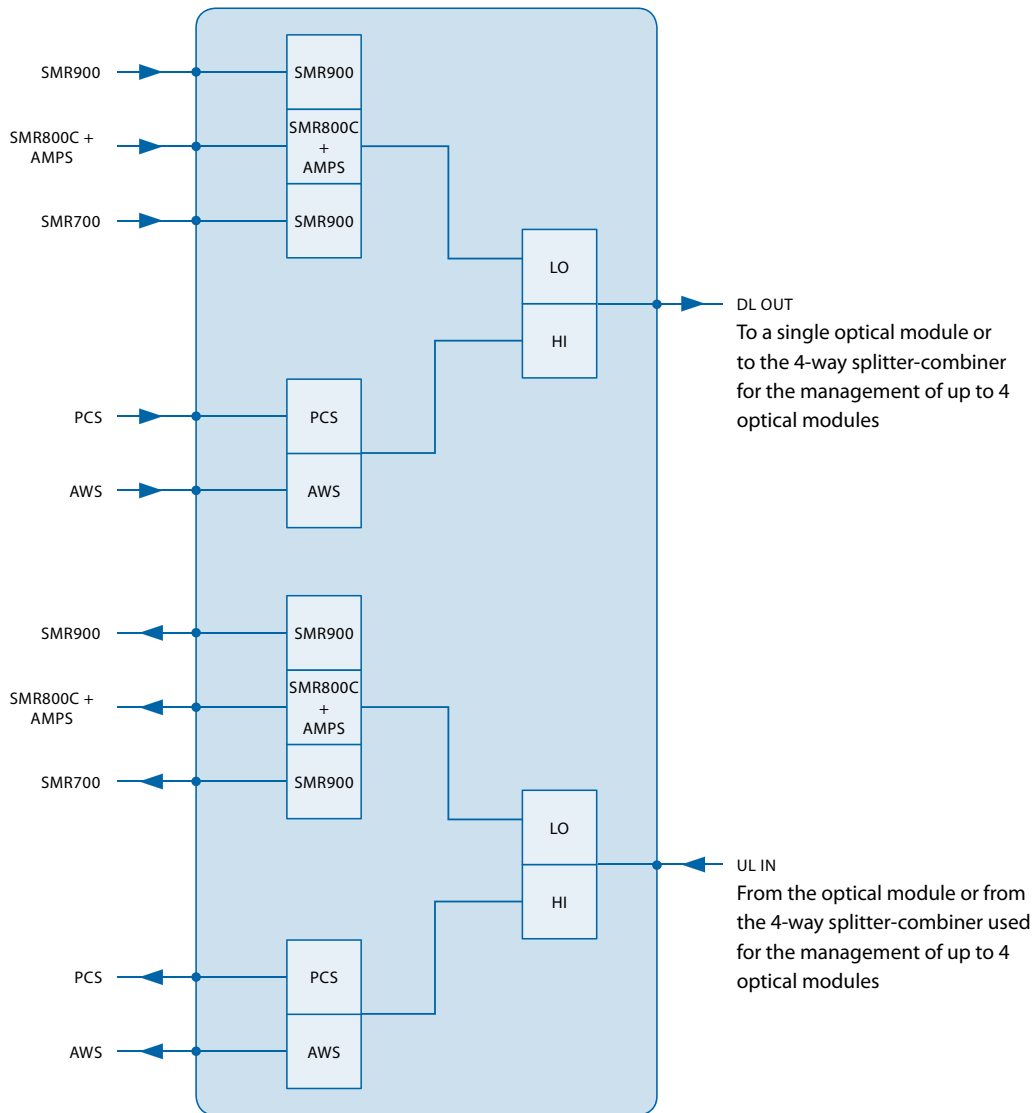
Connectors		Description
EU Bands	US Bands	
EGSM	f<1GHz	Low band (700 to 960MHz) input (down-link path)
		Low band (700 to 960MHz) output (up-link path)
DCS	PCS	DCS or PCS input (down-link path)
	AWS	DCS or AWS output (up-link path)
UMTS	AWS	UMTS or AWS input (down-link path)
	PCS	UMTS or PCS output (up-link path)

UL	WHEN USED TO MANAGE MULTIPLE FIBER OPTIC MODULES	Up-link path input connectors (from optical subrack)	WHEN USED TO MANAGE MULTIPLE FOUR-WAY COMBINER/SPLITTER MODULES	Up-link path output connectors (to 4-way combiner/splitter modules)
DL		Down-link path output connectors (to optical subrack)		Down-link path input connectors (from 4-way combiner/splitter modules)

• **Esaplexer (US bands)**

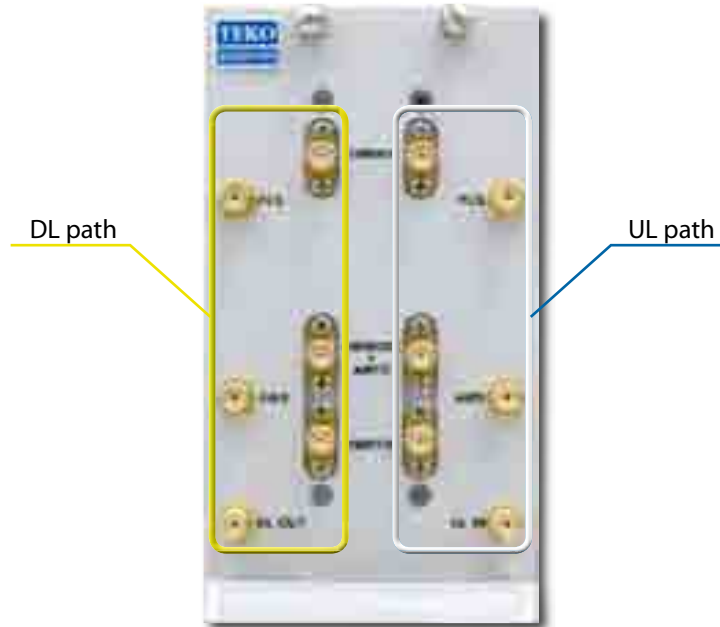
The Esaplexer is used in multi-band configurations to distribute signals operating over up to 6 different bands.

The Esaplexer can be connected to a 4-way splitter/combiner in order to manage up to 4 Fiber Optic Transmitter/Receiver Modules (i.e. up to 16 Remote Units).



Esaplexer block diagram

- **Esaplexer Access Points**

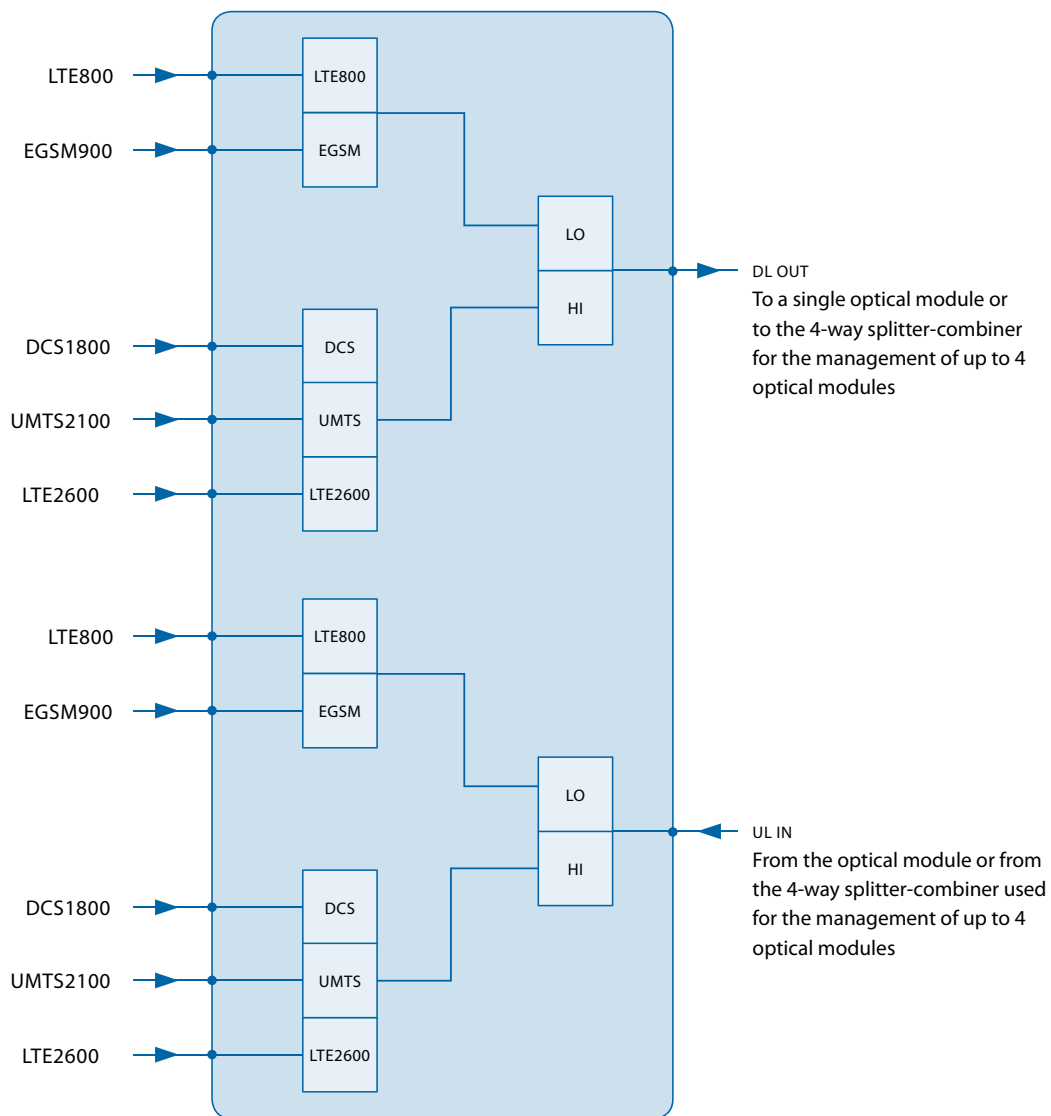


Label	Description
DL OUT	Down-link path output connector
UL IN	Up-link path input connector
SMR700	SMR700 band input (down-link path)
	SMR700 band output (up-link path)
SMR800C+AMPS	SMR800C+AMPS bands input (down-link path)
	SMR800C+AMPS bands output (up-link path)
SMR900	SMR900 band input (down-link path)
	SMR900 band output (up-link path)
PCS	PCS band input (down-link path)
	PCS output (up-link path)
AWS	AWS band input (down-link path)
	AWS output (up-link path)

• **Pentaplexer (EU bands)**

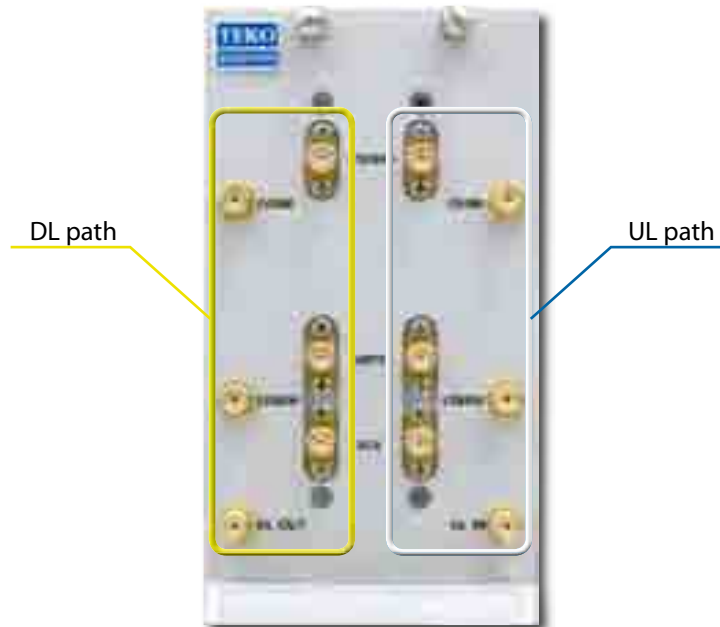
The Pentaplexer is used in multi-band configurations to distribute signals operating over up to 5 different bands.

The Pentaplexer can be connected to a 4-way splitter/combiner in order to manage up to 4 Fiber Optic Transmitter/Receiver Modules (i.e. up to 16 Remote Units).



Pentaplexer block diagram

- **Pentaplexer Access Points**



Label	Description
DL OUT	Down-link path output connector
UL IN	Up-link path input connector
LTE800	LTE800 band input (down-link path)
	LTE800 band output (up-link path)
EGSM900	EGSM900 band input (down-link path)
	EGSM900 band output (up-link path)
DCS1800	DCS1800 band input (down-link path)
	DCS1800 band output (up-link path)
UMTS2100	UMTS2100 band input (down-link path)
	UMTS2100 output (up-link path)
LTE2600	LTE2600 band input (down-link path)
	LTE2600 output (up-link path)

1.1.5 Modules for the management of the System

- **Supervision Module**

The Supervision Module (TSPV) allows the control and management of the entire Coverage and Capacity System. The Supervision Module is provided with its own TCP/IP address and with a built-in web server that allows control and management via a standard web browser. The Coverage System can be accessed either via a physical (Ethernet LAN) connection or via a modem connection.

Up to 9 Active Subracks can be monitored connecting a PC, either locally or remotely, to the Ethernet port (LAN, RJ45 connector), available on the Supervision Module front panel.



Supervision Module equipped with optional built-in wireless modem



Supervision Module with RS232 port

For remote control the System can also be accessed via optional wireless modem (integrated inside the supervision module).

When the optional built-in wireless modem is equipped an SMA input/output connector is available on the Supervision front panel for remote management.

When the optional built-in wireless modem is not equipped, an RS232 port is available on the Supervision front panel for connection to an external PSTN or wireless modem

A VPN application is installed on the Supervision Module to provide remote and secure access to the System using the Internet.

The Supervision Module can also act as an SNMP-agent providing integration into upper-level management systems (NEM).

4 external alarms inputs and 4 dry contacts outputs are available on the Supervision module front panel.

Please note

In order to more handily connect to EXT OUT / EXT IN dry contacts, 2x4-pole female connectors are provided along with the Supervision Module.



2x4-pole female connector

Teko Telecom Operation and Maintenance Terminal (OMT) web pages allow the commissioning, monitoring, setting and troubleshooting of the whole Coverage and Capacity System via a user friendly graphical interface.

Teko Telecom OMC (Operation Management Centre) proprietary software is available to control multiple Supervision Modules managing different Coverage and Capacity Systems in a Network.

Supervision Module Access Points



Supervision Module equipped with optional built-in wireless modem



Supervision Module with RS232 connector

Label (Connectors)	Description
RS485 (1 to 8)	RJ45 connectors for monitored Optical Subracks management
RS485 (S1 to S4)	RJ45 connectors for remote Slave Supervision Modules management
EXT OUT	Dry contacts output connector
EXT IN	External alarms input connector
RS232	9-pole D-Sub RS232 connector for connection to an external modem
ANT	Optional built-in modem input/output connector for remote management
LAN	RJ45 connector Local Control Interface

Label (LEDs)	Description
ON	Supervision Module operating status green LED: ON when power supply is present
ALM	Supervision Module alarm status LED. OFF: regular operation Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)

- **Alarm Board**

The Alarm Board is an optional I/O Module that can be equipped in addition to the Supervision Module, in order to increase the number of supported external alarms.



Alarm Board equipped with 16 input pins - TEA-I16

The Alarm Board allows to manage up to 16 external alarms inputs: 16 external alarms input connectors are available on the module front panel.

The 16 Input lines are opto-isolated and are activated by a short circuit between input pins (max current flow during short = 6mA; max Vdc at input pins = 3,3V).

On request inputs 1-to-4 can be switched to dry output contacts, normally open or closed, depending on HW configuration.

In order to more handily connect to the dry contacts input/output connectors, four 2x4-pole female connectors are provided along with the Alarm Board Module.



2x4-pole female connector

Alarm Board Access Points



Alarm Board
with female dry connectors



Alarm Board
without female dry connectors

Label (Connectors)	Description
EXT IN	External alarms input connector
EXT OUT	Optional external alarms output connector (TEA-I1204)

Label (LEDs)	Description
ON	Alarm Board Module operating status green LED: ON when power supply is present
ALM	Alarm Board Module alarm status LED. OFF: regular operation Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)

1.1.6 Power Supply Modules

- **Power Supply Module**

Power Supply modules are used to supply Active Subracks.

Active Subracks can be AC powered (Universal mains, 85÷264Vac, 50-60Hz) or DC powered (-72 ÷ -36Vdc): they can be equipped with either AC or DC Power Supply modules.

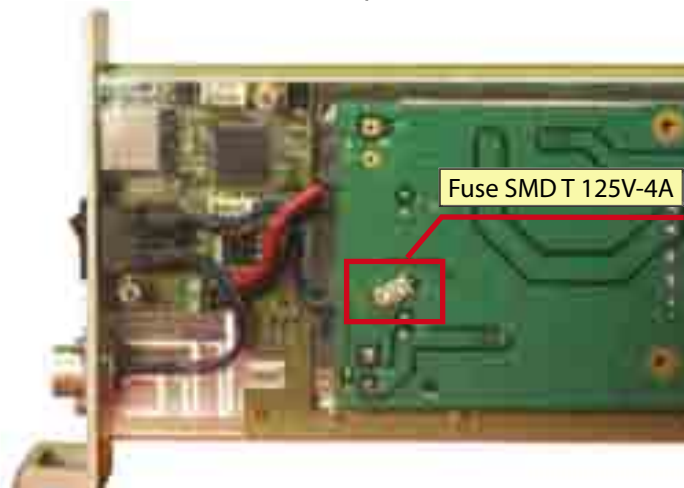


AC Power Supply Module



DC Power Supply Module

The following figure shows the DC/DC Power Supply Module protection fuse position and electrical rating. If the fuse blows, it has to be replaced.



Power Supply modules can be equipped in monitored Active Subracks, in the Master Active Subrack or in a dedicated Active Subrack.

When Power Supply modules are equipped in monitored Active Subracks, the RJ45 connector

available on the Power Supply Module front panel can be used for connection to the Supervision Module, equipped in the Master Active Subrack.

Hot-plug 1+1 Redundancy feature is supported: it can be implemented to achieve high system reliability.

Power Supply Module Access Points



AC MAINS
switch

AC Power Supply Module



DC switch

DC Power Supply Module

Connectors	Description
RS485	RJ45 connector for RS485 connection to the Supervision Module (monitored Subracks)
AC switch	AC MAINS switch
AC MAINS	AC MAINS socket (100-240Vac)

Connectors	Description
RS485	RJ45 connector for RS485 connection to the Supervision Module (monitored Subracks)
DC switch	48Vdc switch
DC MAINS	Vdc input connector (48Vdc)

Label (LEDs)	Description
POWER ON	Power Supply Module operating status green LED: ON when power supply is present
ALM	Power Supply Module alarm status LED. OFF: regular operation Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)

1.1.7 Subracks hosting the System modules

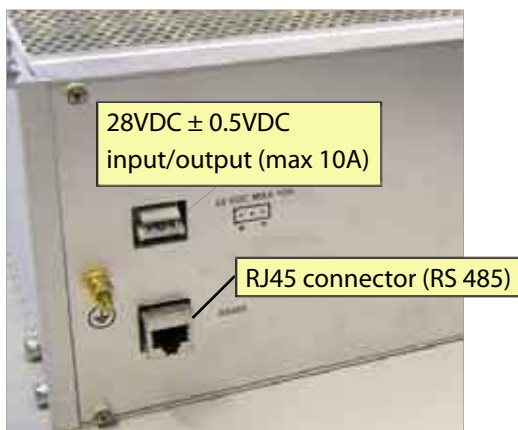
- **Active subracks**

Active Subracks are provided with a backplane that allows the management and power supply of up to 12 active modules and/or Power Supply modules.

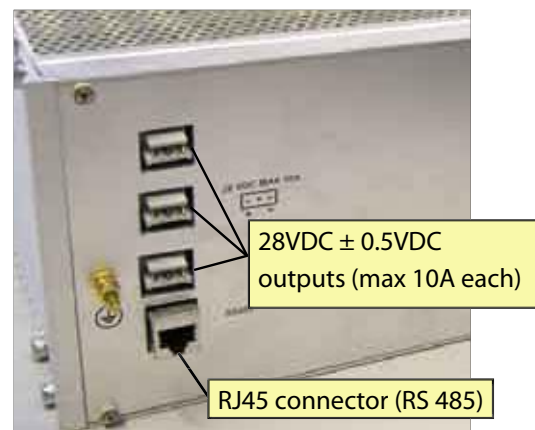
Active subracks can be equipped with either AC or DC Power Supply modules.

The following connectors are available on each active subrack rear panel:

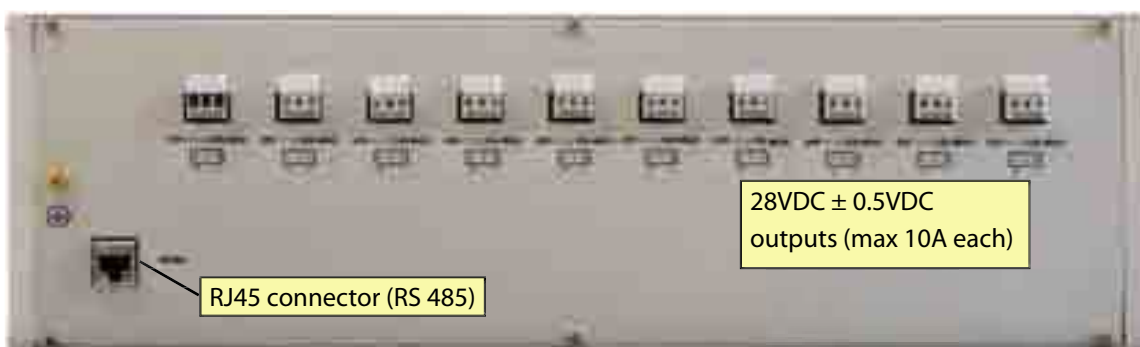
- one or more 28Vdc input/output connectors.
- An RJ45 connector (RS485) to be used when power supply modules are not equipped in monitored Active Subracks. It allows connection of monitored Active Subracks to the Supervision Module.
- A ground bolt.



Active Subrack with one 28Vdc input/output connector



Active Subrack with three 28Vdc input/output connectors



Active Subrack provided with ten 28Vdc input/output connectors

- **Passive subracks**

Passive modules that do not require power nor management to function can be housed in Passive subracks thus allowing a reduction in the cost of the whole system.

1.1.8 Forced-air cooling Subrack

Teko Telecom forced-air cooling subrack is able to provide a maximum air flow of 180cfm (5m³/min) in order to ensure the proper operation of cabinet installed equipment.

Forced-air cooling Subrack Access Points



Forced-air cooling subrack - Front view



Forced-air cooling subrack - Rear view

Access Point	Description
LED	Forced-air cooling subrack general operating status LED Green: normal operation Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)
RS485	RJ45 connector for RS485 connection to the Supervision Module
28V ⎓ ;10A MAX	28VDC ± 0.5VDC input (max 10A)

1.2 Coverage and Capacity Solutions

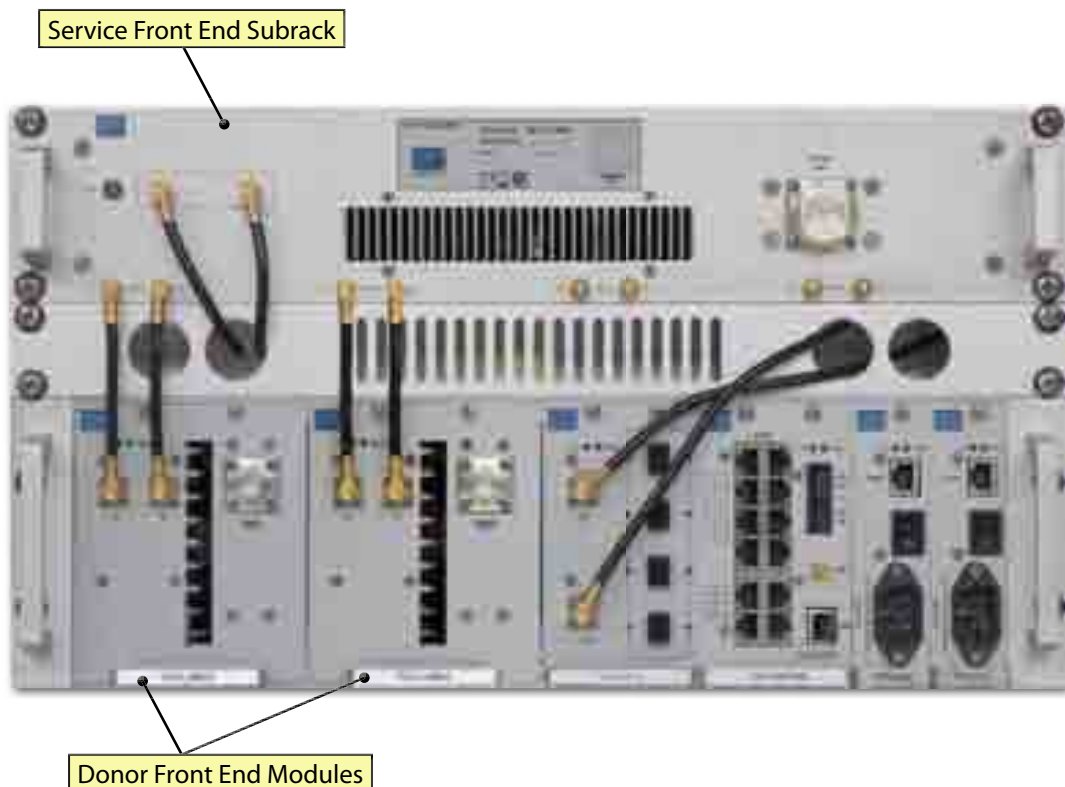
The components of SIRIUS, Teko Telecom Modular Coverage and Capacity System, can be assembled to provide Modular Repeaters, Optical Systems and integrated solutions to improve coverage in different environments.

1.2.1 Modular Off-air Repeaters - General description

Teko Telecom multi-band multi-operator Off-air Modular Repeaters represent the ideal solution for cellular coverage extension, offering a cost effective alternative to dedicated BTSs or Node Bs. They operate over different frequencies and with various frequency combinations in the 380 to 2700MHz frequency range.

No physical connections are required between the Modular Repeaters and the cellular network: the Digital Donor Front End Module is connected to a Donor Antenna, providing the connection towards a BTS or Node B over an air link.

Teko Telecom Modular Off-air Repeaters can be set up by proper combination of Digital Donor Front End Modules and Service Front End Subracks.



The **Digital Donor Front End** is the single-band/single-operator RF interface towards the signal source; the **Service Front End** is the multi-band/single operator equipment that

provides wireless signal to the area to be covered.

Off-air Modular Repeaters can be equipped with one Donor Front End or more Donor Front End modules to make multiple configurations available: single operator (single band / multi-band) and multi-operator (single-band / multi-band).

A single-band single-operator Repeater can be set-up combining a Digital Donor Front End Module and a Service Front End Subrack.

Up to 4 Digital Donor Front End Modules can be connected to a single Service Front End obtaining a single-band 4-operator Off-air Repeater.

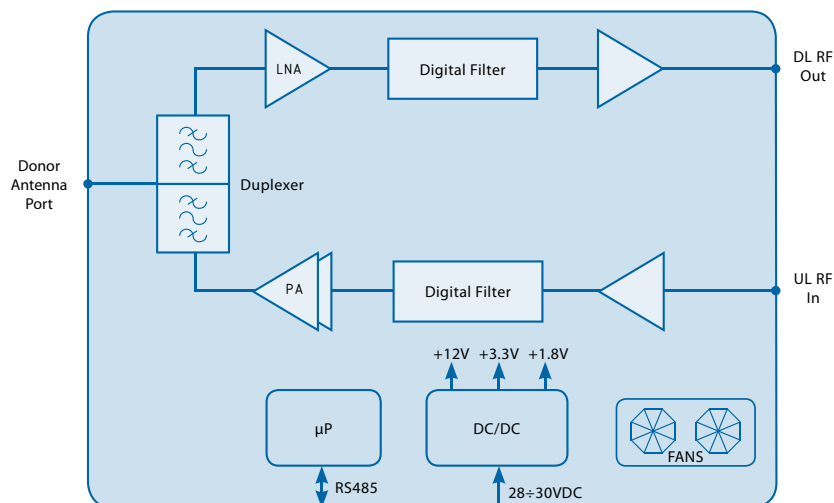
Digital Donor Front End Modules can be connected to different Service Front End Subracks to provide multi-band/multi-operator Systems.

Operating principle

Modular repeaters use a directional antenna to interface with the operator's donor BTS (or Node B) and one or more service antennas to transmit the amplified wireless signals to the area to be covered.

In down-link the repeater receives the signals from the BTS (or Node B), amplifies them and re-transmits them to the mobiles. In the up-link path the repeater receives the signals from the mobiles (MS), amplifies them and re-transmits them to the base station.

Each DFE module hosts the duplexer, to be connected to the Donor Antenna to separate/combine Downlink and Uplink paths.



In downlink the signal from the Donor antenna is preamplified by a Low Noise Amplifier and

converted into an IF signal by a down converter. The selection of the band of frequencies or channels to be extended is handled by a digital filter.

The digital filtering can manage 1 variable band or 2 variable sub-bands.

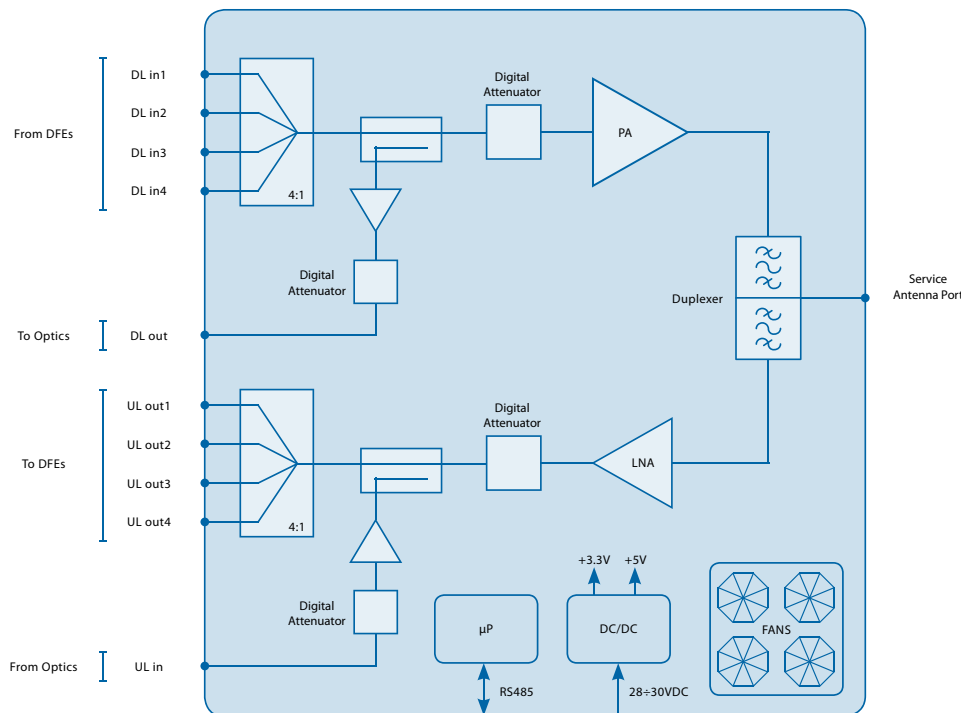
An up converter converts the IF signal into an RF signal.

In uplink the signal from the Service Front End Subrack is converted into an IF signal by a down converter, filtered and re-converted into an RF signal, amplified by a power amplifier and re-transmitted to the signal source.

Each TSFE subrack hosts the duplexer, to be connected to a Service antenna to separate/combine Downlink and Uplink paths.

In Downlink the signals from the Donor Front-End Modules are combined, amplified (High Power Amplifier) and then transmitted to the area to be covered by the Service Front End Subrack.

In Uplink, the RF signal from the Service antenna is amplified by a Low Noise Amplifier (LNA) and split to feed up to 4 Donor Front-End Modules.



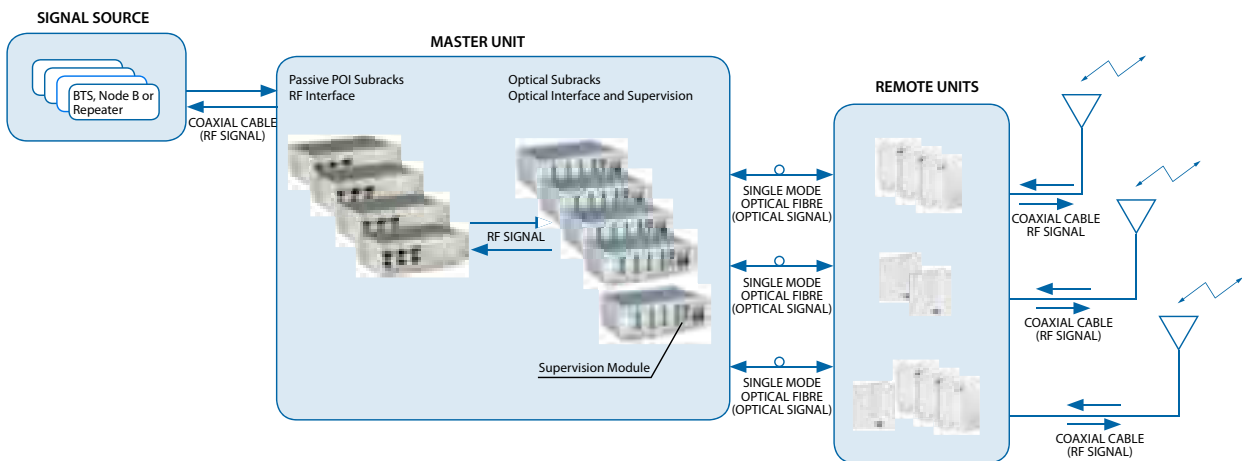
When Modular Repeaters do not provide satisfactory coverage (extensive areas, long tunnels), they can be used along with a fiber fed System (Teko Telecom Optical System).

1.2.2 Optical Systems - General Description

Teko Telecom Coverage and Capacity System components can be configured to provide a modular multi-band multi-operator Optical System.

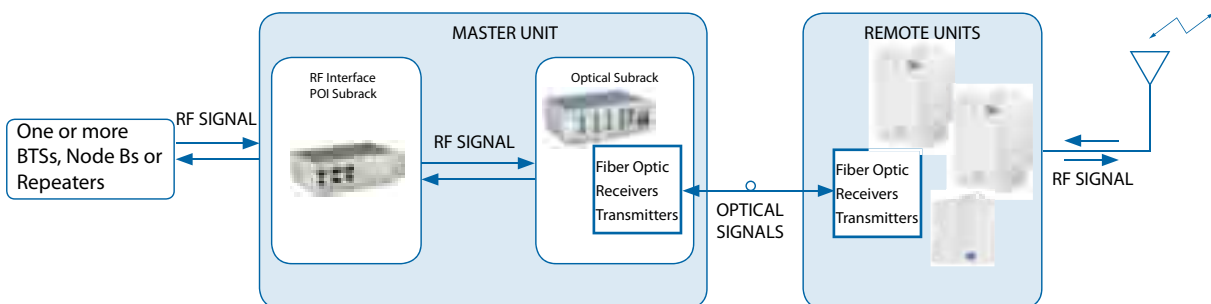
Optical Systems are based on the Radio over Fibre technology, which enables radio signals transmission over optical fibres. This technology offers wide bandwidth and very little loss along the fiber optic fibre, allowing the signals to be propagated over long distances. This allows extensive areas coverage.

Each Teko Telecom Optical System is made up of two main parts: the Master Unit, interfacing the signal source, and Remote Units, distributed throughout the territory to be served. Master Unit and Remote Units are connected via single mode optical fibres (SMR 9/125).



A – Master Unit

The **Master Unit** provides both the RF interface towards the signal source (one or more BTSs or Node Bs) and the optical interface towards Remote Units.



It is a rack-based modular equipment: Teko Telecom Coverage and Capacity Systems components can be assembled in a variety of ways providing different Master Unit configuration

options.

Each Master Unit can be equipped with one or more RF interface subracks (subracks hosting RF interface modules) and with one or more Optical Subracks (Active Subracks hosting Fiber Optic Transmitter/Receiver modules).

When the Master Unit is equipped with Master and Slave Point to Point Modules, RF interface subracks and optical subracks can be separated by a maximum distance of 20km.

- **RF interface subracks**

RF Interface subracks operate over different frequencies and with various frequency combinations in the frequency range from 380 to 2700MHz.

Each RF interface subrack can be equipped with one or more RF Interface modules. Each module interfaces to a single mobile operator / mobile standard signal source, making multiple configurations available: single operator (single band / multi-band) and multi-operator (single-band / multi-band).

Master Unit RF Interface modules can be Point of Interface (POI/TAPOI) modules and/or Donor Front End modules.

Point of Interface modules are connected to the signal source via coaxial cable: each module is connected to a single operator/ single standard signal source (BTS or Node B). Master Units equipped with POI/TAPOI modules must be installed next to the donor BTS or Node B.

POI modules can be equipped in passive subracks; TAPOI modules require active subracks (SUB-TRX).

Donor Front End modules allow the Optical System to be driven without the need of a dedicated BTS or Node B: each Donor Front End module interfaces with a Donor Antenna oriented towards a BTS or NodeB (connection over an air link).

Donor Front End modules require an active subrack (SUB-TRX). Each subrack can be equipped with up to 4 Donor Front End Modules.

RF Interface subracks also host **passive modules providing distribution and filtering:**

- 1:4 Splitter/Combiner
- Band Splitter/Combiner (Triplexer) with built-in 1:4 Splitter/Combiner
- Pentaplexer/Esaplexer.

Due to the flexible configuration options of Teko Telecom Coverage and Capacity Systems, the same passive modules can be used for different purposes:

- the 4-way splitter/combiner can be used to manage: multiple RF interface modules, operating in the same band (Multi-Operator Optical Systems) or multiple Fiber Optic

modules;

- the triplexer can be used to manage
 - up to 3 RF interface modules operating in different bands and up to 4 Fiber Optic Transmitter/Receiver Modules or
 - up to 3 Service Front End subracks operating in different bands and up to 4 Fiber Optic Transmitter/Receiver Modules or
 - up to 3 four-way splitter/combiner modules - used to manage multiple RF interface modules (up to 4 for each band) - and up to 4 Fiber Optic Transmitter/Receiver Modules.
- the Pentaplexer and Esaplexer can be used to manage
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) RF interface modules operating in different bands or
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) Service Front End subracks operating in different bands or
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) four-way splitter/combiner modules- used to manage multiple RF interface modules (up to 4 for each band).

The RF Interface subracks can also be equipped with up to 4 Master Point to Point modules for the management of up to 4 optical subracks installed in different remote locations.

Digital Donor Front End modules can be connected to Service Front End Subracks to provide coverage to the area adjoining the Master Unit site.

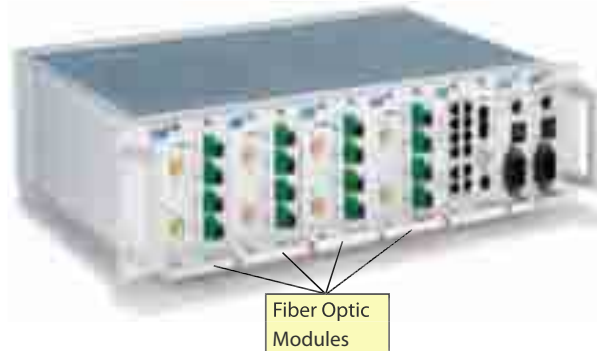
Each Service Front End can be fed by up to 4 Donor Front-End Modules interfacing the signal source. Downlink and uplink auxiliary ports are available to drive the Optical System.



Service Front End Subrack

- **Optical Subracks**

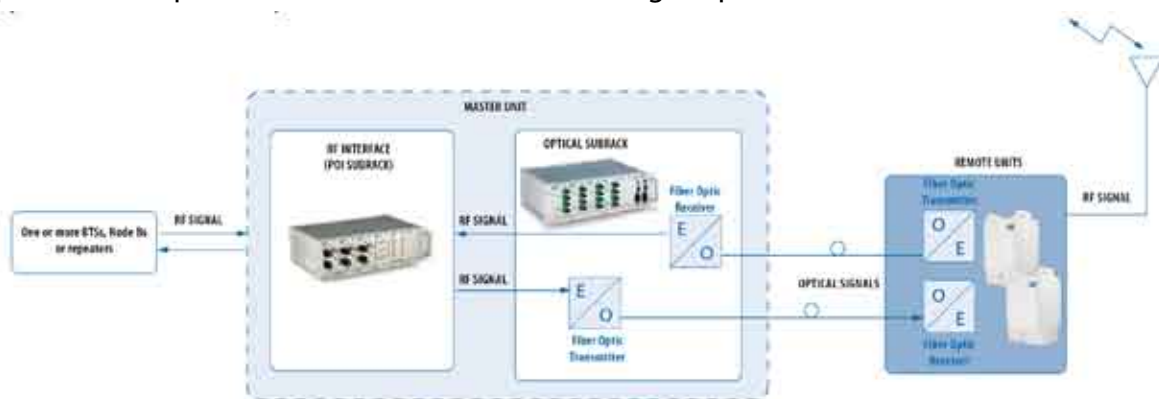
Optical Subracks are Active Subracks hosting Fiber Optic Transmitter/Receiver modules.



Fiber Optic Transmitter/Receiver modules are the optical interface towards Remote Units: they provide RF to optical /optical to RF conversion.

Fiber Optic modules are connected to Remote Units via single-mode optical fiber (SMR 9/125); each Fiber Optic Module can manage up to 4 Remote Units (up to 5 in cascade configuration).

Up to 6 Fiber Optic Modules can be housed in a single Optical Subrack.



In Downlink RF signals are converted into optical signals in the Fiber Optic Transmitter modules of the Master Unit and then they are propagated through optical fibre distribution to Remote Units. In the Fiber Optic Receiver of each Remote Unit, the optical signal is then converted back into an RF signal that is amplified and transmitted to mobiles through an antenna or a passive distribution system.

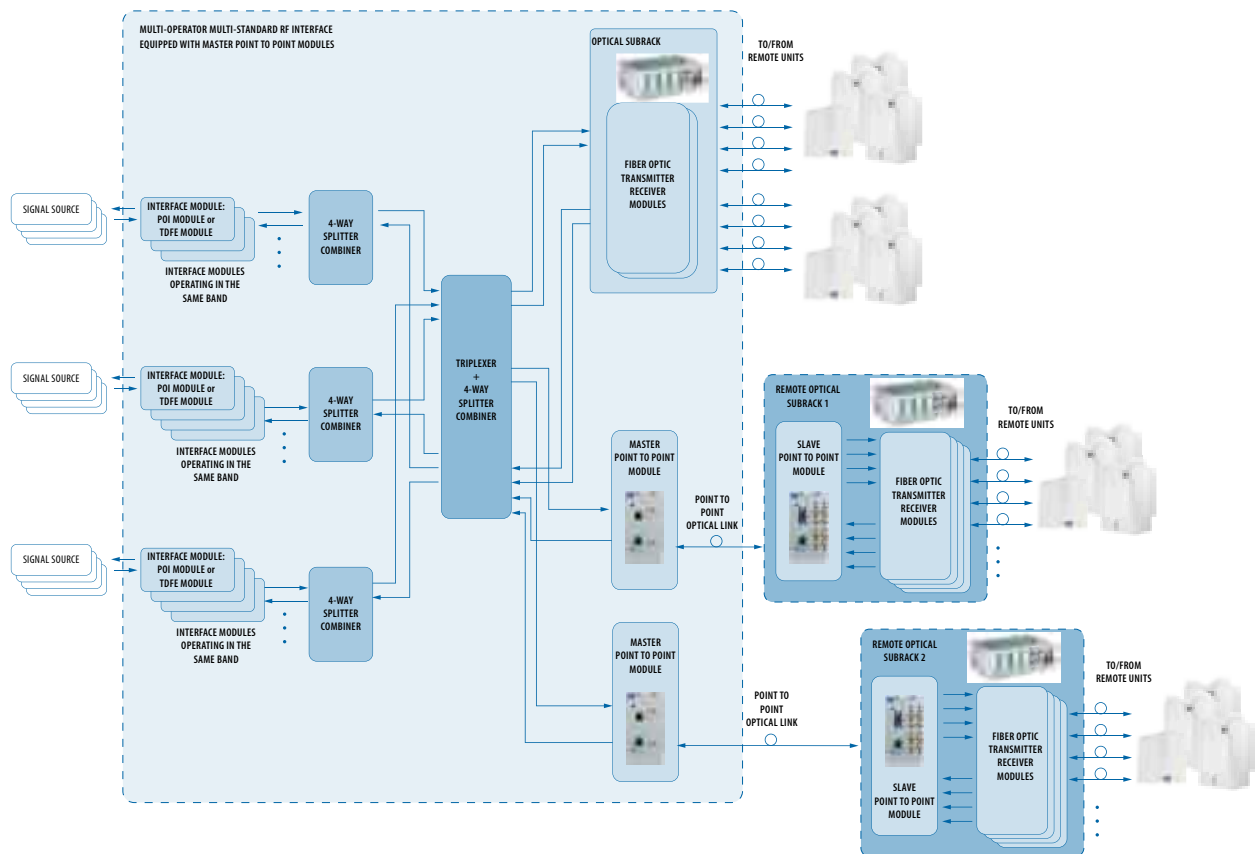
In Uplink RF signal is converted into an optical signal in the Fiber Optic Transmitter of each Remote Unit and then it is propagated via fibre optics to the Master Unit. Optical signals from Remote Units are then converted by the Fiber Optic Receiver modules of the Master Unit into RF signals and transmitted to the signal recipient.

Uplink and downlink optical signals are transmitted over the same single mode optical fibre (Wavelength Division Multiplexing -WDM- technology).

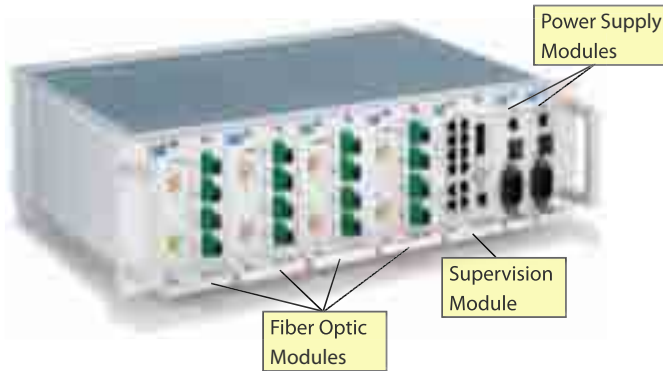
The Master Optical Subrack also hosts the Supervision Module for the management of the whole System.

When the Coverage System includes point to point links, each remote optical subrack hosts the Slave point to point module to be connected, via optical fibre, to its Master Point to Point module, equipped in the RF interface subracks.

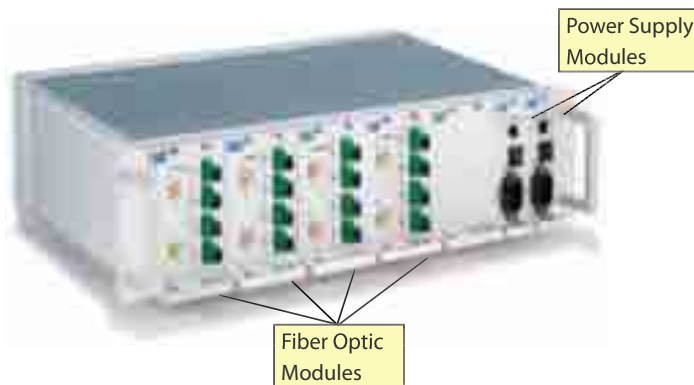
The slave point to point module includes the 4-way splitter/combiner to manage up to 4 Fiber Optic Transmitter/Receiver Modules and a built-in Supervision unit for the management of the remote subrack and connected Remote Units.



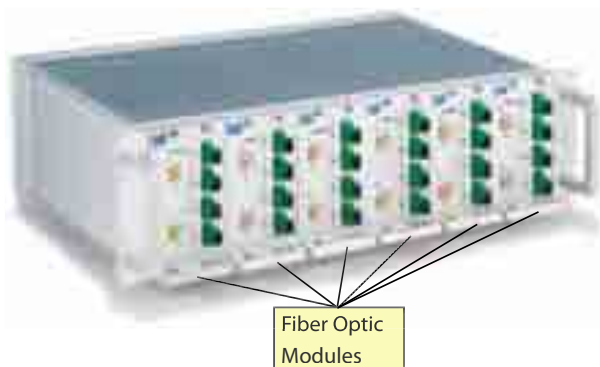
Optical Subracks can be AC or DC powered. Power Supply modules can be equipped in monitored Optical Subracks or in the Master Optical Subrack or in dedicated Active Subracks.



Example of Master Optical Subrack hosting the Supervision module, 4 Fiber Optic Transmitter/Receiver modules, and 2 Power Supply Modules (the second Power Supply Module, optional, provides power supply redundancy for higher reliability)



Example of Monitored Optical Subrack equipped with 4 Fiber Optic Transmitter/Receiver Modules and 2 Power Supply Modules



Example of Monitored Optical Subrack equipped with 6 Fiber Optic Transmitter/Receiver Modules

B – Remote Units

Remote Units distribute wireless signals throughout the area to be covered ; they can be installed up to 20km (12.4miles) from the Master Unit site.

Remote Units can be Single, Dual or Tri-band with different power classes: Very High, High, Medium and Low.



Single, Dual or Tri-band Very High, High and Medium Power Remote Unit



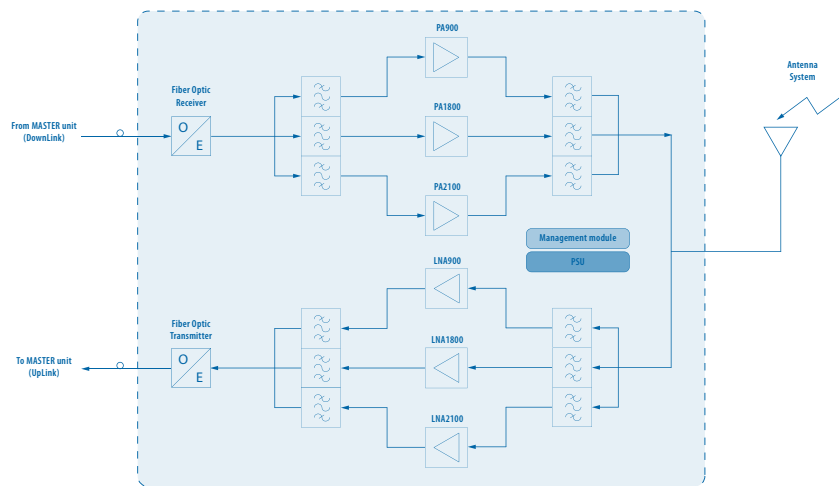
Single, Dual or Tri-band Low Power Remote Unit

Remote Units are equipped with the Fiber Optic Receiver and Transmitter modules (for Optical to RF and RF to Optical conversion) power amplifiers and filtering.

A single Master Unit can drive up to 144 Remote Units. Various network structures can be supported by the Master Unit: the Remote Units of the same Optical System can be deployed with a point-to-point connection (star-configuration - using one fiber optic per Remote Unit) or with cascading of up to 5 Remote Units using a single fibre and optimized optical couplers.

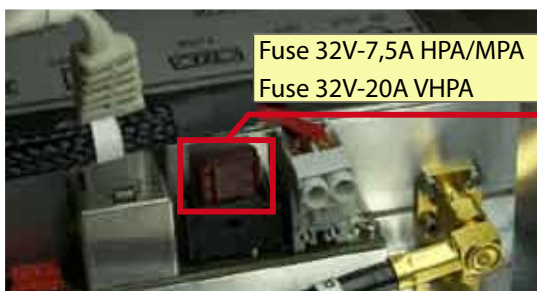
The following figure shows the Tri-band Remote Unit block diagram: in down-link the optical signal from Master Unit is converted into an RF signal by the Fiber Optic Receiver module. RF signals, filtered by the triplexer, are amplified by Low, Medium, High or Very High Power amplifiers (Low, Medium, High or Very High Power Remote Units), filtered and transmitted through an antenna or a passive distribution system.

In up-link the RF signal is filtered by the triplexer. The three RF signals are amplified by Low-Noise Amplifiers, filtered and then converted into an optical signal by the Fiber Optic Transmitter module. The signal is transmitted via fiber optics to the Master Unit.

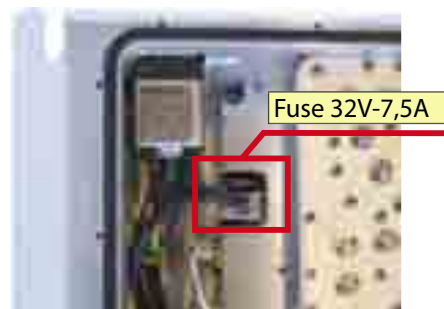


Example: Tri-band Remote Unit block diagram

Please Note: each final power amplifier is protected by a fuse.



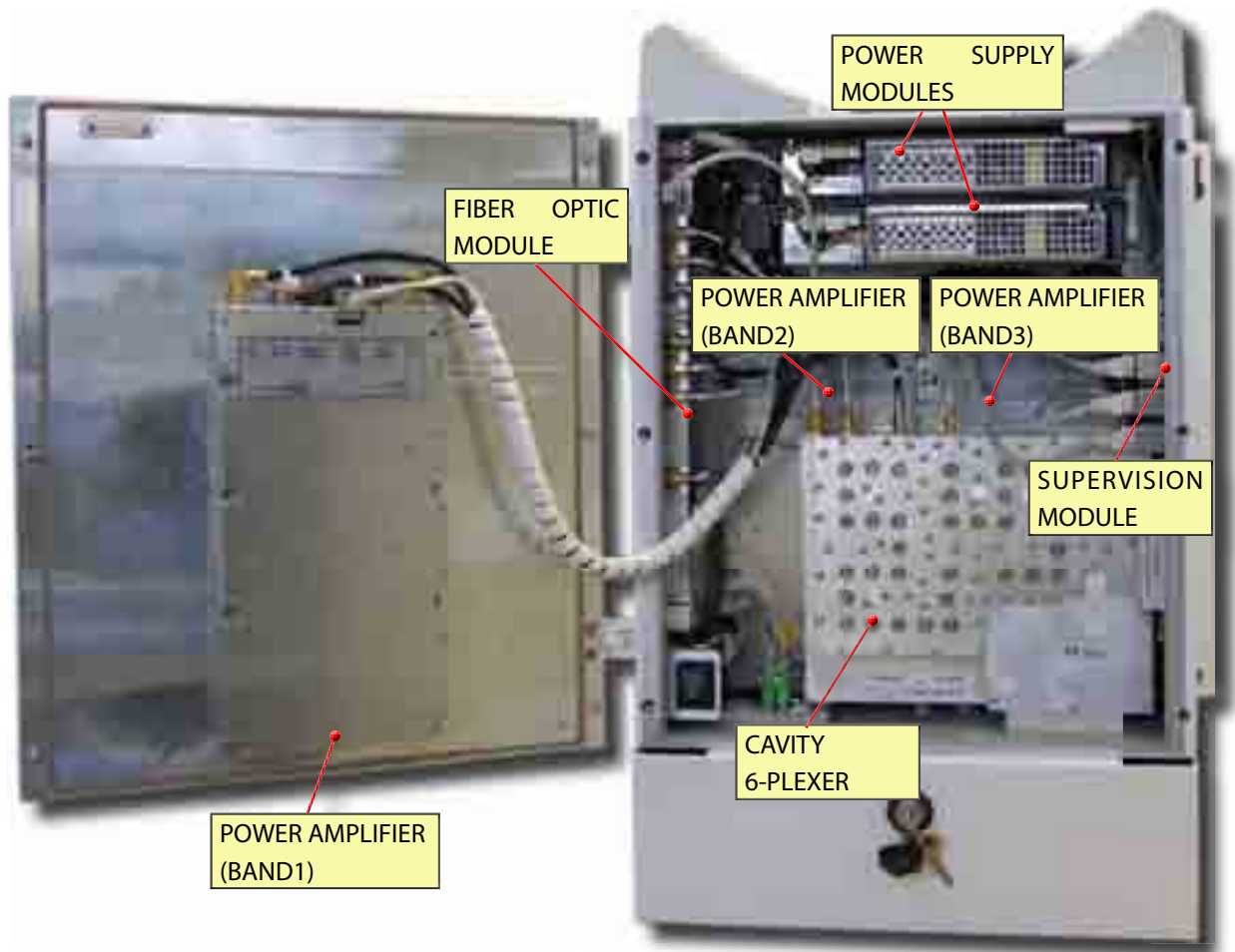
Very High Power/High Power/Medium Power final amplifiers fuse position and electrical rating



Low Power final amplifier fuse position and electrical rating

The management module collects information relevant to the various modules. An RF modem allows data communication over fiber between Remote Unit and Master Unit.

- **High/Medium Power Remote Units Composition**



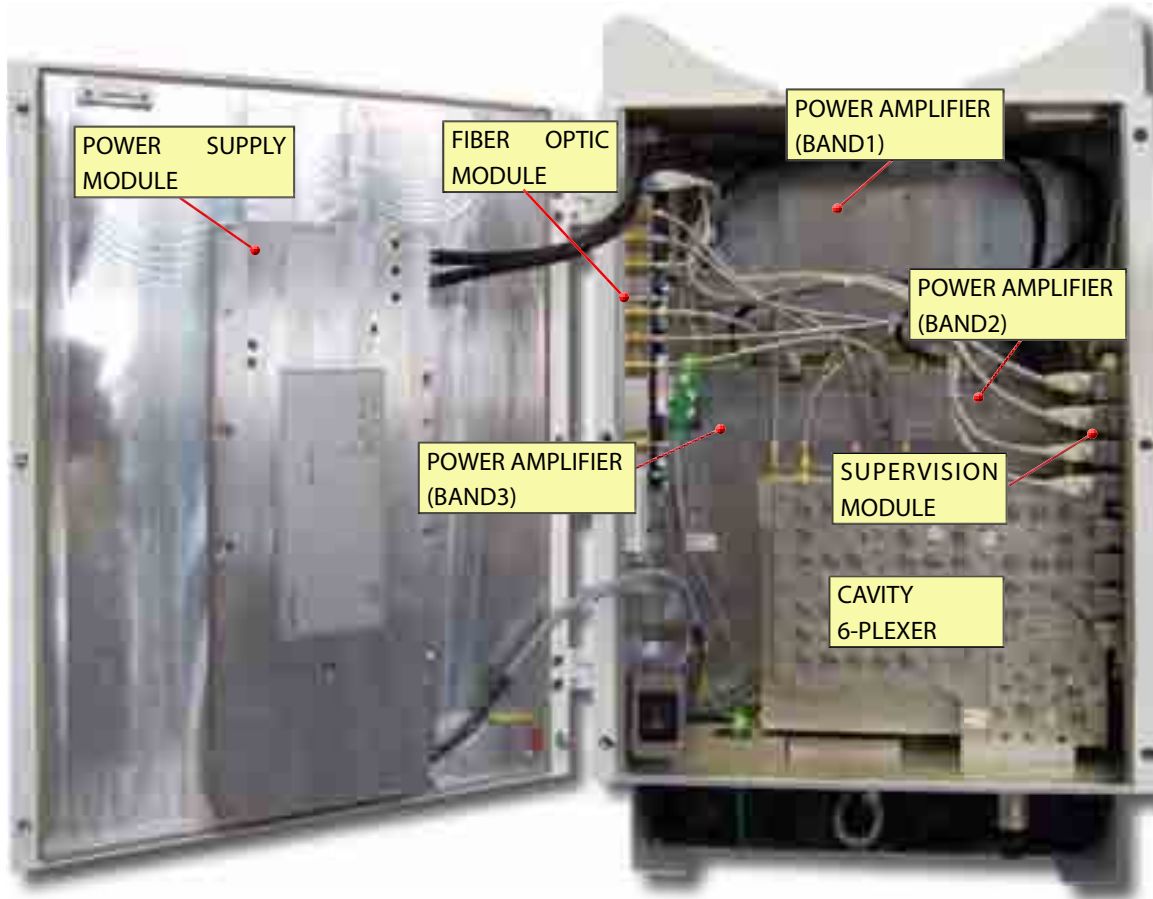
PLEASE NOTE:

The Very High/High/Medium Power Remote Unit case is equipped with a lock to guarantee protection of the equipment. The following procedure describes how to open the equipment.

OPENING THE REMOTE UNIT

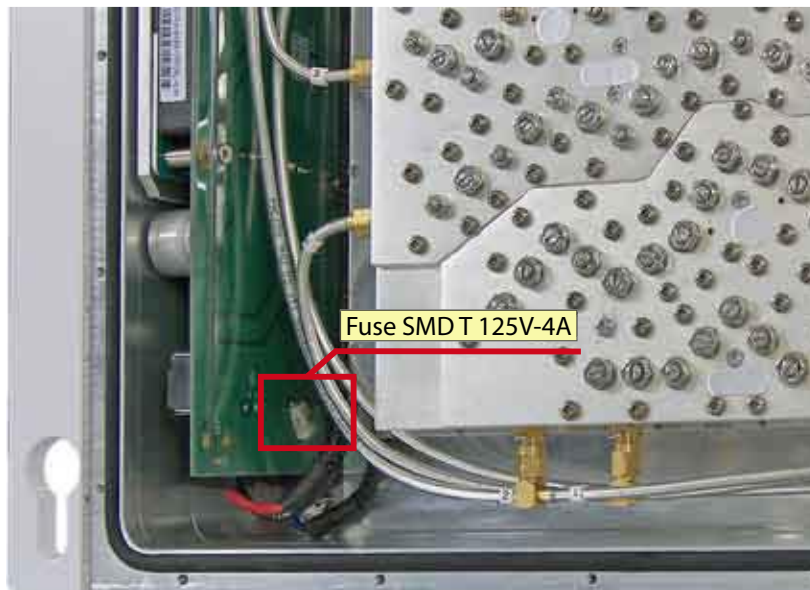
- Unlock the cables protection using the keys delivered with the equipment
- Remove the cables protection
- Remove the Remote Unit cover, sliding it downwards
- Unscrew the 6 screws on the Remote Unit door
- Open the Remote Unit door.

Very High Power Remote Unit Composition



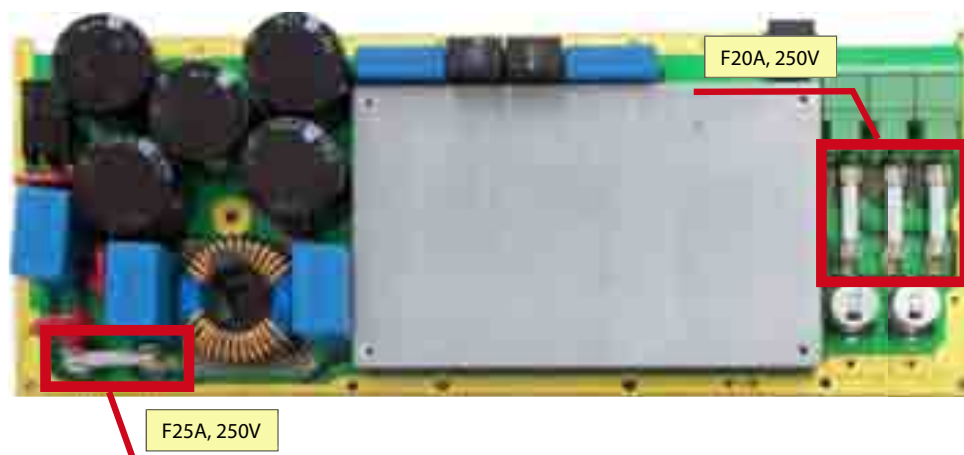
Low Power Remote Units can be either AC powered (Universal mains, 85÷264Vac, 50-60Hz) or DC powered (-72 ÷ -36Vdc).

The following figure shows the DC powered Low Power DC/DC Power Supply Module protection fuse position and electrical rating.



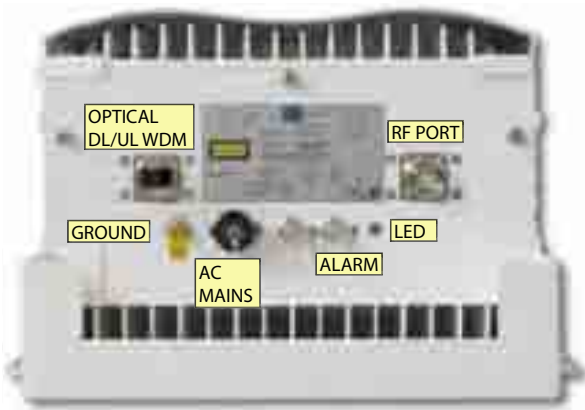
Very High/ High and Medium power Remote Units are AC powered (Universal mains, 85÷264Vac, 50-60Hz).

The Very High Power Remote Unit Power Supply module is protected by 4 fuses. The following figure shows the protection fuses position and electrical ratings.

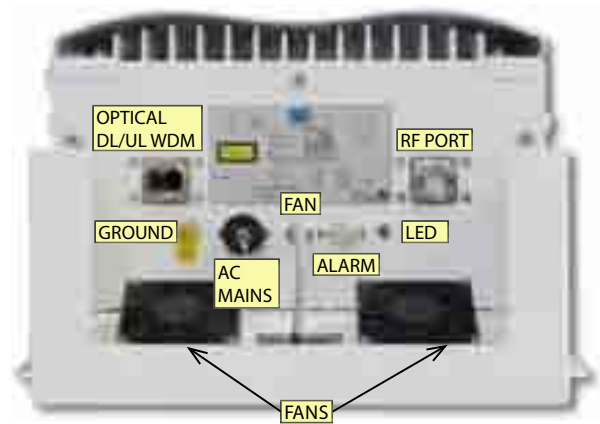


• Remote Units External Access Points

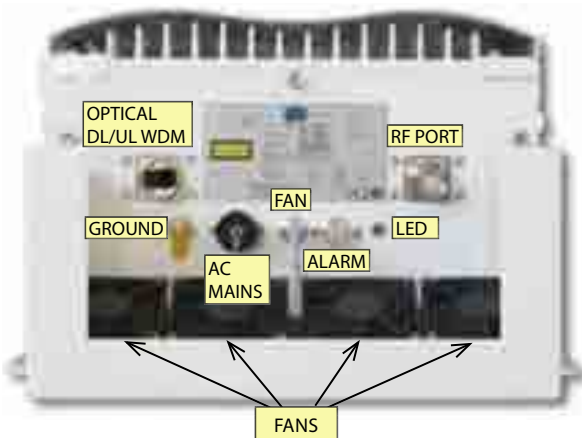
Medium/ High and Very High Power Remote Units External Access Points



Medium power and Single band high power Remote Units
Bottom view



Dual band/Triband high power Remote Units
Bottom view



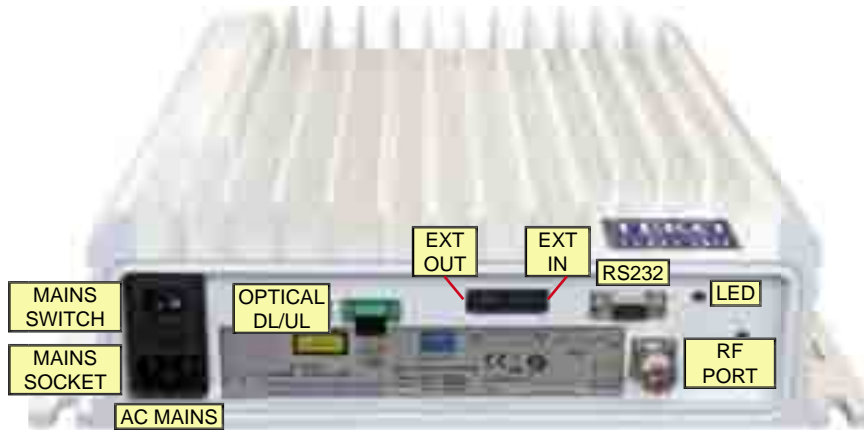
Very high power Remote Units and high power Remote Units
equipped with amplifiers operating in the LTE2600 band
Bottom view

REMOTE UNIT GENERAL OPERATING STATUS
LED DESCRIPTION (LED)

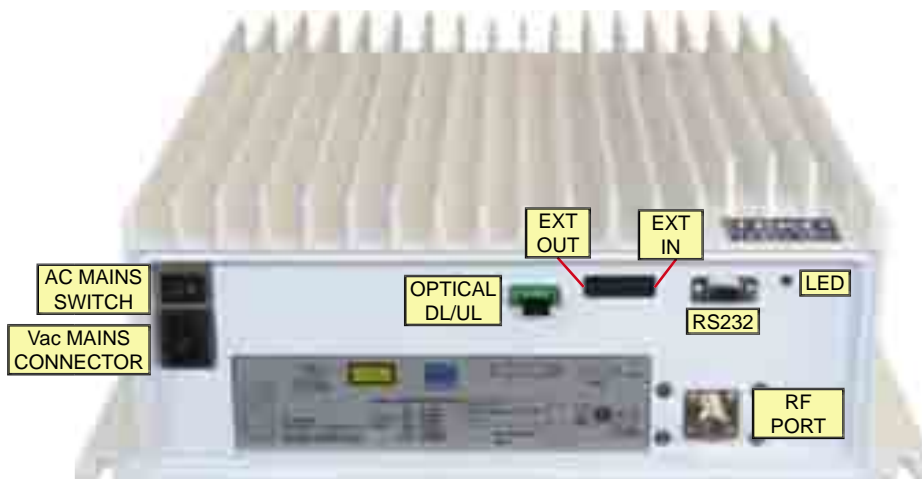
Green: regular operation (no alarm)
 Blinking Orange: presence of active alarms with **warning** severity level (4)
 Orange: presence of active alarms with **minor** severity level (3)
 Blinking Red: presence of active alarms with **major** severity level (2)
 Red: presence of active alarms with **critical** severity level (1)

Connectors	Description
RF PORT	Down Link/Up Link 7/16 RF connector
OPTICAL DL/UL WDM	Optical fibres input/output connector
GROUND	Equipment grounding
AC MAINS	AC voltage input (100-240Vac)
FAN	Fans power supply and control connector
ALARM	Auxiliary alarms connector (4 in, 4 out)

Low Power Remote Units External Access Points (AC Powered)



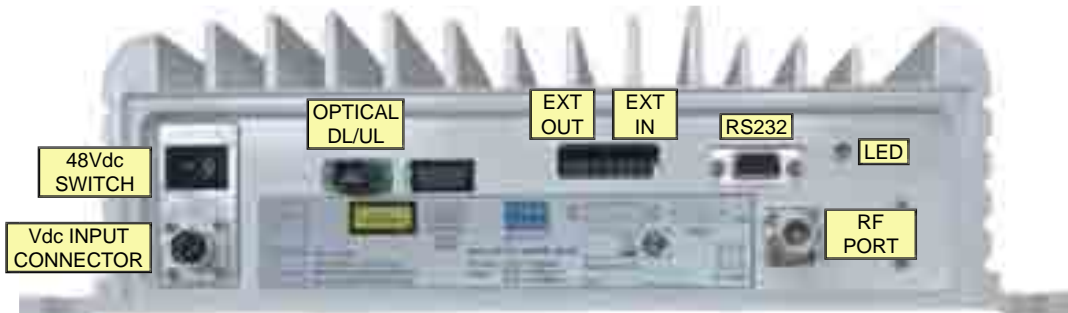
Single/Dual/Tri-Band Low Power Remote Units External Access Points



Six-Band Low Power Remote Unit External Access Points

Connectors	Description
RF PORT	Down Link/Up Link RF connector (N type)
OPTICAL DL/UL	Optical fibres input/output connector
AC MAINS	AC voltage input (100-240Vac) and switch
EXT OUT	External alarms output connector
EXT IN	External alarms input connector
RS 232	9-pole D-Sub RS232 connector for Local Management
LED	Remote Unit general operating status LED Green: no alarm Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)

DC Powered Low Power Remote Unit External Access Points



Connectors	Description
RF PORT	Down Link/Up Link RF connector (N type)
OPTICAL DL/UL	Optical fibres input/output connector
48V 3A	Vdc input connector (48Vdc) and switch
EXT OUT	External alarms output connector
EXT IN	External alarms input connector
RS 232	9-pole D-Sub RS232 connector for Local Management
LED	Remote Unit general operating status LED Green: no alarm Blinking Orange: presence of active alarms with warning severity level (4) Orange: presence of active alarms with minor severity level (3) Blinking Red: presence of active alarms with major severity level (2) Red: presence of active alarms with critical severity level (1)

1.2.3 Coverage Systems Management and Power Supply Management

Teko Telecom Supervision Module (TSPV) allows the management of the entire Coverage and Capacity System.

The System Supervision Module is able to manage the Active Subrack it is equipped in (Master Subrack) and up to other 12 Active Subracks (Monitored Subracks).

Twelve ports (1 to 8 and S1 to S4) are available on the Supervision Module front panel to be connected to the RS485 ports of monitored Active Subracks.

The ports numbered from 1 to 8 are available for the connection to monitored subracks mounted within the same rack hosting the Master Subrack.

The other four ports (S1 to S4) are available for the management of remote subracks equipped with Slave supervision units.

When the Coverage System includes point to point links these ports allow the management of the Slave Point to Point modules built-in Supervision units. Each Slave Point to Point module Supervision unit manages the remote optical subrack - hosting the module - and all connected Remote Units.

The Coverage System Supervision Module communicates with the Slave Point to Point built-in Supervision via the single-mode optical fiber (SMR 9/125) connecting Master and Slave Point to Point modules.

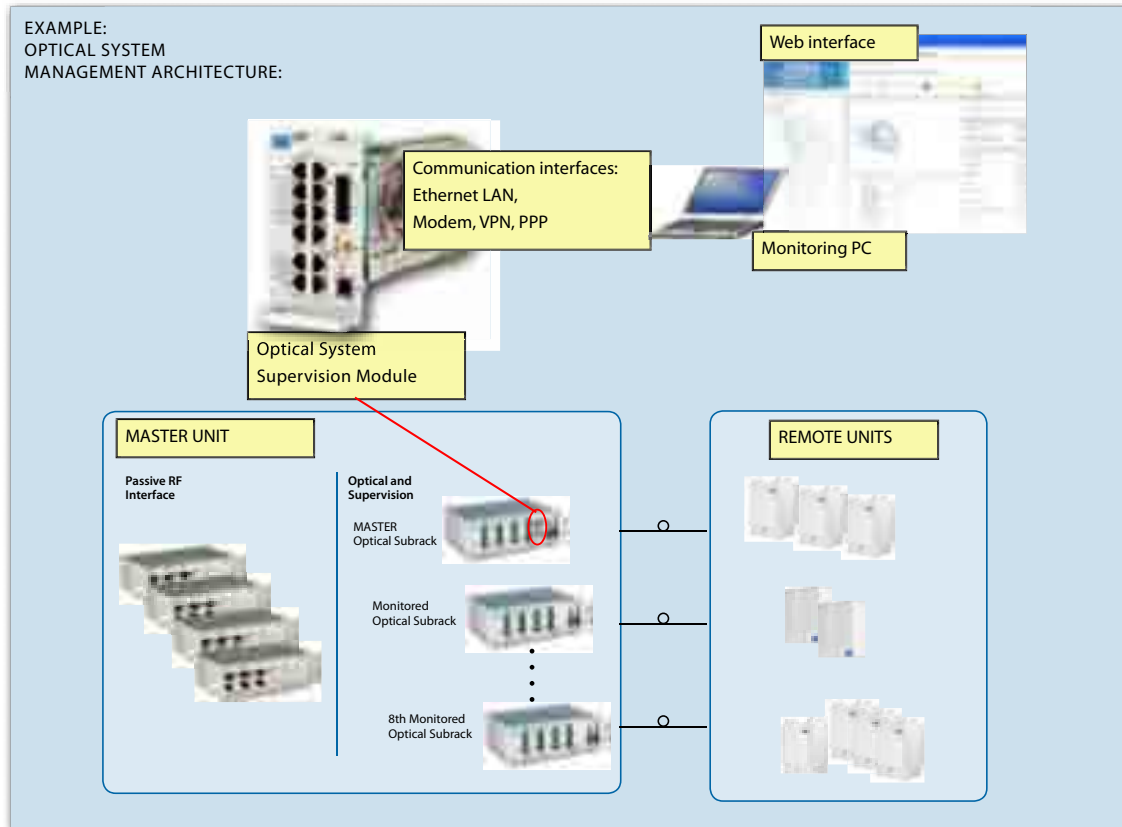
When the Coverage System does not include point to point links, the master supervision module communicates with the Remote Units via the single-mode optical fiber (SMR 9/125) connecting Fiber Optic modules to Remote Units.

Address assignement

Each monitored Subrack takes its address from the Supervision Module port it is connected to (please refer to Paragraph 2.2.2 RS485 Connections for details).

The Active Subrack equipped with the Supervision Module (Master Subrack) takes address = 0 (zero).

The whole Coverage System can be accessed and managed simply connecting a PC, either locally or remotely, to the IP address of the System Supervision Module.



Local management is performed connecting a PC to the Ethernet port (LAN, RJ45 connector), available on the Supervision Module front panel. A local connection is required to perform commissioning.

For remote control the System can be accessed via Ethernet, via external PSTN or wireless modem or via optional built-in wireless modem.

The management of the System is performed via web pages: the Supervision Module is equipped with a web-server and each component of the System is associated to a web page displaying detailed information about the component.

The Supervision Module is also equipped with an SNMP-agent, which allows the control of each parameter of the system via SNMP get/set/trap operations.

The Supervision Module is also provided with an OpenVPN application that allows remote and secure access to the System using the Internet.

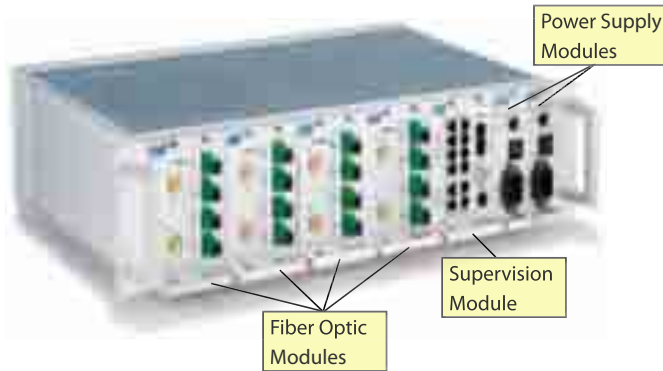
Teko Telecom Operation and Maintenance Terminal (OMT) web pages show the Coverage System operating parameters and alarm status. They allow the commissioning, monitoring,

setting and troubleshooting of the whole Coverage System.

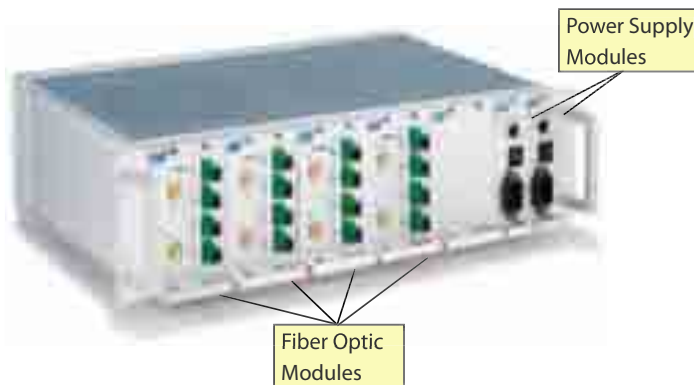
Teko Telecom Operation Management Centre (OMC) proprietary software allows the management of multiple Teko Telecom Coverage and Capacity Systems in a Network. OMC is a client-server application: the server collects information, such as System status and alarms, relevant to the Systems in the Network. The Server communicates with each System Supervision Module via Ethernet (TCP-IP socket) or via PSTN or wireless modem. The Client provides access to the information stored in the Server database. It allows end-users to check the status of the Coverage Systems in the Network via a user friendly graphical interface.

Power Supply

Coverage Systems can be AC or DC powered. Power supply modules can be equipped in monitored Active Subracks or in the Master Subrack or in dedicated Active Subracks.



Example of Power Supply Modules equipped in the Master Optical Subrack (the second Power Supply Module, optional, provides power supply redundancy for higher reliability).



Example of Power Supply Modules equipped in a monitored Active Subrack. The RJ45 connector available on the Power Supply Module front panel can be used for connection to the Supervision Module, equipped in the Master Active Subrack.



Example of Power Supply Modules equipped in a dedicated Active Subrack.

1.2.4 Teko Telecom Coverage Systems Technical Specifications

This paragraph makes Coverage and Capacity Systems mechanical, environmental and power supply specifications available. Please refer to product datasheets for detailed electrical specifications. Contact Teko Telecom Sales Office for further information.

- Remote Units**

Remote Unit model	Dimensions (HxWxD)	Weight	Operating temperature range	Degree of protection (IP)	Power supply
LOW POWER					
Single / Dual / Triband	350x350x100mm (13.78x13.78x3.94 in) max volume - heat sinks and connectors included	13 kg (28.7 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP32 (box) IP66 (with optional protection kit)	85÷264Vac (50-60Hz) AC version -72 ÷ -36Vdc DC version
6-band	395 x 414 x 144 mm (15.55 x 16.30 x 5.67in) max volume - heat sinks and connectors included	19 kg (41.9lbs)			
MEDIUM POWER					
Triband	570x415x260mm (22.44x16.34x10.24 in)	30 kg (66.1 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP66	85÷264Vac (50-60Hz)
Dual band	max volume - heat sinks, handles and connectors included	28 kg (61.73 lbs)			
Single band		26 kg (57.32 lbs)			
HIGH POWER					
Triband	570x415x260mm (22.44x16.34x10.24 in)	32 kg (70.5 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP66	85÷264Vac (50-60Hz)
Dual band	max volume - heat sinks, handles and connectors included	30 kg (66.1 lbs)			
Single band		28 kg (61.73 lbs)			
VERY HIGH POWER					
Triband	620x415x260mm (24.41x16.34x10.24 in)	38 kg (83.78 lbs)	-20°C up to +55°C (-4°F up to +131°F)	IP66	85÷264Vac (50-60Hz)
Dual band	max volume - heat sinks, handles and connectors included	37 kg (81.57 lbs)			
Single band		36 kg (79.37 lbs)			

- **System Subracks**

Dimensions	19" - 3U racks / depth 270 mm (10.63 in) - Active and Passive Subracks
	19" - 2U rack / depth 360 mm (14.17 in) - Service Front End Subrack
	19" - 1U rack / depth 270 mm (10.63 in) - Forced-Air Cooling Subrack
Power supply (Active Subracks)	85÷264Vac (50-60Hz) (TPSU/AC) -72÷-36Vdc (TPSU/48)
Operating temperature range	-5°C up to +55°C (+23°F up to +131°F) with proper forced-air cooling

SIRIUS: Teko Telecom Modular Coverage and Capacity System



2. System Installation

2. System Installation



Before installing the equipment, carefully read the safety rules herewith attached.

A correct system installation and setting procedure requires a good knowledge and experience in installing telecommunication equipment. These activities should be performed by skilled personnel only.

A cabinet cooling forced air ventilation system, able to provide an air flow of up to 180cfm (5m³/min), is required to ensure cabinet installed equipment proper operation.

In Finland, Norway and Sweden, the equipment is intended to be installed in RAL (Restricted Access Location), where the equipotential bonding has been applied.

The RESTRICTED ACCESS LOCATION is a location for equipment where both of the following apply:

- access can only be gained by SERVICE PERSONS or by USERS who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and
- access is through the use of a TOOL or lock and key, or other means of security, and is controlled by the authority responsible for the location.

In Finland, Norway and Sweden, the equipment intended for connection to other equipment or a network shall have a marking stating that the equipment must be connected to an earthed mains socket-outlet.

In Finland: "Laite on liitettävä suojamaadoituskoskettimilla varustettuun pistorasiaan"

In Norway: "Apparatet må tilkoples jordet stikkontakt"

In Sweden: "Apparaten skall anslutas till jordat uttag"

Initial Check

Make sure that the supply is complete and/or that the material has not been damaged during transport.

The list of the materials that make up the equipment is described in the relative PACKING LIST. Should any parts be missing, or should some be damaged, kindly inform the Sales Dept. of Teko Telecom immediately, in order to facilitate replacing and/or repairing involved parts.

2.1 Mechanical Installation



Before starting mechanical installation, make sure that the components of the System are not powered.

Master Units: make sure that the switches of all the power supply modules equipped in the System are set to O (OFF).

Remote Units: make sure that Remote Units are not connected to the MAINS.

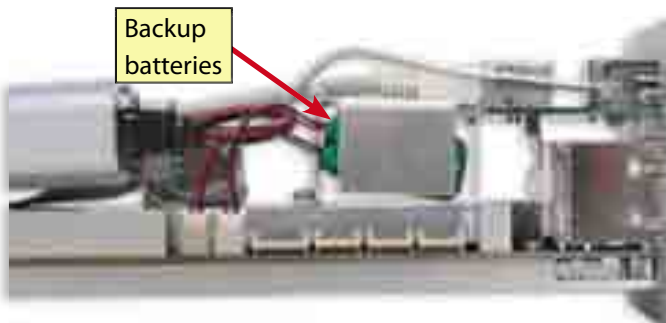
Please Note

If the Supervision Module is equipped with the optional wireless modem and/or the optional battery backup, before starting the System installation, please activate the options as follows:

> **Battery backup option:** the two internal backup batteries are not connected to the Supervision board in order to prevent batteries from discharging during shipment. To activate the option, perform the following steps:

1. Remove the Supervision module (if necessary): loosen the four screws that fix the module to the Subrack and carefully slide the module forward.
2. Connect the terminals of the two backup batteries to the J9 and J10 connectors, available on the Supervision board.

Please refer to the following figures for details about the cabling.



Backup battery and Supervision board connections - Side view



Backup Battery and Supervision board connections - Top view

BACKUP BATTERY SPECIFICATIONS

Nominal Voltage	3.7 V
Nominal Capacity	> 1100 mAh
Type	Rechargeable



CAUTION

Risk of explosion if battery is replaced by an incorrect type.

Dispose of used batteries according to the instructions.

Backup Batteries Installation and replacement should be performed by skilled personnel only.

3. If the **optional wireless modem** is equipped inside the Supervision module, please refer to the following procedure to insert the SIM card, otherwise carefully slide the Supervision module back into the slot and fix its position tightening the 4 screws.

> **Wireless modem option:** to insert the wireless modem SIM card perform the following steps:

1. Remove the Supervision module (if necessary): loosen the four screws that fix the module to the Active Subrack and carefully slide the module forward.
2. Insert the SIM card into the wireless modem.

• **GSM/GPRS modem**

SIM card - gold side up



Insert the SIM card (PIN code disabled / data transfer enabled), with the gold side up, into the modem dedicated card slot.

SIM lock switch opened



Push the SIM card into the slot until it clicks into place. The SIM card slot is provided with a lock switch (black slider on the left of the SIM slot).

SIM card in place

SIM lock switch closed



Close the SIM lock switch. Move the black slider to the right position. The SIM card is locked in place.

SIM card locked

• **UMTS modem**

SIM card holder cover



Remove the SIM card holder cover. To avoid damages to the cover, press lightly and slide the cover away as shown in figure.

SIM card holder - open position



Slide the SIM card holder to the open position and lift it up. Slide the SIM card (PIN code disabled/data transfer enabled for 3G operation) into the card holder.

SIM card holder - lock position



Lower the SIM card holder and slide it back to the lock position. Replace the card holder cover, sliding it into position carefully, until it clicks.

3. Carefully slide the Supervision module back into the slot and fix its position tightening the 4 screws.

2.1.1 Positioning Master Unit Subracks

The modular Master Unit is composed of 19" subracks (N3 compatible). So, it needs to be positioned indoor or inside cabinets to guarantee the protection of the equipment against atmospheric agents, humidity and temperature changes.

1. Fasten the rack cabinet, so as to prevent it from turning over.
2. Connect the cabinet to the station ground.
3. Position the subracks inside the cabinet as follows:
 - mount the horizontal rails for support of the equipment;
 - insert each subrack into the rails and slide it into position carefully. Leave one unit distance between active subracks for air flow to assure proper cooling;
 - fix each subrack to the vertical mounting guides of the cabinet using four screws, to be inserted into the proper slots;
 - connect each subrack to the cabinet ground bus bar;
 - insert the modules and tighten the screws available on the module front panel to fasten the module to the subrack.

Please note

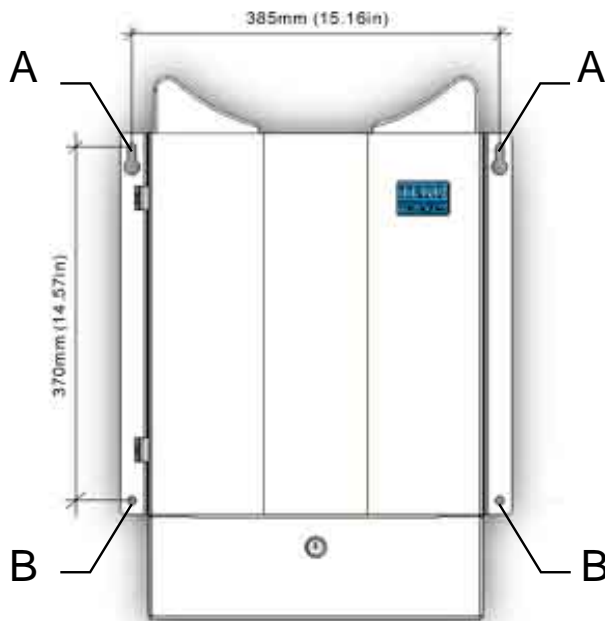
Make sure that the System is equipped with the same type of Power Supply modules (same commercial code on handles).

To make connections easier, position the subracks as follows:

- the Service Front End subrack should be positioned over the subrack / subracks hosting RF interface modules (with TDFE subracks over POI subracks);
- the subracks hosting RF interface modules and/ or passive components should be positioned over Optical Subracks;
- the subracks hosting Power Supply modules should be installed in the lower position. Power supply modules providing power supply to other active subracks should be grouped on the right side of the subrack;
- the forced-air cooling subrack should be installed below the subracks hosting Power Supply modules, in order to ensure the air flow volume required for the equipment proper operation.

2.1.2 Positioning Remote Units

Remote Units can be installed either outdoor (on a wall or pole) or inside specific cabinets. Very High/High/Medium power Remote Unit weatherproof IP66 case is equipped with handles to make mounting easier. Very High/High/Medium power Remote Units fixing holes position is shown in the following figure.



Dimensions (max volume - heat sinks, handles and connectors included)

- HIGH/MEDIUM POWER REMOTE UNIT
approx 570 x 415 x 260 mm (22.44 x 16.34 x 10.24 in)
- VERY HIGH POWER REMOTE UNIT
approx 620 x 415 x 260 mm (24.41 x 16.34 x 10.24 in)

Weight

- approx 30 kg (66.14 lbs) - Triband Medium Power Remote Unit
- approx 32 kg (70.55 lbs) - Triband High Power Remote Unit
- approx 38 Kg (83.78 lbs) - Triband Very High Power Remote Unit

POSITION OF THE PRE-CUT SLOTS IN THE EQUIPMENT SUPPORT-BRACKETS

The SINGLE/DUAL/TRIBAND Low power Remote Units fixing holes position is shown in the following figure.



SINGLE/DUAL/TRIBAND REMOTE UNITS

Dimensions (max volume - heat sinks and connectors included):

approx 350 x 350 x 100mm (13.78 x 13.78 x 3.94 in)

Weight

approx 13 kg (28.7 lbs) - Single/Dual/Triband Low Power Remote Unit

POSITION OF THE PRE-CUT SLOTS IN THE EQUIPMENT SUPPORT BRACKETS

The SIX-BAND Low power Remote Unit fixing holes position is shown in the following figure.



6-BAND REMOTE UNITS

Dimensions (max volume - heat sinks and connectors included):

approx 395 x 414 x 144 mm (15.55 x 16.30 x 5.67in)

Weight

approx 19 kg (41.9lbs)

POSITION OF THE PRE-CUT SLOTS IN THE EQUIPMENT SUPPORT BRACKETS

Remote Units have to be fixed in vertical position on the wall or pole, or on the vertical guides present inside the cabinet.

WALL MOUNTING

- Mark the four pre-cut slots position
- Drill 4 holes at the marked position
- Insert the dowels into the 4 holes
- Screw 2 M8 screws into the 2 upper dowels
- Hang the Remote Unit inserting the upper pre-cut slots (ref. A) through the screws
- Fix the equipment position with other 2 M8 screws to be inserted through the lower pre-cut slots (ref. B) into the lower holes
- After checking the correct positioning of the equipment, fully tighten the screws.

POLE MOUNTING: a pole mounting kit is available (option).

Adequate Remote Units mounting is checked by the following test: a force, in addition to the weight of the equipment, is applied downwards through the centre of gravity of the equipment, for 1 minute. The additional force shall be equal to three (3) times the weight of the equipment but not less than 50N. The equipment shall remain secure during the test.

IP66 PROTECTION KIT MOUNTING - LOW POWER REMOTE UNITS

A protection kit, providing IP66 protection degree, is available as option for Low Power Remote Units outdoor or harsh environment installation.

Protection kit mounting instructions

- Lead the equipment external connection cables through the cable glands, available on the bottom of the IP66 protection kit.
- **When the Commissioning of the equipment has been completed**, carefully slide the IP66 kit upwards and tighten the cable glands until the gasket of the lead-through is tightly around the cable.
- Fully tighten the 4 screws available inside the 4 fixing holes of the IP66 kit to fasten the kit to the Unit - tool: 4mm (0.16in) Allen key.

To remove the kit, loosen the 4 screws fixing the kit to the Unit, loosen the cable glands and carefully slide the kit downwards.

2.2 Connections

The following connections must be performed:

- **RF connections**

RF connections change according to the application scenario. This document describes how to:

1. Connect RF interface modules (TDFE modules or Point of Interface modules) to a single Fiber Optic Transmitter/Receiver Module (Optical Systems).
2. Connect RF interface modules to Master Point to Point modules.
3. Connect RF interface modules to Passive Modules providing distribution and filtering and Passive Modules to Optical Modules- Fiber Optic Transmitter/Receiver Modules or Master Point to Point modules (Optical Systems).
4. Connect the Slave Point to Point module, equipped in a remote optical subrack, to Fiber Optic Transmitter/Receiver Modules.
5. Connect TSFE subracks to TDFE modules (Optical Systems and Modular Repeaters) and to Passive Modules providing distribution and filtering (Optical Systems).
6. Connect the equipment providing coverage (TSFE subracks and Remote Units) to the Antenna System.

- **RS485 connections**

Monitored Active Subracks have to be connected to the System Supervision Module (Optical Systems and Repeaters);

- **OPTICAL connections**

Remote Units have to be connected to Optical Subracks via fiber optics (Optical Systems).

When the Coverage System includes point to point links, the Master and Slave Point to Point modules have to be connected via fiber optics.

- **Power Supply connections**

Active Subracks and Remote Units have to be connected to their power supply sources (Optical Systems and Repeaters).

Please Note

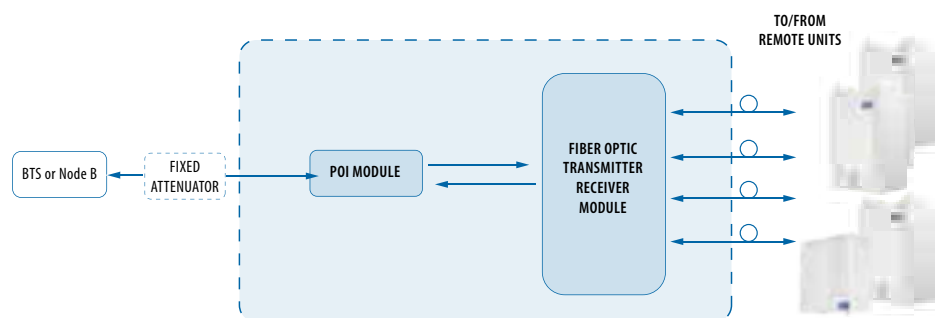
In any event, the installer should never connect an antenna to the Master Unit BTS port.

2.2.1 RF Connections

1. Connecting RF interface modules (TDFE modules or Point of Interface modules) to a single Optical Module

The typical scenario for this module application is the **single operator / single band Optical System**. The RF interface subrack is equipped either with one POI module or with one Donor Front End module (**single operator / single band Optical Systems**). The Master Unit can drive 1 Fiber Optic Transmitter/Receiver Module (i.e. up to 4 Remote Units or up to 5 cascaded Remote Units).

- POI module driving a single Fiber Optic Transmitter/Receiver



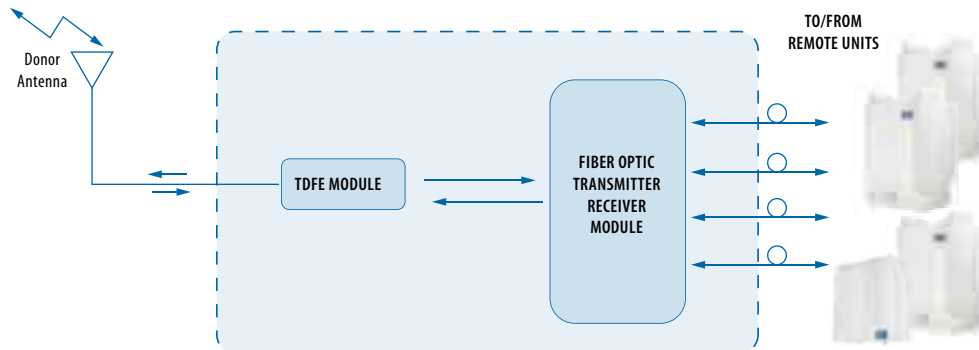
Example - Block diagram of single operator/single band Systems equipped with one POI module

Connections



Connect the POI module DL OUT connector to the Optical module DL RF connector (red line).
Connect the POI module UL IN connector to the Optical module UL RF connector (blue line).

- TDFE module driving a single Fiber Optic Transmitter/Receiver



Example - Block diagram of single operator/single band Systems equipped with one DFE module

Connections



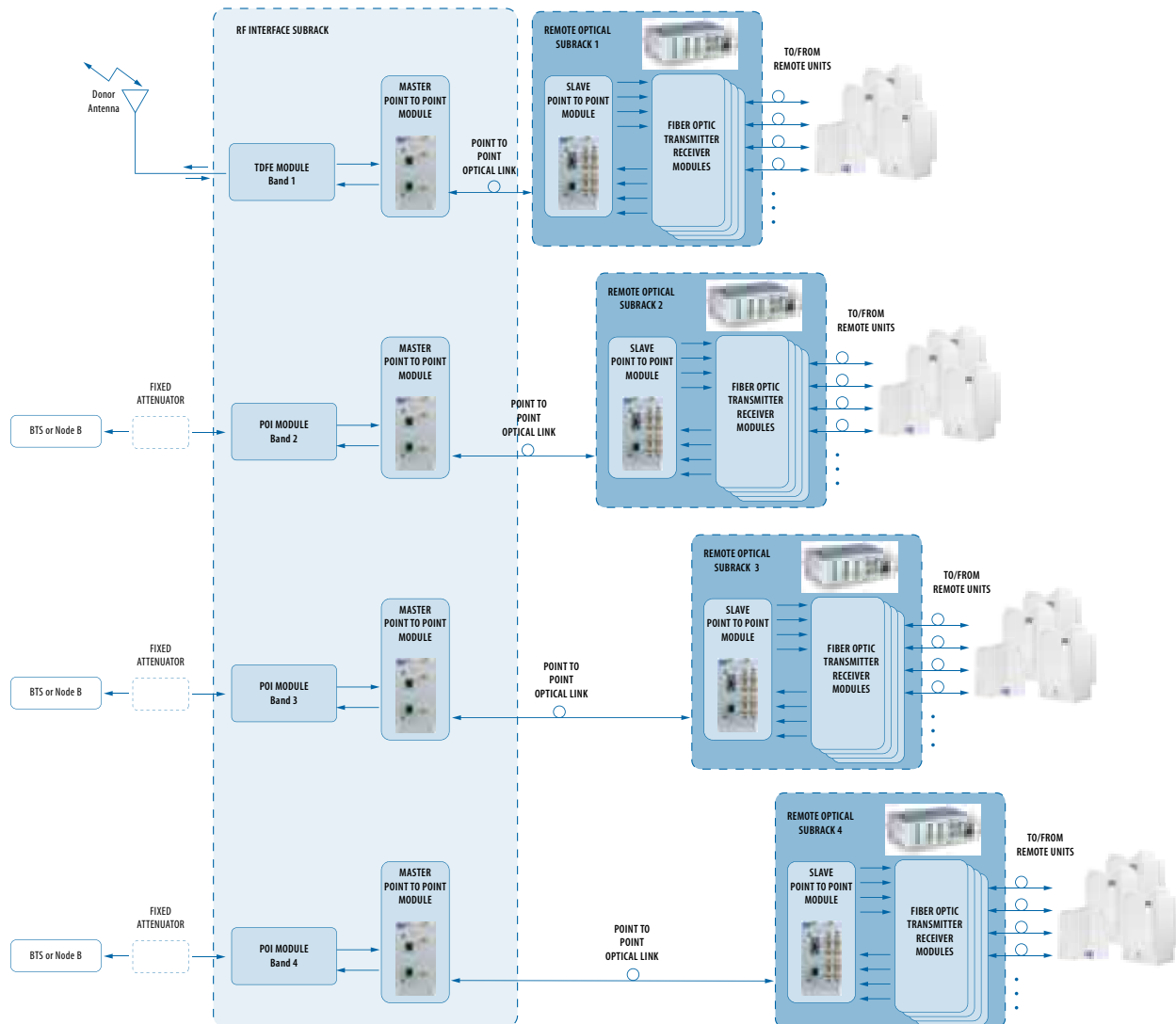
Connect the TDFE module DL output connector to the Optical module DL RF input connector (red line).

Connect the TDFE module UL input connector to the Optical module UL RF output connector (blue line).

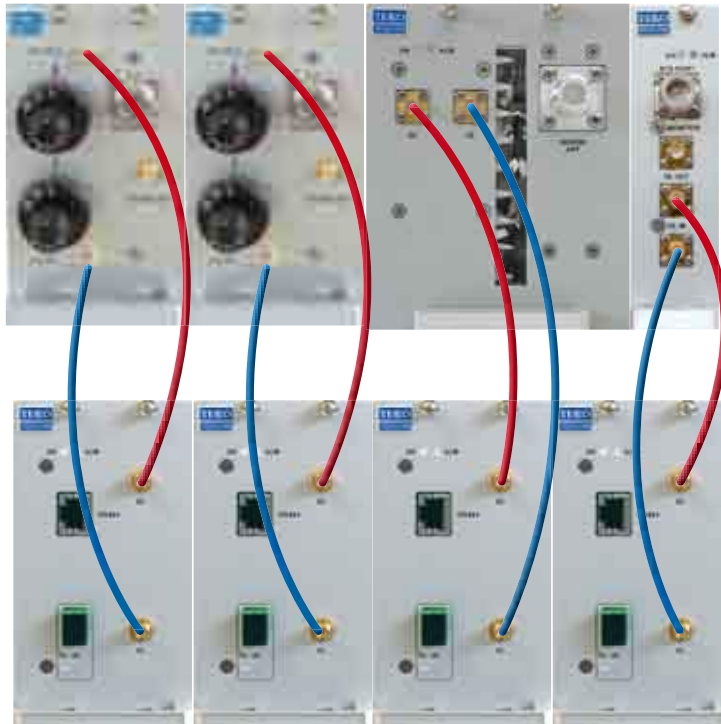
2. Connecting RF interface modules (TDFE modules or Point of Interface modules) to Master Point to Point modules

The typical scenario for a point to point link application is an Optical System providing coverage to several separate buildings (up to 4); in this application the transmission of signals from/to a group of remote units over a single optical fibre allows a significant reduction in the number of fiber optics running long distances. The point to point link requires the RF interface subracks to be equipped with the Master Point to Point module and the remote optical subracks to be equipped with the Slave Point to Point modules.

An Optical System serving 4 remote optical subracks via point to point optical links is provided as example.



Connections



- POI and TAPOI modules

Connect the Point of Interface module DL OUT connector to the DL connector of the Master PTP module to be connected to the remote optical subrack to be served by the Point of Interface (red lines).

Connect the Point of Interface module UL IN connector to the UL connector of the Master PTP module to be connected to the remote optical subrack to be served by the Point of Interface (blue lines).

- TDFE modules

Connect the Donor Front End DL connector to the DL connector of the Master PTP module to be connected to the remote optical subrack to be served by the DFE (red lines).

Connect the Donor Front End UL connector to the UL connector of the Master PTP module to be connected to the remote optical subrack to be served by the DFE (blue lines).

3. Connecting RF Interface Modules (TDFE modules or Point of Interface modules) to Passive Modules providing distribution and filtering and Passive Modules to Optical Modules- Fiber Optic Transmitter/Receiver Modules or Master Point to Point Modules (Optical Systems)

Due to the flexible configuration options of Teko Telecom Coverage and Capacity Systems, the same passive modules can be used for different purposes:

- the 4-way splitter/combiner can be used to manage:
 - one RF Interface module and multiple Fiber Optic Modules - Fiber Optic Transmitter/Receiver Modules or Master Point to Point Modules (Single Operator / Single Band Systems);
 - multiple RF interface modules (TDFE and/or Point of Interface modules) operating in the same band (Multi-Operator Systems).
- the triplexer can be used to manage:
 - up to 3 RF interface modules (TDFE and/or Point of Interface modules) operating in different bands and up to 4 Fiber Optic Modules or
 - up to 3 four-way splitter/combiner - used to manage multiple RF interface modules (up to 4 for each band) - and up to 4 Fiber Optic Modules, or
 - up to 3 Service Front Ends operating in different bands and up to 4 Fiber Optic Modules.
- the Pentaplexer and Esaplexer can be used to manage
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) RF interface modules operating in different bands or
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) Service Front End subracks operating in different bands or
 - up to 5 (Pentaplexer)/ up to 6 (Esaplexer) four-way splitter/combiner modules- used to manage multiple RF interface modules (up to 4 for each band).

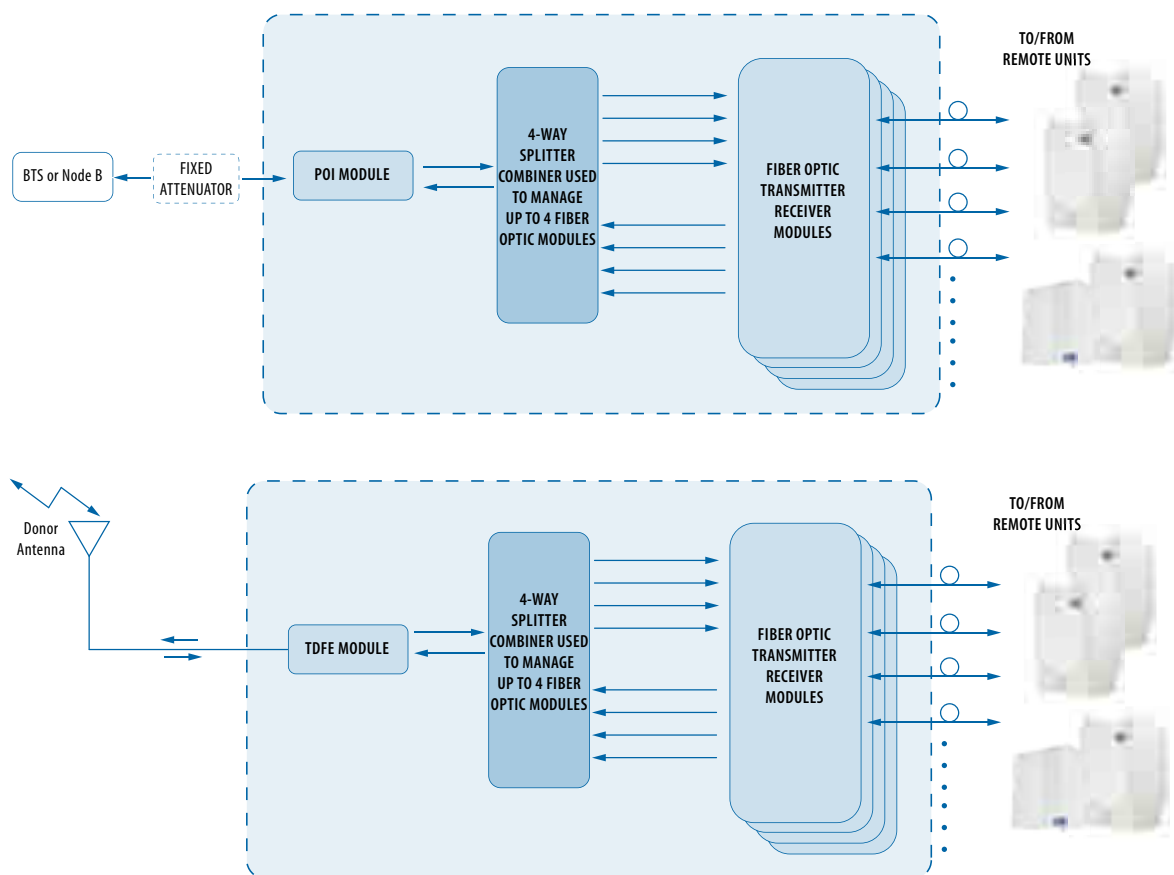
Connections change according to the application scenario: the following describes the connection mode for different modules applications.

Application A. 4-way splitter/combiner used to manage 1 RF Interface module and multiple Fiber Optic Transmitter/Receiver modules

The typical scenario for this module application is the **single operator / single band Optical System**.

The RF interface subrack is equipped with

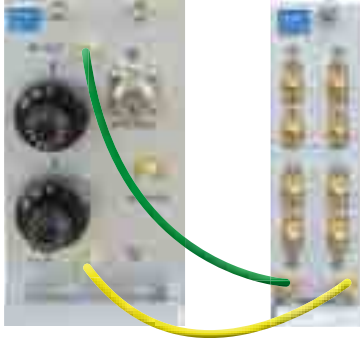
- either one POI (TAPOI) module or one TDFE module,
- the 4-way combiner / splitter to manage up to 4 Fiber Optic Transmitter/Receiver Modules (i.e. up to 16 Remote Units).



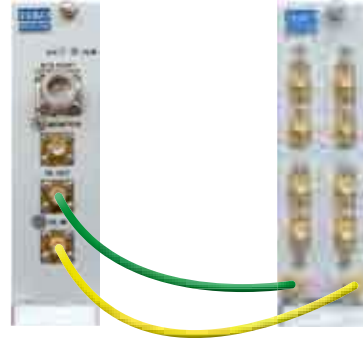
Examples - Block diagrams of single operator/single band Systems equipped with the 4-way combiner/splitter

Connections

- Connecting POI/TAPOI modules to the 4-way splitter/combiner



Connecting a POI module to the 4-way splitter/combiner

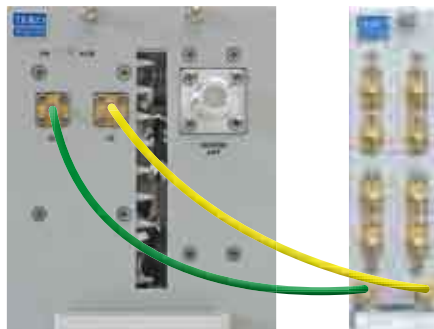


Connecting a TAPOI module to the 4-way splitter/combiner

Connect the POI (TAPOI) module DL OUT connector to the 4-way combiner/splitter DL COMMON input connector (green line).

Connect the 4-way combiner/splitter UL COMMON output connector to the POI (TAPOI) module UL IN connector (yellow line).

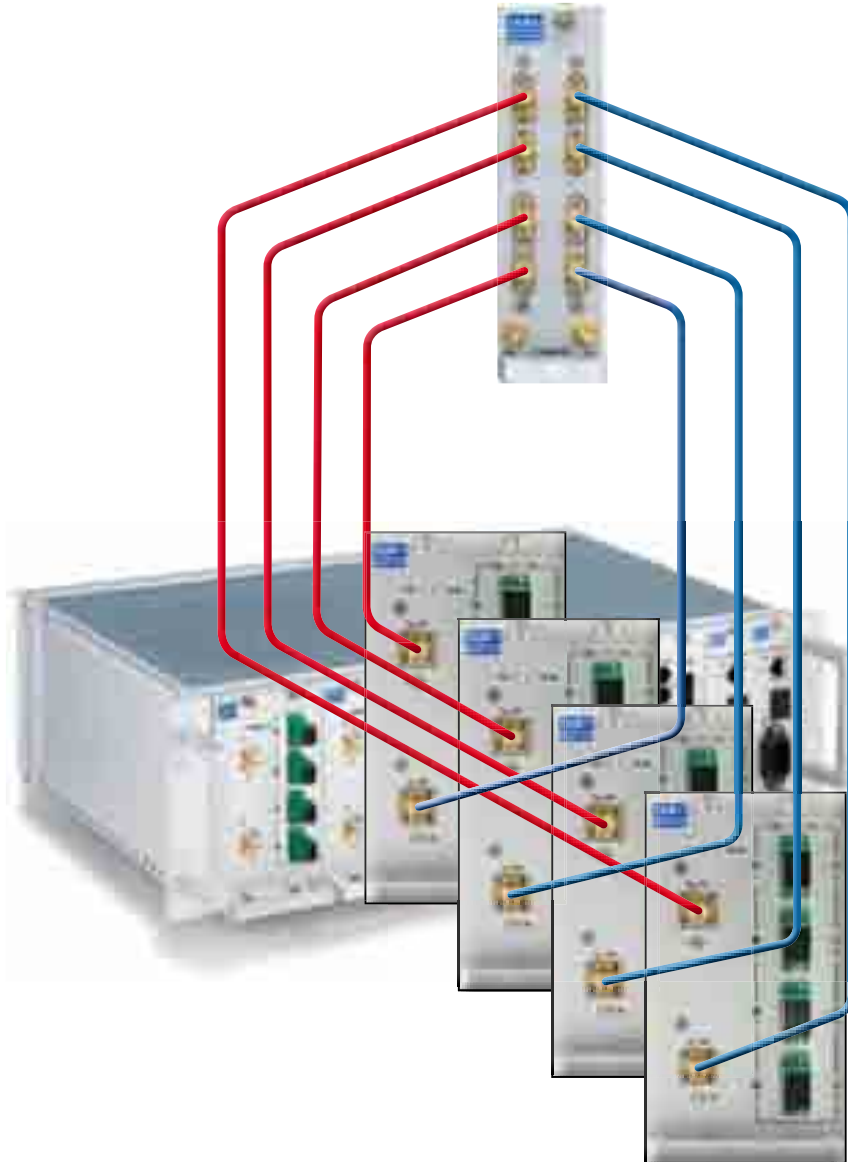
- Connecting TDFE modules to the 4-way splitter/combiner



Connect the DFE module DL connector to the 4-way combiner/splitter DL COMMON input connector (green line).

Connect the 4-way combiner/splitter UL COMMON output connector to the POI module UL connector (yellow line).

- Connecting the 4-way splitter/combiner to Fiber Optic Transmitter/Receiver modules:
Connect each Fiber Optic Transmitter/Receiver Module DL RF input connector to one of the 4-way combiner/splitter DL output connectors (red lines).
Connect each Fiber Optic Transmitter/Receiver Module UL RF output connector to one of the 4-way combiner/splitter UL input connectors (blue lines).

**Please Note**

Each 4-way splitter/combiner output/input connector not connected to fiber optic modules, must be charged with a 50Ω dummy load.

Application B. 4-way splitter/combiner used to manage multiple RF Interface modules operating in the same band

The typical scenario for this module application is the **multi operator / single band Optical System**: the RF Interface subracks can be equipped with

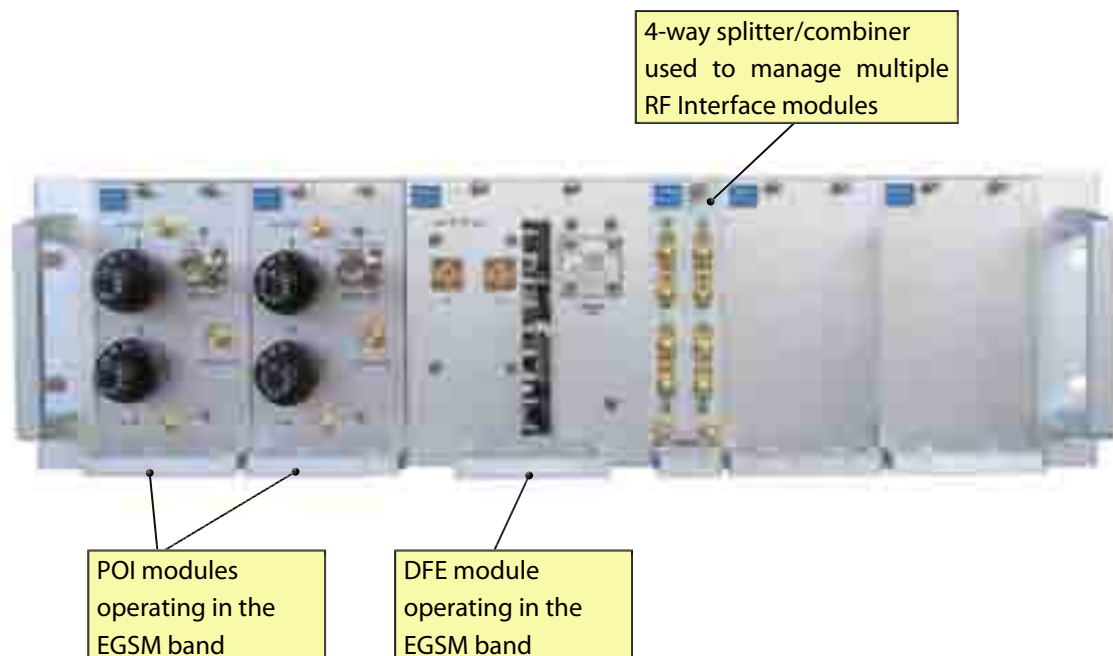
- up to 4 RF Interface modules operating in the same band: 1 POI module or 1 TDFE module for each operator to be extended
- the 4-way combiner / splitter used to manage the RF Interface modules and one optical subrack equipped with one Fiber Optic Transmitter/Receiver Module.

Another 4-way combiner/splitter module can be equipped to handle up to 4 Fiber Optic Transmitter/Receiver Modules (please refer to Application A).

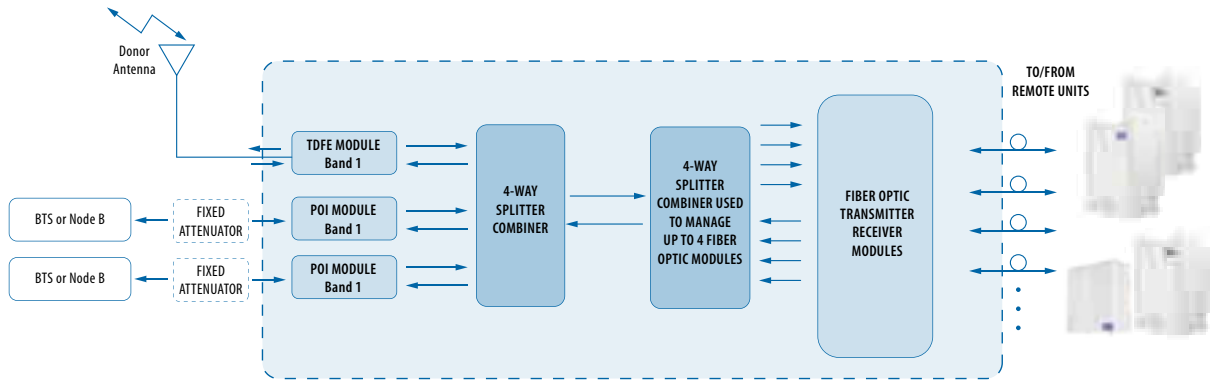
The 3-operator / EGSM RF interface equipped with 2 POI modules and 1 TDFE module is provided as example: it can be housed in 1 space-optimized 19"-3U subrack equipped with:

- the 4-way combiner/splitter module and
- 3 RF Interface modules operating in the same band (GSM or DCS or UMTS - AMPS or PCS or AWS).

The 4-way combiner/splitter module managing up to 4 Fiber Optic Transmitter/Receiver Modules can be housed in the same subrack.



Example: 3-operator / EGSM RF interface layout



Multi-operator / single band Optical System block diagram - Example

Connections

Connect each POI module DL OUT connector to one of the 4-way combiner/splitter DL input connectors (green lines).

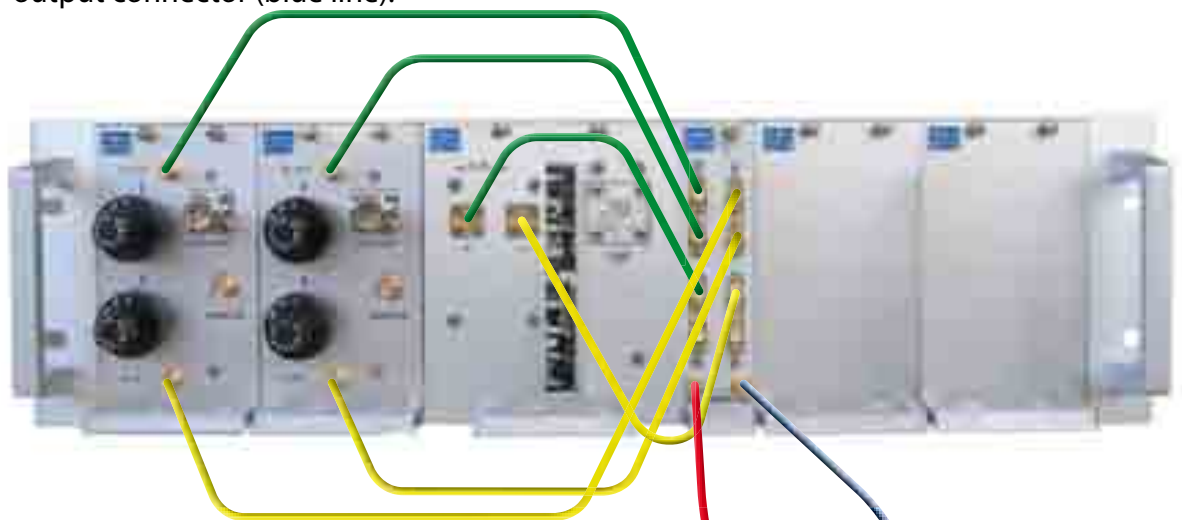
Connect each POI module UL-IN connector to one of the 4-way combiner/splitter UL output connectors (yellow lines).

Connect the DFE module DL connector to one of the 4-way combiner/splitter DL input connectors (green lines).

Connect the DFE module UL connector to one of the 4-way combiner/splitter UL output connectors (yellow lines).

Connect the 4-way combiner/splitter DL COMMON output connector to the optical subrack DL RF input connector (red line).

Connect the 4-way combiner/splitter UL COMMON input connector to the optical subrack UL RF output connector (blue line).



Optical Subrack

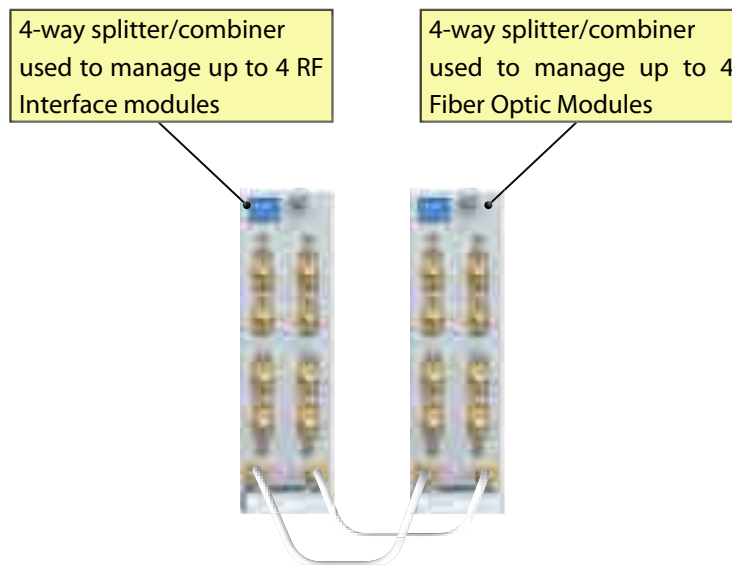
PLEASE NOTE

Each 4-way splitter/combiner output/input connector not connected to POI modules, must be charged with a 50Ω dummy load



Up to 4 Fiber Optic Transmitter/Receiver Modules (i.e. up to 16 Remote Units) can be managed if another 4-way combiner/splitter module is equipped.

- Connect the 4-way combiner/splitter modules UL COMMON connectors (white line).
- Connect the 4-way combiner/splitter modules DL COMMON connectors (light blue line).



Please refer to Application A for details about the cabling when the 4-way splitter/combiner is used to manage multiple Fiber Optic modules.