471587A.101
Nokia UltraSite EDGE BTS, Rel. CX6, Product Documentation, v.1

UltraSite EDGE BTS Product Description

Contents

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1 Summary of changes in UltraSite EDGE BTS Product Description

The following changes have taken place in the *UltraSite EDGE BTS Product Description* document:

Changes made between issues 5-0 and 4-0

The following content has been removed:

- All references to FC E1/T1 and Circuit Manager have been removed.
- Section *Technical description of extreme outdoor filter kit (OEFA)* has been removed.

The following sections have been added:

- *Technical description of Outdoor Side Kit (OSKA)*
- *Technical description of IDC_ Roof and Side Kit (IRSA)*

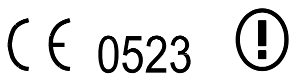
Further options (OSKA and IRSA) have been added to Table *Options* in Section *Assembly tree*.

Changes made in previous issues

- Information on Mini Outdoor cabinet optional heater kit (HETM) added

2 Statutory statements

2.1 CE Marking

Standard	Description
	Hereby, Nokia Corporation, declares that this Nokia UltraSite EDGE Base Station is in compliance with the essential requirements and other relevant provisions of Directive: 1999/5/EC. The product is marked with the CE marking and Notified Body number according to the Directive 1999/5/EC.

2.2 FCC Statement

Standard	Description
FCC Statement	This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment. The term “IC:” before the radio certification number only signifies that Industry Canada technical specifications were met.

3 Technical overview

3.1 General description

The UltraSite EDGE BTS supports both omni-directional and sectorised configurations for traditional voice and future data applications. The BTS can be used in GSM/EDGE 800, 900, 1800, or 1900 MHz systems. With the addition of EDGE, the BTS offers a maximum data rate of more than 300 kbit/s with multiple timeslots, as compared to more than 75 kbit/s with multiple timeslots for /GPRS. The BTS is available in different cabinets for indoor and outdoor applications, including:

- BTS ODCA/ODCF/IDCA - 12 TRX Capacity
- Triple Mode BTS ODCA/ODCF/IDCB - 6 TRX + WCDMA Upgrade
- BTS ODCC/IDCC - 6 TRX capacity
- BTS Mini Outdoor ODCM - 4 TRX capacity

There is no requirement to upgrade software when upgrading to the ODCA/ODCF. The ODCA/ODCF cabinet is compatible with the existing software. However, it is recommended to upgrade to the latest software.

3.2 Features

The indoor and outdoor cabinets are delivered completely assembled in one box, reducing installation time and packing waste.

3.2.1 Features for ODCA and ODCF

The components in the following kits are integrated into the ODCA and ODCF cabinets:

- Cabinet core 12 TRX (CRMA + TRSA)
- Outdoor application kit (OAKA)
- Internal antenna feeder kit (ATCA)
- Cable entry kit (OEKA)

The ODCA and ODCF cabinets provide the following features:

- Pre-installed cabinet kit (OAKA) components:
  - Integrated plinth design
  - Back wall
  - Side walls
  - Door
  - Door switch
  - Antenna extension box
  - Roof support
  - Roof
  - Dummy units and connector covers
- Pre-installed internal antenna feeder (ATCA) and cable entry block (rear facing) in the roof (OEKA)
- Easier to install antenna feeder connectors at antenna box (one big nut replaces four screws)
- EMC nets for transmission cable(s) is shorter and closer to the front of the cabinet
- -48 VDC filter with bolt-style terminals (replaces screw type)
- A filter kit is included in the ODCF cabinet

The ODCA and ODCF cabinets are fully compatible with all existing UltraSite units, except:

- Integrated Battery Backup is not supported.

Latest revision of the WCDMA core racking mechanics (WTCA) must be used.

3.2.2 Features for ODCC

The components in the following kits are integrated into the ODCC cabinet:

- Cabinet core 6 TRX (CRMC)
- Outdoor application kit (OAKC)
- Internal antenna feeder kit (ATCA)
- Cable entry kit (OEKA)

The ODCC cabinet provides the following features:

- Pre-installed cabinet kit (OAKC) components:
  - Integrated plinth design
  - Back wall
  - Side walls
  - Door
  - Door switch
  - Antenna extension box
  - Roof support
  - Roof
  - Dummy units and connector covers
- Pre-installed internal antenna feeder (ATCA) and cable entry block (rear facing) in the roof (OEKA)
- Easier to install antenna feeder connectors at antenna box (one big nut replaces four screws)
- EMC nets for transmission cable(s) were shortened and reduced from two to one
- -48 VDC filter with bolt-style terminals (replaces screw type)

The ODCC cabinet supports ODFA filter kit.

3.2.3 Features for IDCA

The IDCA cabinet is delivered pre-configured with six internal antenna cables.

The components in the following kits are integrated into the IDCA cabinet:

- Cabinet core 12 TRX
- Integrated application kit
- Internal antenna feeder kit (ATCA)

Integrated Battery Backup is not supported.

3.2.4 Features for IDCC

The components in the following kits are integrated into the IDCC cabinet:

- Cabinet core 6 TRX
- Integrated application kit
- Internal antenna feeder kit (ATCA)

3.2.5 Features for Mini Outdoor cabinet (ODCM)

The ODCM cabinet has the same components as the other outdoor cabinets. It has additional installation possibilities including pole/top of mast installation and wall installation.

ODCM cabinet consists of the following standard or optional components:

- Outdoor cabinet 4 TRX including Wall Mounting kit
- Pole Mounting kit
- Floor Mounting kit
- Heater unit (HETM) - optional

The 24V cable kit is integrated into the cabinet.

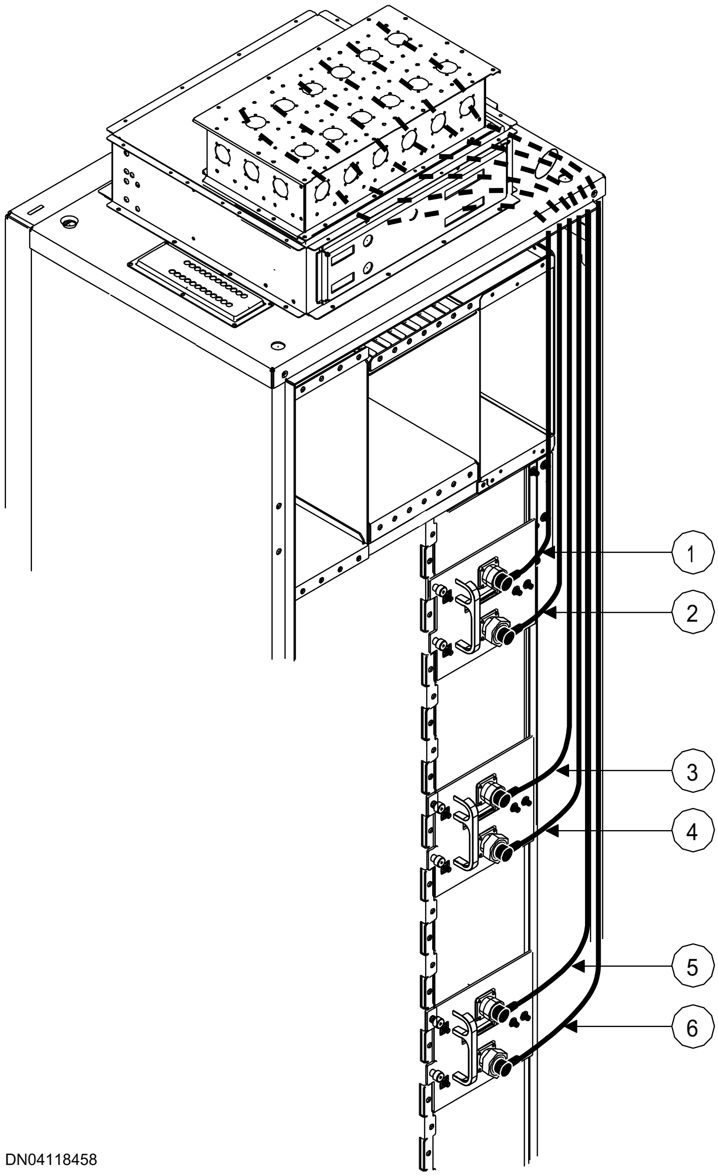
3.3 Construction and units

The BTS cabinet and units are easy to install and move. A uniform footprint allows the BTS, excluding the Mini Outdoor BTS, to be mounted using the same mounting holes as the Nokia Talk-family cabinet. The Mini Outdoor cabinet can be floor, wall or pole mounted.

Mechanics and internal cables

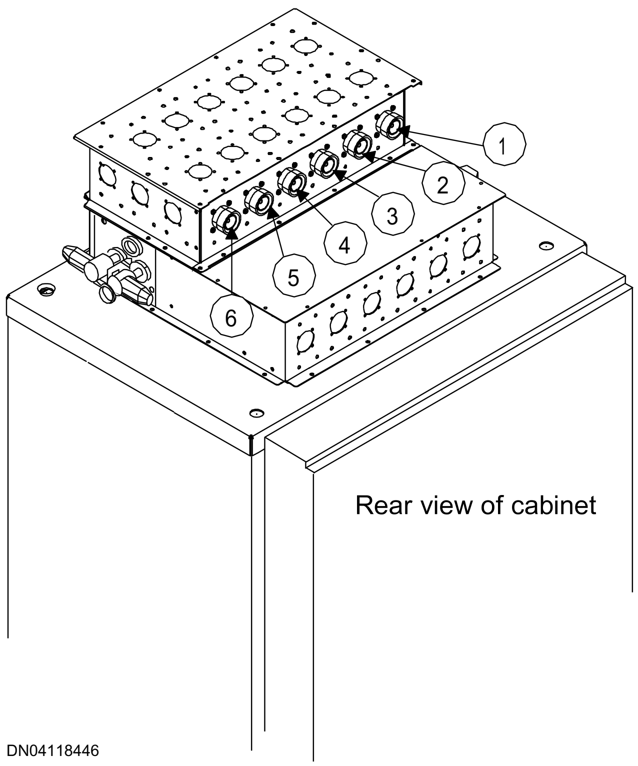
The IDCA and IDCC are designed specifically for indoor applications. The ODCA, ODCF, ODCC and ODCM are designed specifically for outdoor applications. The IDCA, ODCA and ODCF can accommodate 12 TRXs or six TRXs and the WCDMA upgrade kit. The cabinets come delivered with six internal antenna cables. The IDCC and ODCC can accommodate six TRXs and come delivered with six internal antenna cables. The ODCM can accommodate 4 TRXs and comes delivered with four internal antenna cables.

IDCA, IDCC, ODCA, ODCF, and ODCC cabinet types are preconfigured with a -48 VDC line filter. The ODCM cabinet is preconfigured with a combined AC and DC filter.



1	Main cable with one red stripe, 1.4m (4.6 ft)
2	DIV cable with two red stripes, 1.4m (4.6 ft)
3	Main cable with one green stripe, 1.7m (5.6 ft)
4	DIV cable with two green stripes, 1.7m (5.6 ft)
5	Main cable with one blue stripe, 2.0m (6.6 ft)
6	DIV cable with two blue stripes, 2.0m (6.6 ft)

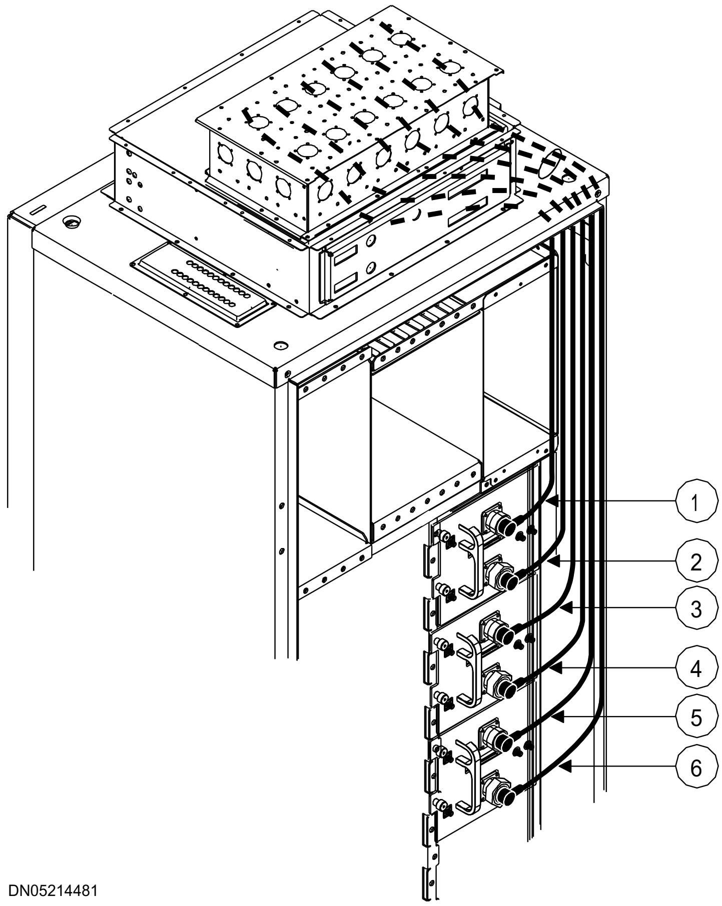
Figure 1. IDCA/ODCA/ODCF antenna cabling - front view



1	Connector for Main cable with one red stripe, 1.4m (4.6 ft)
2	Connector for DIV cable with two red stripes, 1.4m (4.6 ft)

3	Connector for Main cable with one green stripe, 1.7m (5.6 ft)
4	Connector for DIV cable with two green stripes, 1.7m (5.6 ft)
5	Connector for Main cable with one blue stripe, 2.0m (6.6 ft)
6	Connector for DIV cable with two blue stripes, 2.0m (6.6 ft)

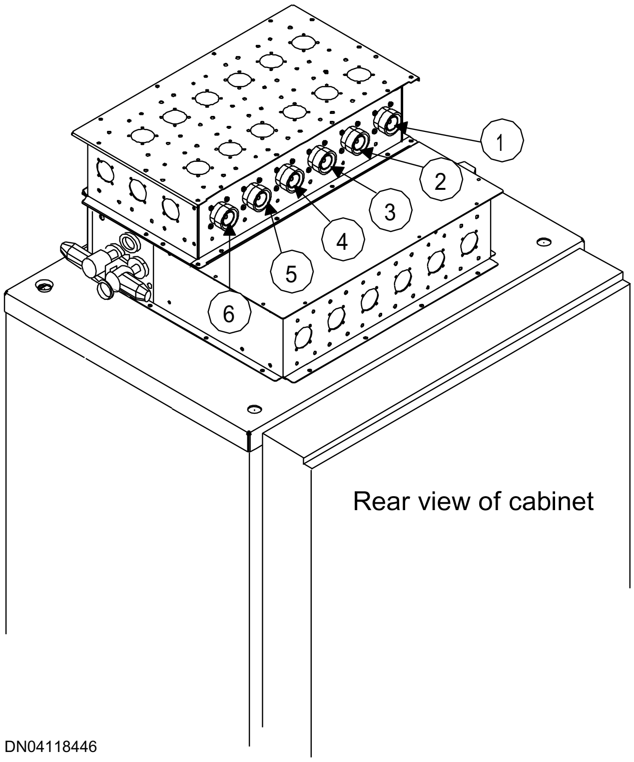
Figure 2. IDCA/ODCA/ODCF antenna cabling - rear view



1	Main cable with one red stripe, 1.4 m (4.6 ft)
2	DIV cable with two red stripes, 1.4 m (4.6 ft)

3	Main cable with one green stripe, 1.4 m (4.6 ft)
4	DIV cable with two green stripes, 1.4 m 4.6 ft)
5	Main cable with one blue stripe, 1.7 m (5.6 ft)
6	DIV cable with two blue stripes, 1.7 m (5.6 ft)

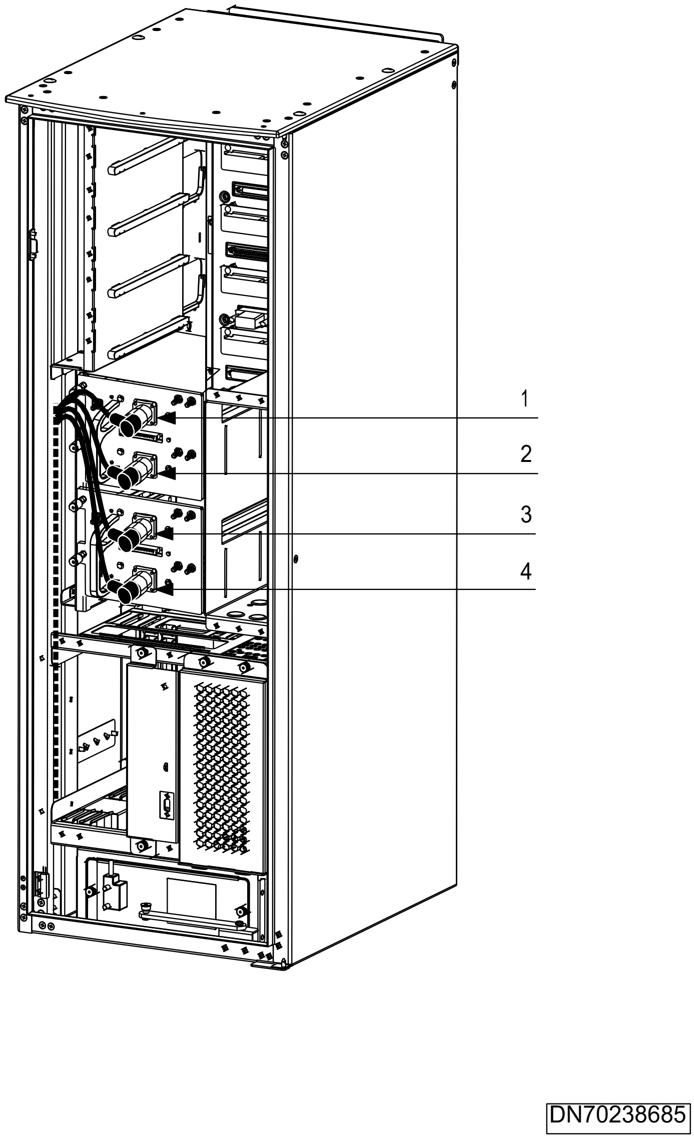
Figure 3. IDCC/ODCC antenna cabling - front view



1	Connector for Main cable with one red stripe, 1.4 m (4.6 ft)
2	Connector for DIV cable with two red stripes, 1.4 m (4.6 ft)
3	Connector for Main cable with one green stripe, 1.4 m (4.6 ft)
4	Connector for DIV cable with two green stripes, 1.4 m (4.6 ft)

5	Connector for Main cable with one blue stripe, 1.7 m (5.6 ft)
6	Connector for DIV cable with two blue stripes, 1.7 m (5.6 ft)

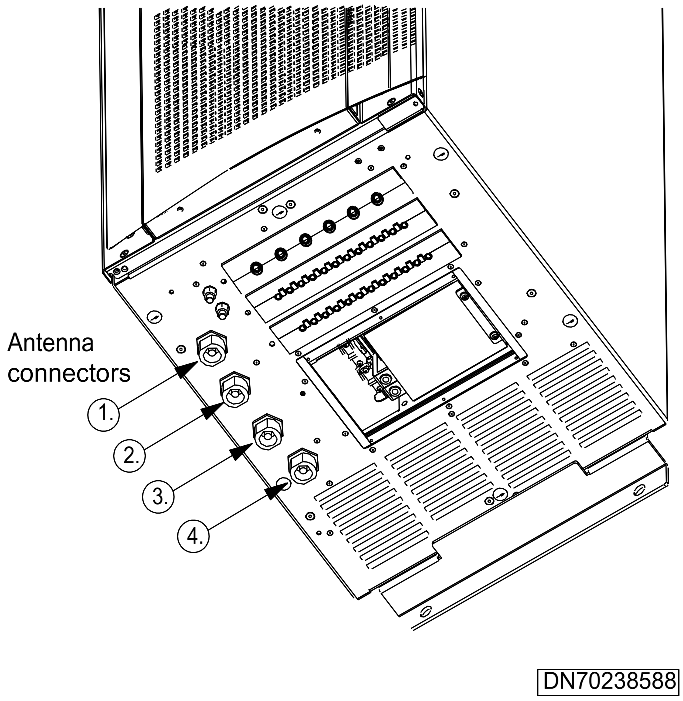
Figure 4. IDCC/ODCC antenna cabling - rear view



1	Main cable 1.0 m (3.28 ft)
2	Main cable 1.0 m (3.28 ft)

3	DIV cable 1.0 m (3.28 ft)
4	DIV cable 1.0 m (3.28 ft)

Figure 5. ODCM antenna cabling - front view



1	Connector for Main cable 1.0 m (3.28 ft)
2	Connector for Main cable 1.0 m (3.28 ft)
3	Connector for DIV cable 1.0 m (3.28 ft)
4	Connector for DIV cable 1.0 m (3.28 ft)

Figure 6. ODCM antenna cabling - rear view

3.4 Operation

The BTS performs the radio functions of the Base Station Subsystem (BSS).

The BTS receives and sends signals through:

- Air interface – frequencies that connect the BTS to the Mobile Station (MS)
- Abis interface – cable, optical fibre, or radio link that connects the BTS to the Base Station Controller (BSC), which is the central element of the BSS

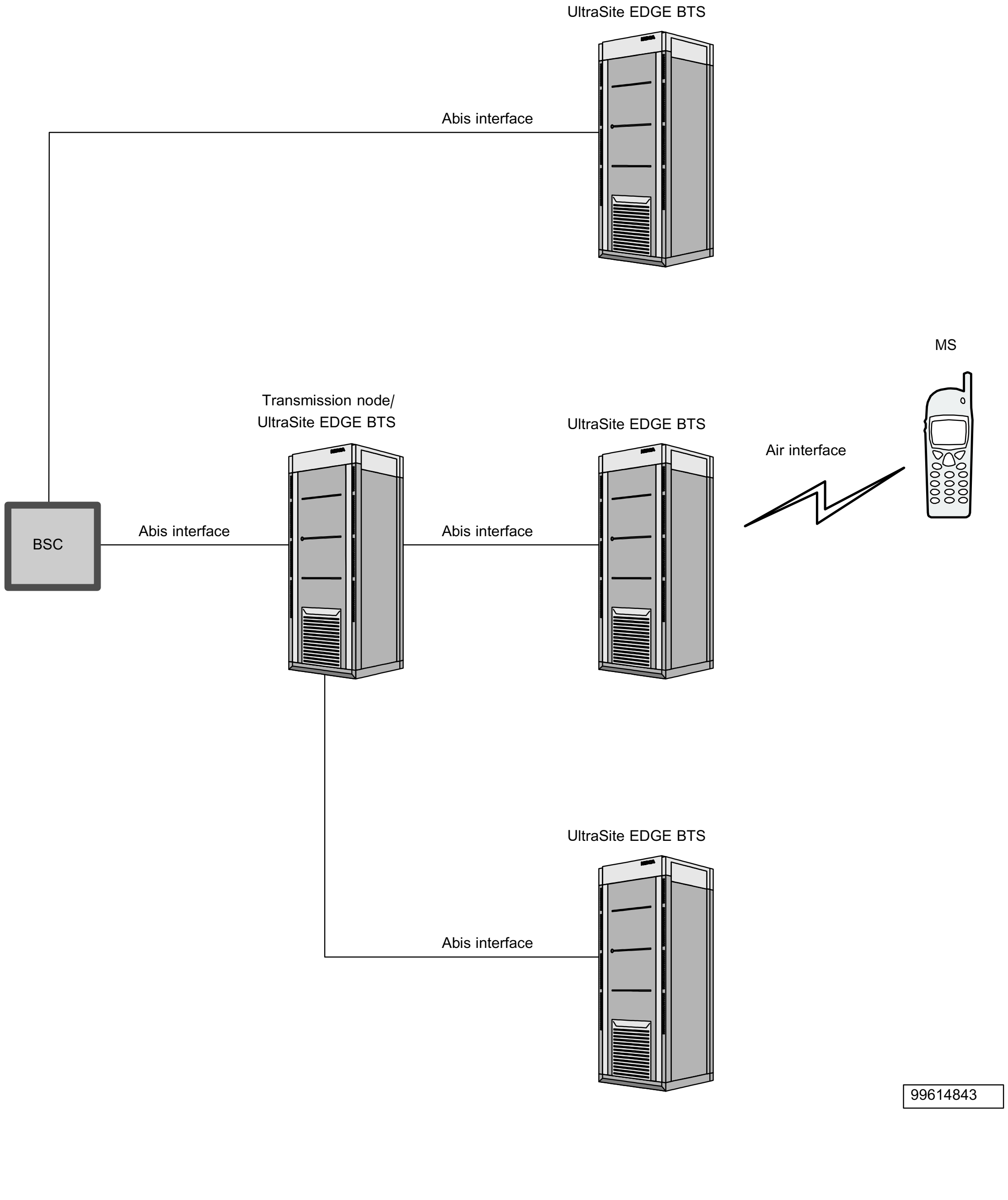


Figure 7. BTS interfaces

3.4.1 Uplink and downlink signalling

In the uplink path, the BTS receives signals from the MS. In the downlink path, the BTS sends signals to the MS. Uplink and downlink signals travel through the Air interface on different frequencies, with the higher frequency carrying downlink signals.

The uplink signal path involves the following actions:

- The antenna picks up a signal from the MS through the Air interface.
- The antenna passes the signal to the optional Masthead Amplifier (MNxx) and Bias Tee (BPxx) units or to the optional Dual Band Diplex Filter (DU2A) unit.
- The signal passes through either the Dual Variable Gain Duplex Filter (DVxx) or Remote Tune Combiner (RTxx) unit to the Receiver Multicoupler (M2xA or M6xA) and Transceiver RF (TSxx) units.
- The Transceiver module (TRX) on the TSxx unit converts the received signal to Intermediate Frequency (IF) levels and filters the signal.
- The TSxx unit then sends the signal to the Transceiver Baseband (BB2x) unit for digital signal processing.
- The BB2x unit sends the processed signal to the Transmission (VXxx) unit, which transmits the signal to the BSC utilizing standard transmission technologies.

The downlink signal path involves the following actions:

- The BSC receives a signal from the core network and sends the signal to the VXxx unit using standard transmission technologies.
- The VXxx passes the signal to the BB2x unit for digital signal processing.
- The BB2x unit sends the processed signal to the TSxx unit.
- The TRX module on the TSxx unit filters the signal, raises it to the carrier frequency, and amplifies it.
- The TSxx unit then sends the signal either to the RTxx unit or through the optional Wideband Combiner (WCxA) unit to the DVxx unit.
- The DVxx or RTxx unit sends the signal through either the optional DU2A unit or the BPxx and MNxx units to the antenna, which passes the signal through the Air interface to the MS.

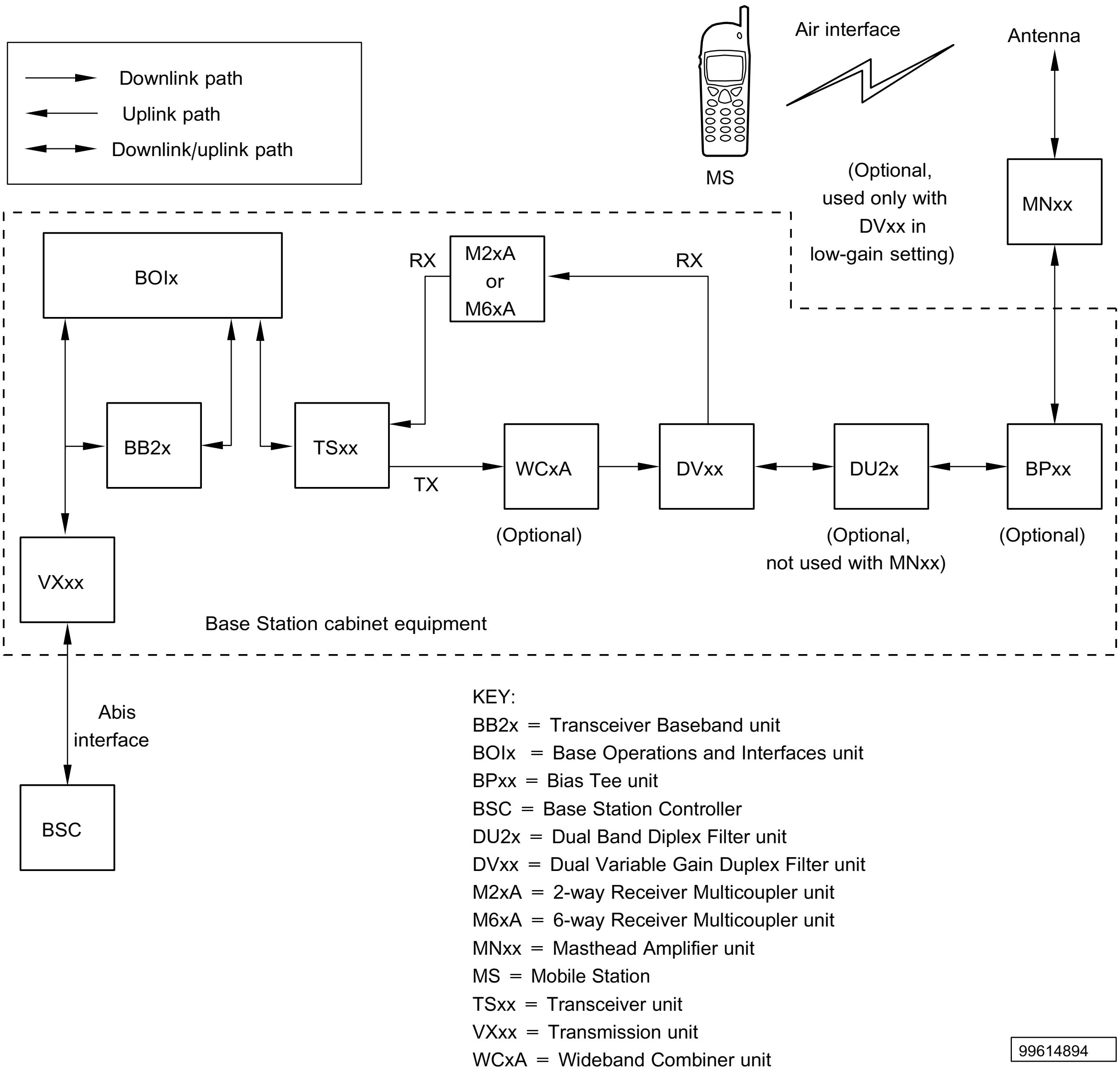


Figure 8. Uplink and downlink signal paths (using DVxx)

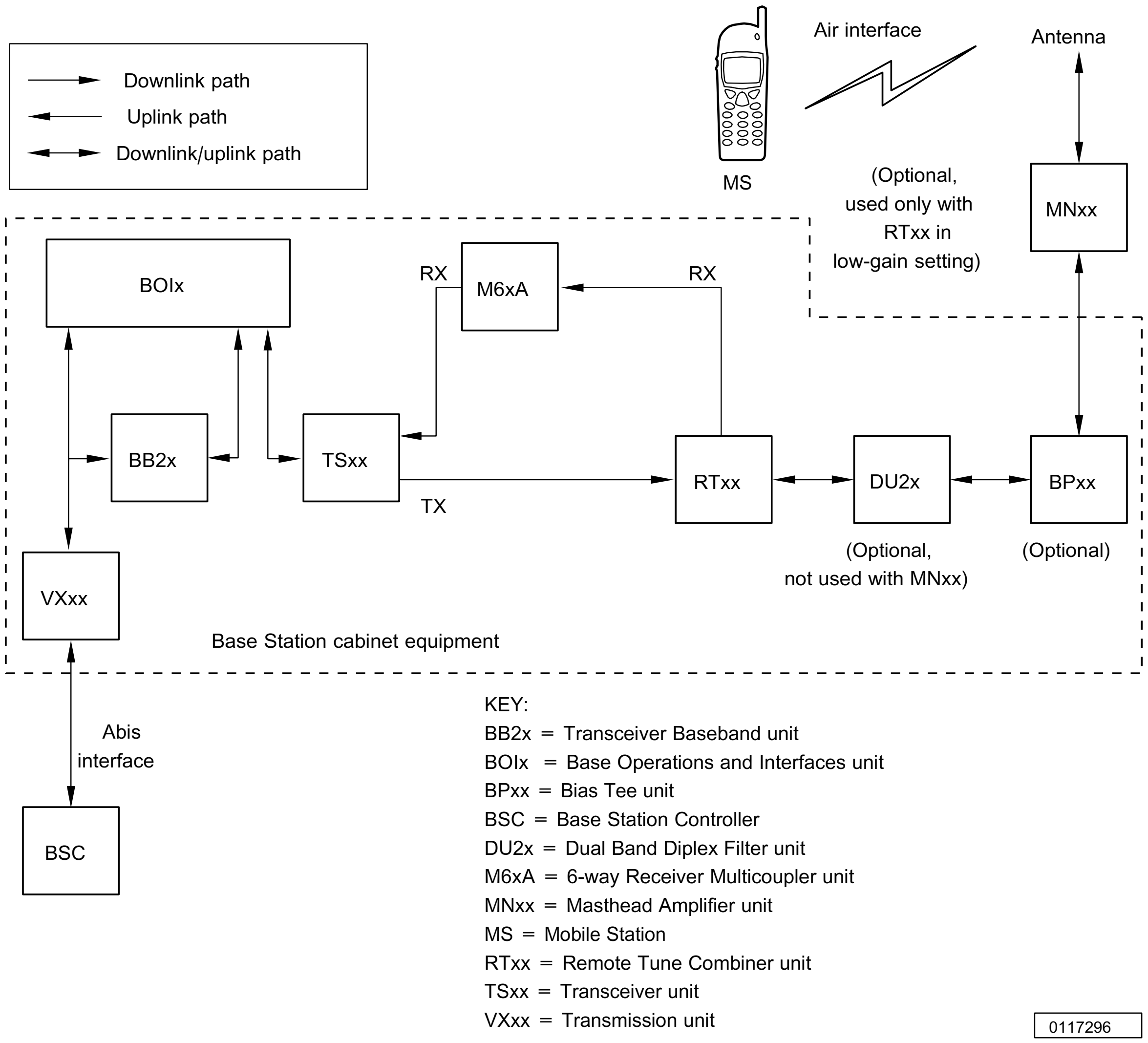


Figure 9. Uplink and downlink signal paths (using RTxx)

3.4.2 Internal BTS signalling

Buses on the BTS backplane and interconnected cables carry signals between the internal BTS units.

Table 1. BTS buses

Bus	Function
D1-bus	Data transfer and signalling between BOIx, BB2x, and VXxx units: • GSM - uses one D1-bus • EDGE - uses three D1-buses
D2-bus	Internal Operations and Maintenance (O&M) functions and communication between BOIx, BB2x, and RTxx units; software download
Local Management Bus (LMB)	Control of VXxx unit
Q1-bus	Polling and management of VXxx units and other equipment at site with Q1 management interface
I^2C-data buses	Polling, auto detection, temperature readings, and alarm collection – Power Supply (PWSx) unit, DVxx unit, and interface module
Uplink/downlink serial data bus[1]	Control, status, and traffic data between BB2x and TSxx units
F-bus[2]	Baseband frequency hopping

[1]Located between the BB2x and TSxx units (through the BOIx unit cross-connection).

[2]Located between BB2x units.

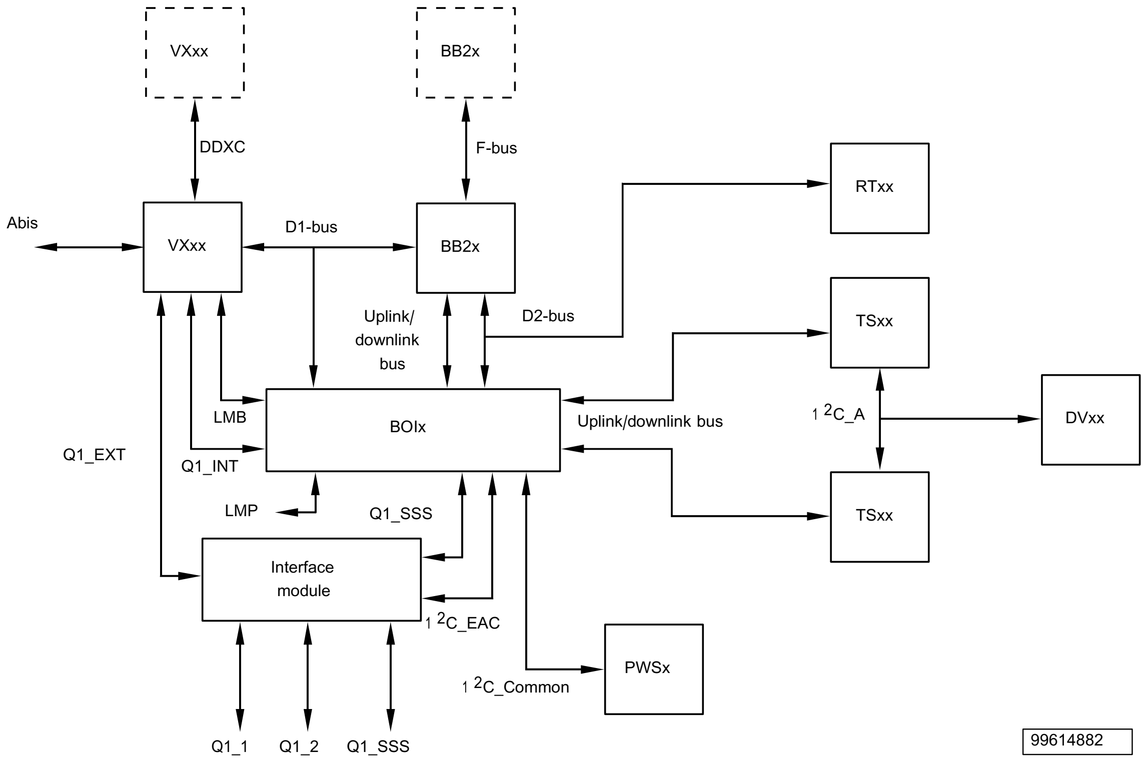


Figure 10. Internal bus architecture

3.5 Transmission

The BTS provides scalable, high-capacity access transmission for large-capacity networks and data services. The BTS supports 16, 32, and 64 kbit/s telecom signalling through the Abis interface. The O&M signalling speed can be 16, 32, or 64 kbit/s.

3.5.1 Transmission media

The BTS supports the following transmissions:

- radio-link
- wireline
- fibre-based

The signals are multiplexed and cross-connected to a level of 8 kbit/s in the BTS using the Plesiochronous Digital Hierarchy (PDH).

Radio-link transmission

The FXC RRI unit is the radio-link transmission unit for the BTS. The unit has two Flexbus interfaces for connecting:

- one or two microwave radio outdoor units
- two FXC RRI units in different BTS cabinets or transmission nodes
- one FXC RRI unit to another transmission device offering a FlexBus interface (such as FIU19)

The proprietary Nokia Flexbus is a coaxial cable that:

- carries power for the radio outdoor unit
- carries a maximum of 16 x 2 Mbit/s in both directions
- has a maximum cable length of 300 metres
- is compatible with Nokia FlexiHopper Microwave Radio and Nokia MetroHopper Radio

Wireline transmission

Cellular access networks are based mainly on the E1 (ETSI) and T1 (ANSI) standards. E1 capacity is 2 Mbit/s, and T1 capacity is 1.5 Mbit/s. The BTS supports these standards with the following wireline transmission units:

- FXC E1 – four 75 Ω coaxial for E1
- FXC E1/T1 – four 120 Ω twisted pair for E1 or 100 Ω twisted pair for T1

Any combination of up to four FXC E1, FXC E1/T1, or FXC RRI units can be used in one BTS cabinet.

Fibre-based transmission

FXC STM-1 and Bridge units are fibre-based transmission units, with optical interfaces. FXC STM-1 has two L-1.1 long-haul optical STM-1 interfaces. In addition, the FXC Bridge unit has a test interface. The FXC STM units do not have separate Q1 management interfaces, but instead, they are managed locally via the local management port (LMP) of Nokia BTS or MetroHub, or remotely through the Nokia Q1 bus.

The main features of the FXC STM-1 and FXC Bridge units provide support for:

- automatic laser shutdown (ALS).
- both SDH STM-1 TM and STM-1 ADM node types.
- fully non-blocking cross-connections on TU-12 level between both STM-1 aggregate interfaces and the add/drop traffic.
- SDH S12 SNC/I+ (Inherently monitored sub network connection protection), that is, protection on the VC-12 level.

  VC-12 is a virtual container inside VC-4 with a capacity of 2 Mbit/s.
- up to 20 x TU-12 (2M) drop capacity from SDH.
- grooming via PDH cross-connections for the add/drop traffic with the following granularity: 8k, 16k, 32k, 64k, Nx64k.
- interface statistics collection in compliance with ITU-T G.826.
- easy management of settings and transmission configuration (locally and remotely) with the Nokia Q1 management protocol. Management is carried out with a Nokia NetAct compatible node manager.
- remote and local software download.

3.5.2 Network configuration

For information about the BTS configurations, see *Overview of configurations*.

The BTS uses the following transmission units:

- FXC RRI
- FXC E1
- FXC E1/T1

- FXC STM-1
- FXC Bridge

FXC RRI unit

With two radio-link Flexbus connections per unit, the FXC RRI unit operates as a repeater and interconnects the BTS cabinets and the BSC using loop, chain, star, and point-to-point network configurations. Each FlexBus interface has a capacity of up to 16 x 2M, dependent on the capacity of the microwave link and if the FlexBus is used for direct interconnection to a different FlexBus interface.

FXC E1 or FXC E1/T1

With four wireline connections per unit (E1 has 2Mbit/s capacity, and T1 has 1.5 Mbit/s capacity), the FXC E1 or FXC E1/T1 unit operates as a branching point and interconnects the BTS cabinets and the BSC using the loop, chain, star, and point-to-point network configurations. With up to four FXC E1 or FXC E1/T1 units per cabinet, a single cabinet supports a maximum of 16 wireline connections.

FXC STM-1 and FXC Bridge transmission units

The FXC STM-1 and FXC Bridge transmission units allow cross connections between PDH (Plesiochronous Digital Hierarchy) and SDH (Synchronous Digital Hierarchy) transmission rates. The units work together to form a complete SDH STM-1 terminal multiplexer (TM) or add-drop multiplexer (ADM) node inside Nokia base stations or MetroHub transmission nodes. FXC STM-1 performs the main SDH functions, whereas the FXC Bridge forms a bridge for the signals between the SDH part and the PDH cross-connect part of the node. The two units are always used together.

Co-located Nokia Talk-family

A co-located Nokia Talk-family BTS can connect to the BTS using the integrated E1/T1 interface or Flexbus. During the upgrade phase, the Nokia Talk-family transmission interface to the BSC can provide the Abis capacity for the BTS. This configuration, however, limits the capacity and expandability of the BTS. Therefore, it is recommended that the Abis capacity for the Nokia Talk BTS is connected through the BTS transmission Hub.

3.5.3 Cross-connections

The BTS integrated transmission Hub does provide the cross-connect functionality and granularities necessary to create a transmission network that supports the specific needs of GSM/EDGE. The maximum DXC capacity of the BTS integrated transmission Hub is 56 x 2 Mbit/s. Various cross-connection granularities are supported down to a level of 8kbit/s. 16kbit/s cross connects can be used, for example, to cross-connect the BTS signalling links or BTS O&M channels when the bandwidth is 16kbit/s.

The BTS can handle the following cross-connection granularities:

- 8k (1 bit in a time slot)
- 16K (2 bits in a time slot)
- 32K (4 bits in a time slot)
- 64K (all 8 bits in a time slot)
- n x 64k
- 2M

  All 2Mbit/s interfaces are terminated, which means that TS0 is not cross connected but regenerated. Only the 2Mbit/s cross-connections that are made from FlexBus to FlexBus inside one FXC RRI are transparent.
- VC-12

3.5.4 Protection

The BTS-integrated transmission Hub supports protection functions against transmission problems, such as cable cuts, equipment faults, or fading radio links:

- Transmission network protection using loop topology
- Hot Stand By (HSB)
- Lazy transmitter changeover

Transmission network protection using loop topology

Nokia loop protection is an efficient way to protect traffic in a transmission network, such as a GSM BSS. In a live telecommunication network, it is important to secure, in addition to actual payload traffic, the network synchronisation and the centralised network management during any period of abnormal circumstances.

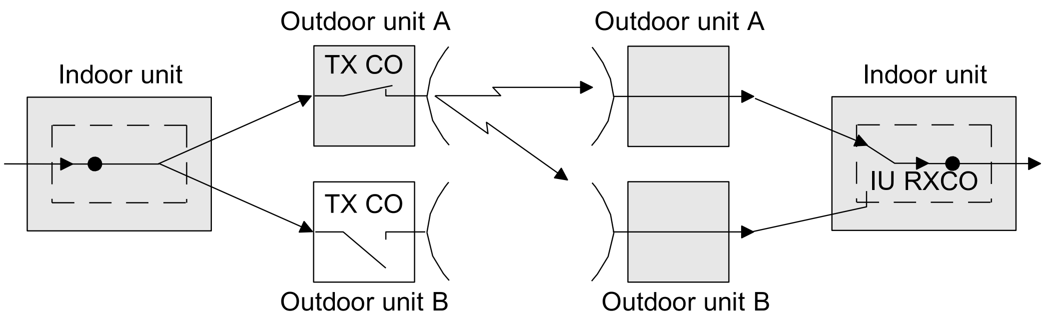
For these reasons, Nokia loop protection protects:

- Payload traffic
- Network synchronisation
- Network management connections

Hot Stand By (HSB)

HSB is a method of equipment redundancy in which two radio transmitters are kept ready (switched on), so that if one fails, the other one immediately picks up where the first one left off.

In single use, the signal is not protected against equipment or propagation faults. In the event of a fault, the connection remains broken until the equipment fault is repaired or the cause for the propagation fault vanishes. HSB provides protection against equipment faults.



IU RXCO	Indoor unit hitless changeover switch (In ASIC)
TX CO	Transmitter changeover switch (transmitter mute control)

Figure 11. Nokia FlexiHoppers with FXC RRI, 1IU/2OU HSB (only one direction shown)

Lazy transmitter changeover

Lazy transmitter changeover is a protection method against transmitter faults that cannot be detected by the equipment itself, for example, a faulty antenna. The FXC RRI unit sends periodic notifications to the far-end about the radio signal quality. Lazy transmitter changeover is performed, if there are errors in the transmitted data over a specified time interval that are caused by the near-end transmitter.

3.6 Cabinet dimensions and weights

Table 2. Cabinet dimensions and weights

Parameter	Outdoor	Midi Outdoor	Indoor	Midi Indoor	Mini Outdoor
Height	1940 mm (76.4 in.)	1320 mm (52.0 in.)	1800 mm (70.9 in.)	1180 mm (46.5 in.)	1130 mm (44.5 in.)
Depth	750 mm (29.5 in.)	750 mm (29.5 in.)	620 mm[1] (24.4 in.)	620 mm [1] (24.4 in.)	537 mm (21.1 in.)
Width	770 mm (30.0 in.)	770 mm (30.0 in.)	600 mm (23.6 in.)	600 mm (23.6 in.)	411 mm (16.2 in.)
Maximum cabinet weight (with units)	342 kg (755 lb)	233 kg (513.7 lb)	281 kg (629 lb)		110 kg (243 lb)
Maximum cabinet weight (without units)	152 kg (335 lb)	125.1 kg (275.7 lb)	95 kg (210 lb)	62.4 kg (137.5 lb)	38 kg (84 lb)

[1] Includes 52 mm (2.05 in.) behind the cabinet for the spacer part, which is required for cabinet cooling.

3.7 Assembly tree

UltraSite EDGE BTS is a subsystem in the UltraSite System concept, which includes the following:

- Base Station Terminal (BTS)
- Site Support System
- Radio Relay System

- Masthead Amplifier (MHA) Kit
- Antenna System

The BTS performs the radio functions of the Base Station Subsystem (BSS). The BTS receives and sends signals through the following interfaces:

- Air interface – frequencies that connect the BTS to the Mobile Station (MS)
- Abis interface – cable or radio link that connects the BTS to the Base Station Controller (BSC), which is the central element of the BSS

With the BSC, Nokia NetAct manages the entire GSM/EDGE network, including the BTS.

BTS components

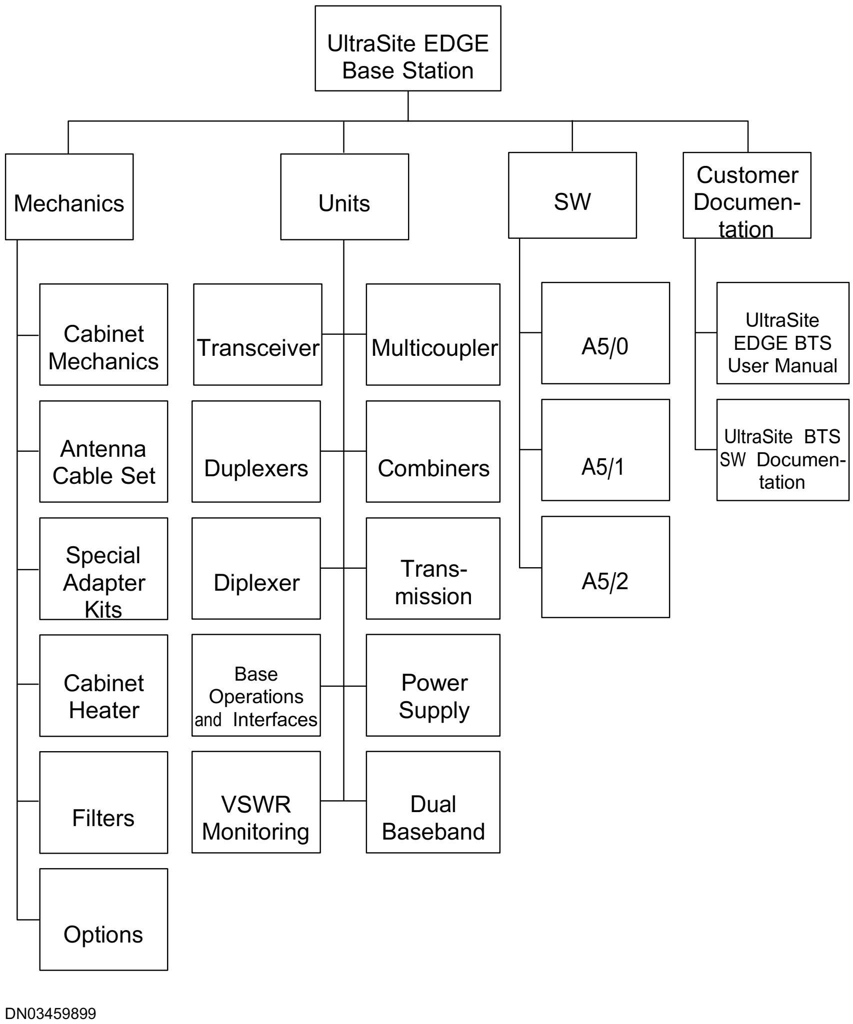


Figure 12. BTS product tree

3.7.1 Mechanics

The BTS is available in the following cabinets for outdoor and indoor applications:

- BTS Indoor - 12 TRX
- BTS Outdoor - 12 TRX

- BTS Midi Indoor - 6 TRX
- BTS Midi Outdoor - 6 TRX
- BTS Mini Outdoor - 4 TRX

Table 3. Mechanics

Category	Property
Mechanics	Cabinet Mechanics
Mechanics	Panel Kits
Mechanics	Special Adapter Kits
Mechanics	Cabinet Heater
Mechanics	Filters
Mechanics	Options

Cabinet mechanics

Table 4. Cabinet mechanics

ID	Category	Property
469725A IDCA	Mechanics	12 TRX indoor cabinet
470263A IDCC	Mechanics	6 TRX indoor cabinet
469873A ODCA	Mechanics	12 TRX outdoor cabinet
470264A ODCC	Mechanics	6 TRX outdoor cabinet
471010A ODCF	Mechanics	12 TRX outdoor cabinet (with airfilter)
471421A ODCM	Mechanics	4 TRX outdoor cabinet

Table 5. TRSA Mechanics 6 TRX

ID	Category	Property
469324A	Mechanics	Transceiver Rack Set Note that this unit is available only via HWS.
063912A	Mechanics	RFU Backplane Module
066971A	Mechanics	Unit Cooling Fan Module

Table 6. Cabinet mechanics IDCA

ID	Category	Property
082595A	Mechanics	EMC Mesh Sub Module
082594A	Mechanics	Common Rack Sub Module
082593A	Mechanics	Power Rack Sub Module
082598A	Mechanics	DTRU Rack Sub Module
082677A	Mechanics	DTRU Cover Sub Module
081910A	Mechanics	DTRU Backplane Module
082609A	Mechanics	Door Sub Module
063912A	Mechanics	RFU Backplane
082126A	Mechanics	Common Backplane
064276A	Mechanics	Interface Module
065551A	Mechanics	Bias-T Interface
081684A	Mechanics	Voltage Distribution Bus Bar
081936A	Mechanics	DC Filter
066971	Mechanics	Unit Cooling Fan

Table 7. Cabinet mechanics IDCC

ID	Category	Property
082595A	Mechanics	EMC Mesh Sub Module
082594A	Mechanics	Common Rack Sub Module
082593A	Mechanics	Power Rack Sub Module
082598A	Mechanics	DTRU Rack Sub Module
082677A	Mechanics	DTRU Cover Sub Module
081910A	Mechanics	DTRU Backplane Module
063912A	Mechanics	RFU Backplane
082126A	Mechanics	Common Backplane
064276A	Mechanics	Interface Module
065551A	Mechanics	Bias-T Interface
081684A	Mechanics	Voltage Distribution Bus Bar
081936A	Mechanics	DC Filter
066971	Mechanics	Unit Cooling Fan
083635A	Mechanics	IDCC Door Sub Module

Table 8. Cabinet mechanics ODCA

ID	Category	Property
066971A	Mechanics	Unit Cooling Fan
082126A	Mechanics	Common Backplane
063912A	Mechanics	RFU Backplane
064276A	Mechanics	Interface Module
065551A	Mechanics	Bias Tee Interface
081936A	Mechanics	DC Filter Module
081910A	Mechanics	DTRU Backplane Module
081684A	Mechanics	Voltage Distribution Bus
083219A	Mechanics	Roof
081673A	Mechanics	Door
083707A	Mechanics	Door Frame
082714A	Mechanics	Common Rack Sub Assembly

Table 8. Cabinet mechanics ODCA (cont.)

ID	Category	Property
082593A	Mechanics	Power Rack Sub Assembly
082717A	Mechanics	DTRU Rack Sub Assembly
082595A	Mechanics	EMC Mesh Sub Assembly
083237A	Mechanics	EMC Cover Sub Assembly
468091A	Mechanics	OEKA Entry Kit
073216A	Mechanics	BB2 Dummy Module
073217A	Mechanics	DTRU Dummy Module
083218A	Mechanics	CAFB Fan

Table 9. Cabinet mechanics ODCC

ID	Category	Property
066971A	Mechanics	Unit Cooling Fan
082126A	Mechanics	Common Backplane
063912A	Mechanics	RFU Backplane
064276A	Mechanics	Interface Module
065551A	Mechanics	Bias Tee Interface
081936A	Mechanics	DC Filter Module
081910A	Mechanics	DTRU Backplane Module
081684A	Mechanics	Voltage Distribution Bus
083219A	Mechanics	Roof
073947A	Mechanics	Midi Assembly Door
083758A	Mechanics	ODCC Door Frame Sub Module
082714A	Mechanics	Common Rack Sub Assembly
082593A	Mechanics	Power Rack Sub Assembly
082717A	Mechanics	DTRU Rack Sub Assembly
082595A	Mechanics	EMC Mesh Sub Assembly
083237A	Mechanics	EMC Cover Sub Assembly
468091A	Mechanics	OEKA Entry Kit
073216A	Mechanics	BB2 Dummy Module

Table 9. Cabinet mechanics ODCC (cont.)

ID	Category	Property
073217A	Mechanics	DTRU Dummy Module
083218A	Mechanics	CAFB Fan

Table 10. Cabinet mechanics ODCM

ID	Category	Property
081910A	Mechanics	DTRU Backplane module
082126A	Mechanics	Common backplane module
066971A	Mechanics	Unit cooling fan module
064276A	Mechanics	Interface module
063912A	Mechanics	RFU backplane module

Special adapter kits

Table 11. Special adapter kits

ID	Category	Property
082779A	Mechanics	WCDMA Adapter Kit for IDCA/ODCA
469107A	Mechanics	Abis Cable Set UABA 11
469112A	Mechanics	Ultra/Ultra Synch Cable Set UUIA 11 (Only via HWS)
468789A	Mechanics	Ultra/Ultra Co-Site Cable Set UUAA 11
469111A	Mechanics	Ultra/Ultra Synch Cable Set UUHA 11
469112A	Mechanics	Ultra/Ultra Synch Cable Set UUIA 11
469050A	Mechanics	Ultra/Ultra Synch Cable Set UUJA 11

Table 11. Special adapter kits (cont.)

ID	Category	Property
469400A	Mechanics	Bias-T Adapter Cable Set

Cabinet heater

Table 12. Cabinet heater

ID	Category	Property
467937A	Mechanics	Cabinet Heater HETA
471422A	Mechanics	Mini Outdoor cabinet heater (HETM)

Filters

Table 13. Filters

ID	Category	Property
470225A	Mechanics	AC Filter ACFE (with terminal cover)
469166A	Mechanics	Filter Unit 24/27 VDC DCFB
469442A	Mechanics	Installation Kit (used w/DCFB) FIKA

Options

Table 14. Options

ID	Category	Property
468094A	Mechanics	Bridge Kit OBKA
468091A	Mechanics	Entry Kit OEKA

Table 14. Options (cont.)

ID	Category	Property
470138A	Mechanics	Air Filter Kit ODFA
469554A	Mechanics	Lifting Handle Kit WLHA
469881A	Mechanics	Cosite Kit OCTU
471451A	Mechanics	Mini cabinet pole mounting kit ODPM
471452A	Mechanics	Mini cabinet floor mounting kit ODFM
471669A	Mechanics	Outdoor Side Kit OSKA
471670A	Mechanics	IDC_ Roof and Side Kit IRSA
468092A	Mechanics	OFKA Air Filter Kit
469372A	Mechanics	OBKB Midi to Talk Bridge
466289A	Mechanics	LEKA Lift Eyes kit
471616A	Mechanics	Plinth Covers for UltraSite GSM EDGE (Only via HWS)

Note

Each ODCA cabinet is shipped standard with one OEKA included. Additional entry kits may be ordered, if needed.

3.7.2 Units

Table 15. Units

Category	Property
Units	Transceiver
Units	Multicoupler
Units	Duplexers

Table 15. Units (cont.)

Category	Property
Units	Diplexer
Units	Combiners
Units	Dual Baseband
Units	Transmission
Units	Base Operations and Interfaces
Units	Power Supply
Units	Bias-T
Units	VSWR Monitor

Transceiver

Table 16. Transceiver

ID	Category	Property
469087A	Units	EDGE 800 TSTB
468704A	Units	EDGE 900 TSGB
469089A	Units	EDGE 1800 TSDB
468706A	Units	EDGE 1900 TSPB
467800A	Units	GSM 900 TSGA
467828A	Units	GSM 1800 TSDA

Multicoupler

Table 17. Multicoupler

ID	Category	Property
468530A	Units	GSM800/900 2-Way Multicoupler M2LA
468532A	Units	GSM1800/1900 2-Way Multicoupler M2HA
468531A	Units	GSM800/900 6-Way Multicoupler M6LA

Table 17. Multicoupler (cont.)

ID	Category	Property
468533A	Units	GSM1800/1900 6-Way Multicoupler M6HA

Duplexer

All Duplex Filters can be used for both GSM and EDGE products.

Table 18. Duplexer

ID	Category	Property
468133A	Units	EDGE800 DVTB Full Band
469644A	Units	EDGE800 DVTD Co-Site Full Band
468216A	Units	GSM900 DVGA Full Band
468217A	Units	GSM900 DVHA H Band
468218A	Units	GSM900 DVJA J Band
468220A	Units	GSM1800 DVDB B Band
468219A	Units	GSM1800 DVDA A Band
468619A	Units	GSM1800 DVDC Full Band
468221A	Units	GSM1900 DVPA Full Band

Diplexer

Table 19. Diplexer

ID	Category	Property
467812A	Units	Dual Band Diplex DU2A

Combiner

Table 20. Remote tuned combiners

ID	Category	Property
467861A	Units	GSM900 RTHA H-Band
467862A	Units	GSM900 RTJA J-Band
467857A	Units	GSM900 RTGA Full Band
467859A	Units	GSM1800 RTDB B-Band
467858A	Units	GSM1800 RTDA A-Band
468721A	Units	GSM1800 RTDC Full Band
467860A	Units	GSM1900 RTPA Full Band

Table 21. Wideband combiner unit

ID	Category	Property
467835A	Units	GSM1900 WCPA
467833A	Units	GSM800/900 WCGA
467834A	Units	GSM1800 WCDA

Dual baseband

Table 22. Dual baseband

ID	Category	Property
467869A	Units	Dual Baseband Unit BB2A

Table 22. Dual baseband (cont.)

ID	Category	Property
468131A	Units	Dual Baseband Unit BB2E
469643A	Units	Dual Baseband Unit BB2F

Transmission

Table 23. Transmission

ID	Category	Property
467611A T36130.51	Units	DTRU FXC E1/T1 VXTB
467612A T36120.51	Units	DTRU FXC E1 VXTA
T36140.01	Units	FXC STM-1 VXOA
T36145.01	Units	FXC Bridge VXOB
467610A T55830.51	Units	DTRU FXC RRI VXRB

Base operations and interface

Table 24. Base operations and interface

ID	Category	Property
467868A	Units	BOIA Unit

Power supply

Table 25. Power supply

ID	Category	Property
467865A	Units	PWSA AC

Table 25. Power supply (cont.)

ID	Category	Property
467866A	Units	PWSB DC
468664A	Units	PWSC 24/27 VDC
469441A	Units	PWKA Installation Kit (used w/ PWSC)

VSWR monitor

Table 26. VSWR monitor

ID	Category	Property
468163A	Units	GSM 850/900 W/ VSWR BPGV
468164A	Units	GSM 1800/1900 W/ VSWR BPDV

3.7.3 Internal feeder kit

Table 27. Internal feeder kit

ID	Category	Property
468686A	Internal Feeder Kit	Antenna Cable Set ATCA

3.7.4 Software

Table 28. Software

ID	Category	Property
469057A	Software	A5/0 ciphering algorithm

Table 28. Software (cont.)

ID	Category	Property
469365A	Software	A5/1 ciphering algorithm (Americas only)
	Software	A5/2 ciphering algorithm (Americas only)

3.7.5 Customer documentation

Table 29. Customer documentation

ID	Category	Property
468514A	Customer Documentation	UltraSite EDGE BTS Product Documentation
	Customer Documentation	Ultrasite BTS SW Documentation

4 Network configurations

4.1 Overview of configurations

The choice of network configuration depends mainly on the requirements for transmission media and availability. The loop network configuration is the most reliable, providing excellent protection against equipment failures and radio-link fading.

The BTS directly supports all network configurations—loop, chain, star, point-to-point, and mesh. Separate transmission nodes are unnecessary, because the BTS cabinet can hold up to four integrated transmission units.

Each BTS cabinet uses the FXC transmission units to add or drop capacity to other sites. The integrated transmission can groom traffic and serve as a PDHloop master. Cross-connections to 8 k granularity and grooming at the BTS further optimise transmission capacity.

4.2 Overview of configurations for Nokia BTS Transmission Hub

ITN is the abbreviation for Integrated Transmission Node. It is a synonym for the use of FXC transmission units within Nokia BTSs and MetroHub, as the same FXC units are used within these products to build a transmission node. With ITN units deployed in a BTS hub, chain and tail sites can be supported without additional cabling and a site support cabinet, which would be necessary if an external third party transmission node were used. MetroHub is well integrated into a consistent transmission network solution for radio access networks, as it uses the same ITN units. Further, it is also possible to chain MetroHub to a Nokia BTS for providing a cost-efficient branching solution for micro-BTS sites.

Taking a few capacity limitations into account, flexible node configurations can be created with ITN that serve the diverse needs of the operator within radio access networks:

- There can be only one FXC Bridge and FXC STM-1 unit per cabinet.
- FXC Bridge and FXC STM-1 units are always used together.
- The FXC RRI unit has a maximum add/drop capacity towards the cross-connection bus of 16 x 2M, when the unit is used as the node master unit (left most slot position) or as a slave unit.
  - When FXC RRI is being used as the master unit within a BTS transmission Hub, the add/drop capacity is 13 x 2M.
  - When FXC RRI is being used as the master unit within a MetroHub, which is chained to a BTS, the add/drop capacity is 15 x 2M.
- The FXC STM-1/FXC Bridge units provide an add/drop capacity towards the cross-connection bus of 20 x 2M.

4.3 Technical description of PDH transmission network protection using loop topology

4.3.1 Introduction

Loop protection is considered the most efficient way to protect traffic in a transmission network such as a base station subsystem (BSS). In a live telecommunications network it is important to secure, in addition to the actual payload traffic, the network synchronisation and the centralised network management during any period of abnormal circumstances.

For these reasons, loop protection protects:

- payload traffic
- network synchronisation
- network management connections.

A transmission loop formed with Nokia Siemens Networks (NSN) elements consists of a loop master and one or more loop slaves. Usually the loop master is a transmission node, whereas the loop slaves can be either transmission nodes, BTSs or a combination of both inside one loop.

The loop principle is that the transmitted signal is always sent in both directions, but the received signal is selected from one direction only. The loop master sends pilot bits on the basis of which the switching decision is made. Each individually protected slave station needs one pilot bit.

Network synchronisation must also be ensured in a loop network and it follows the loop principle in a similar way. The synchronisation switching takes place independently from the pilot bits by having Master Clock Bit (MCB) and Loop Control Bit (LCB).

Based on the configured priorities, each network element decides individually from which direction the signal and the synchronisation will be received, and, thus, it does not require any external or additional supervision for its decision.

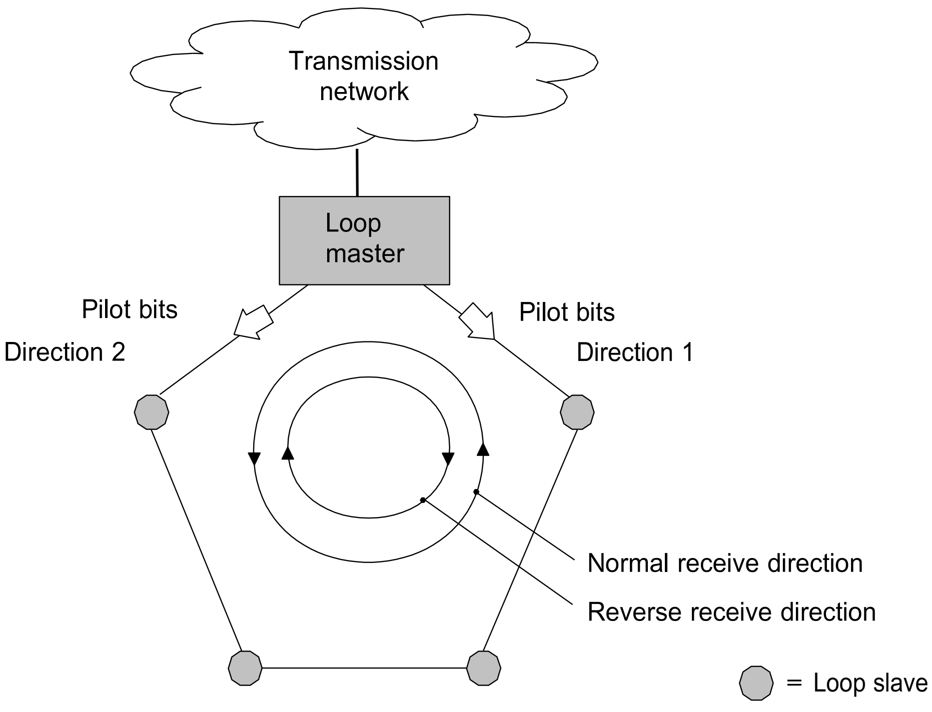


Figure 13. Loop principle

NSN's way of implementing loop protection is ultimately secure, providing very fast route switching that recovers the transmission connections instantly. Loop protection is embedded and thus very fast. Loop protection protects against failures, such as cable-cuts, equipment failures, heavy rain and multipath fading, and against obstacles in the line-of-sight, such as cranes and growing trees.

Compared to an unprotected wireless network, loop protection increases site availability at least tenfold and prevents end-of-chain availability degradation.

Loop protection is an easily activated system feature where MetroHub and UltraSite EDGE BTS can act as the master node. In addition, several MetroHub nodes and base stations can be looped together.

The protection functionality is compatible with the existing BSS transmission.

For more information refer to the *PDH Loop Protection in GSM Networks* document that can be obtained upon request.

4.3.2 Protecting payload traffic

A pilot bit is a special kind of bit with a preset value (zero), and it is sent among the protected traffic in a known position. For example, protecting a 2 Mbit/s link requires one bit out of the 2 Mbit/s stream to be reserved for this purpose. Similarly, if the traffic is protected at a partial 2 Mbit/s level, for example, because two different base stations share one 2 Mbit/s line, one pilot bit is required for each slave station.

The location of the pilot bit is defined in the network plan, and it is often within one of the last time slots of the 2 Mbit/s frame. In principle, the location can be selected freely, but a harmonised practise in the network may be advisable for easy site commissioning and network documentation.

The state of a pilot bit is set to 0 (zero) at the sending station, which sends identical digital streams (payload and the pilot bit protecting it) in directions 1 and 2 in the loop.

Any failure in the connection between the sending station and the intended destination causes the pilot bit to change from zero to one (based on AIS). Thus the target station, receiving a 'one' instead of a 'zero' knows that the connection is faulty.

The following figure shows the loop principle between the loop master and one slave. The traffic in the other slave stations is bypassed.

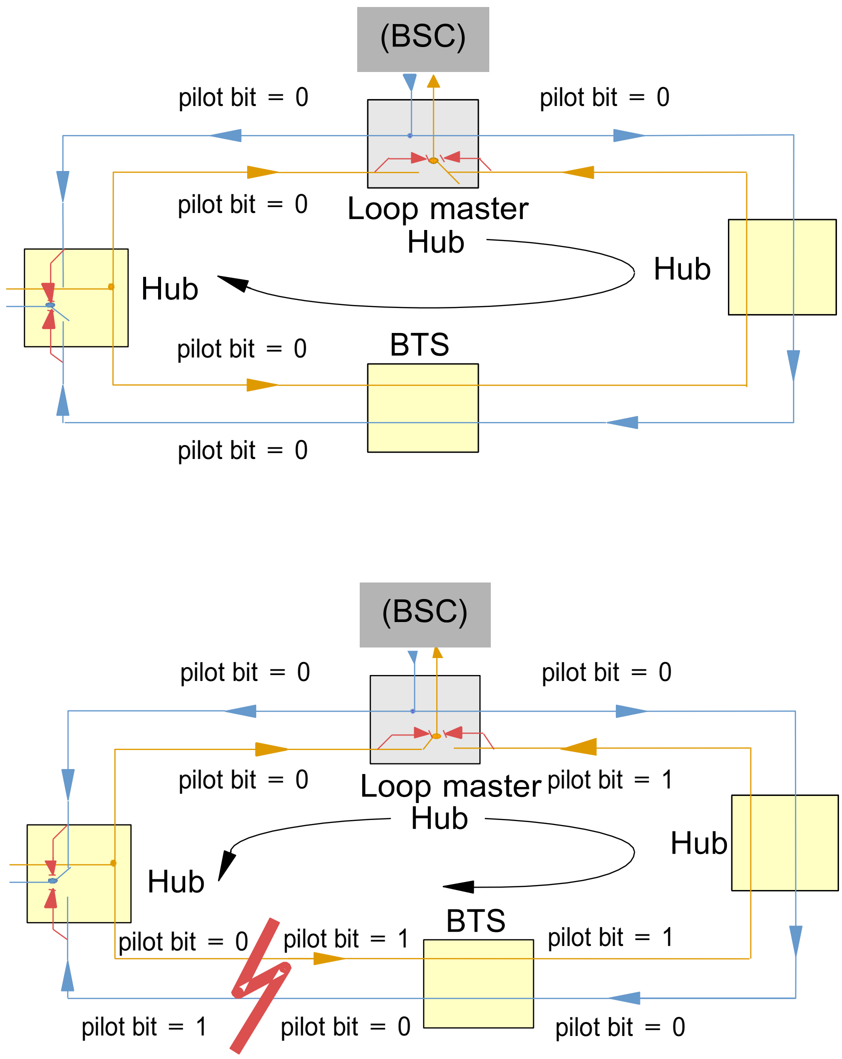


Figure 14. Traffic protection guided by pilot bit monitoring

The pilot bit is sent at the loop master MetroHub site for all the slave stations as zero with 'Uni-directional fixed data' or 'Bi-directional masked' types of cross-connections. You can reduce the amount of connections from two uni-directional to one bi-directional if you use the bi-directional masked type of cross-connection.

Masking pilot bits

The principle of masking in the loop network is to use the logical 'AND' operation with '0', when the result is always '0', and masking with '1' when the output is the same as the input signal (either unchanged '0' or '1').

In the example in the following figure, the pilot bits are sent from the loop master node to eight slave nodes in the loop. The view is from a cross-connection termination point setting.

Note that all bits are masked as '0' because they are all used in the master node.

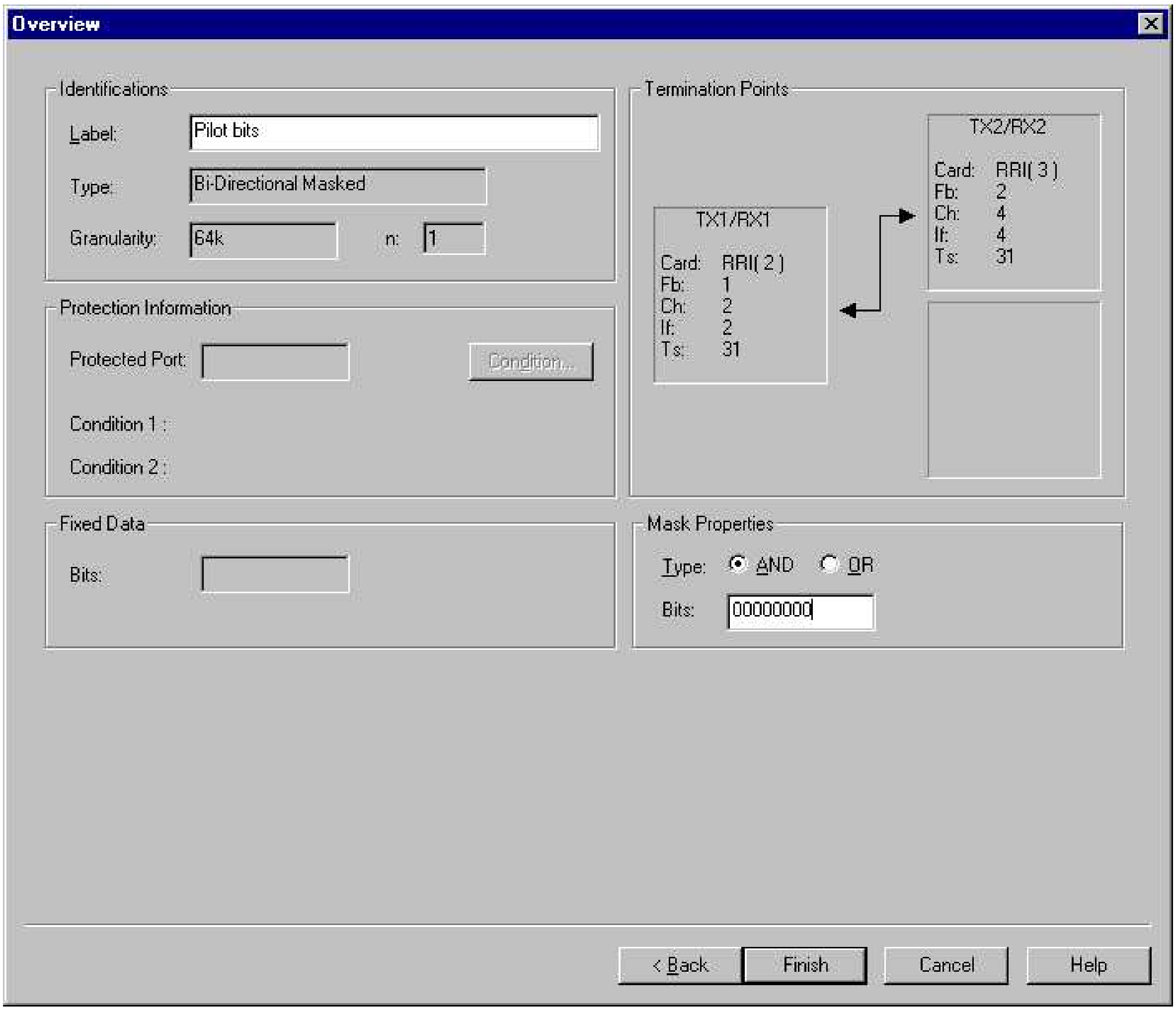


Figure 15. Pilot bit sent from a loop master

At loop slave sites, each node must forward the pilot bits from other slave stations unchanged and send its own pilot bit as zero in both loop directions. This is done with the bi-directional masked type of cross-connections. The following figure presents the pilot bit masking of the second slave node (bit 2) and other pilot bits forwarding in the loop. The view is from a cross-connection termination point setting.

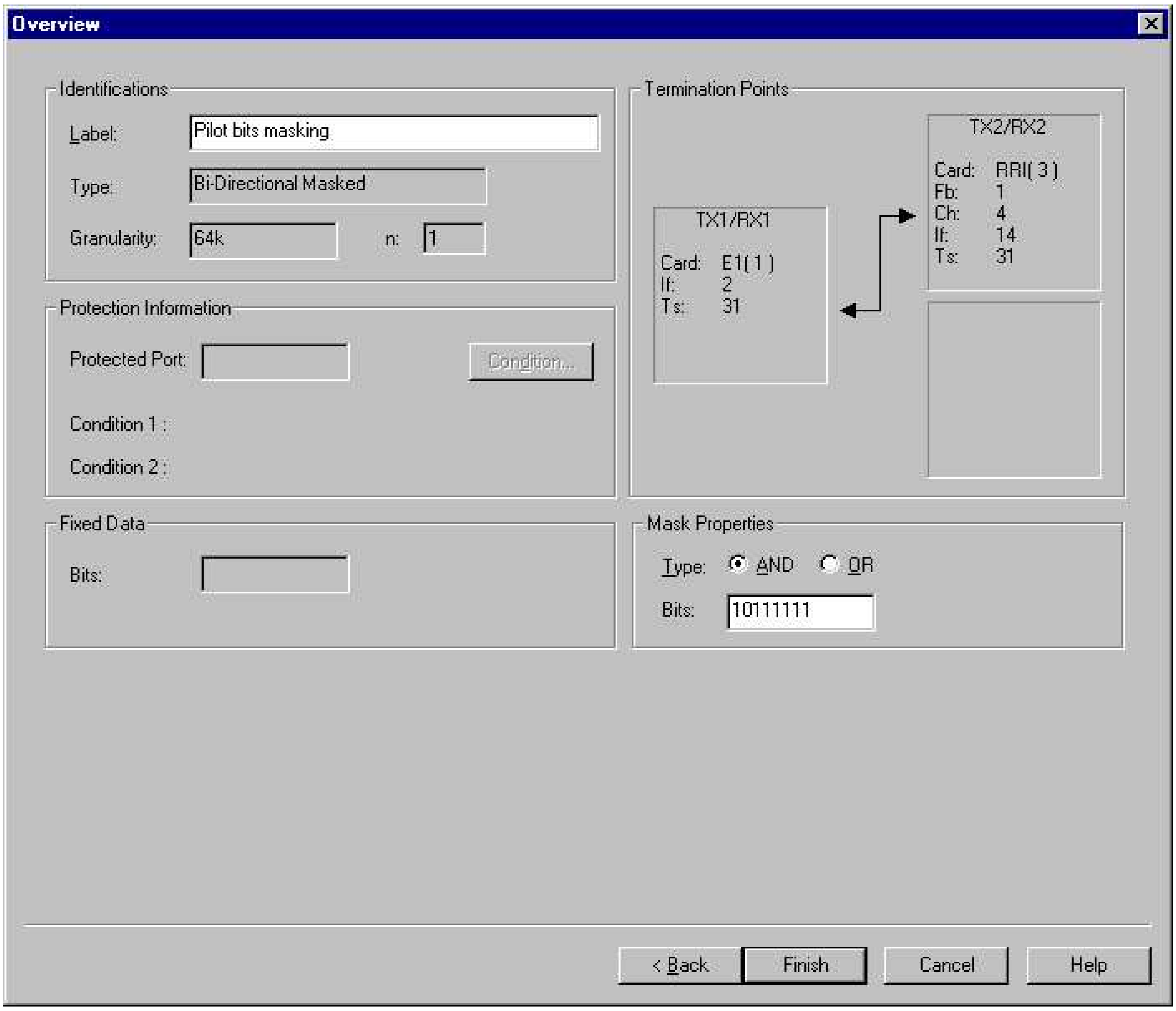


Figure 16. Pilot bit masking in the second loop slave

Loop protection can be configured either as equal switching or priority switching. The difference between these is that in priority switching the connection returns to the initial route as soon as the problem on that link is solved, whereas with the equal switching the system stays on the selected link until it gets faulty. Equal switching provides better stability for the connection, and it is therefore the recommended choice for BSS networks.

4.3.3 Protecting network synchronisation

The implementation mechanism for an automatic detection and recovery of missing or looped network synchronisation is based on loop network clock control bits carried within the protected 2 Mbit/s stream:

- one bit for detecting if the incoming signal is synchronised to the original network synchronisation master or not (master clock bit, MCB), and
- one bit for detecting any breaks or for avoiding loopbacks in the synchronisation chain (loop control bit, LCB).

The loop master sets the MCB and LCB to '0' (zero) state in both directions. Any station using a certain received signal for synchronisation sends the LCB back as '1' (see the following figure), so that the counterpart knows that the synchronisation of the incoming stream is inherited in such a way that it must not be used for synchronisation, to avoid a loopback or otherwise faulty synchronisation. The same applies to all slaves to make sure the synchronisation remains intact.

Similarly, faulty transmission replaces MCB and LCB with '1' so that the affected stations know they are not receiving a valid source signal from that direction.

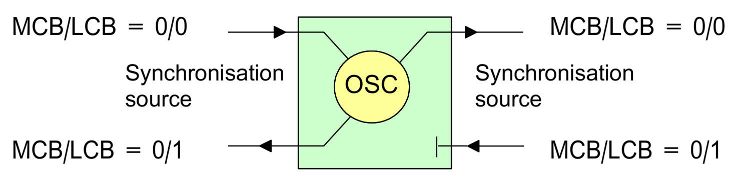


Figure 17. Manipulating synchronisation loop control bit

Based on the following information, the transmission node recognises if it is defined as the master or slave:

- if the interfaces containing the MCB and LCB bits are missing from the synchronisation list, the transmission node is a master
- if the interfaces containing the MCB and LCB bits are in the synchronisation list, the transmission node is used as a slave

The following figure presents the setting of MCB/LCB bits in two directions in different FXC RRI units.

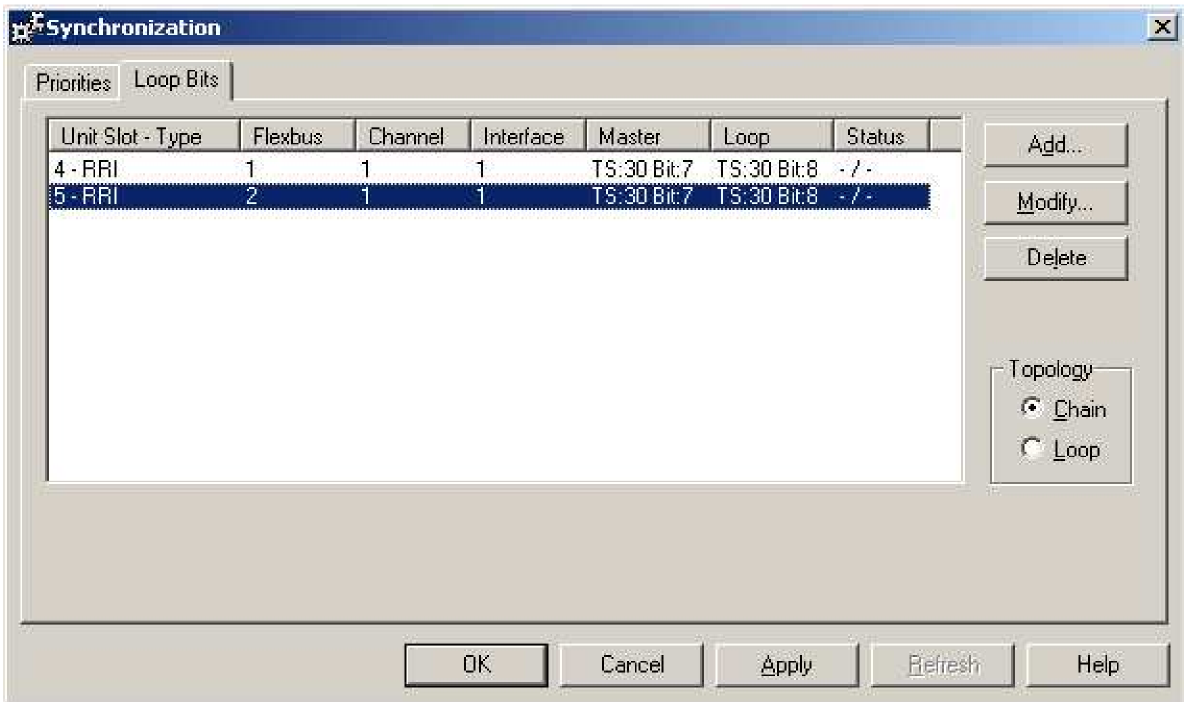


Figure 18. Setting of loop control bits

Note that node synchronisation is always based on priority. The synchronisation always returns to a higher priority route whenever the problem in that link is solved. This does not cause any problems in the traffic, as the synchronisation is coming from the same loop master.

The location of the MCB and LCB is defined in the network plan. In principle, the location can be selected freely, but a harmonised practise in the network is advisable for easy site commissioning and network documentation.

4.3.4 Protecting remote network management channel

This section is only applicable to a BTS integrated transmission node when managed by a dedicated Q1 channel. In most occasions the O&M channel of the BTS is also used to transfer management data for the transmission node, in which case the payload loop protection concept can be applied.

The Q1 network management channel used to manage PDH transmission elements is a bus, and therefore it must not be looped.

Q1 loop protection is based on switching into a faultless direction when there is a break somewhere in transmission. The direction is changed according to an LCB bit.

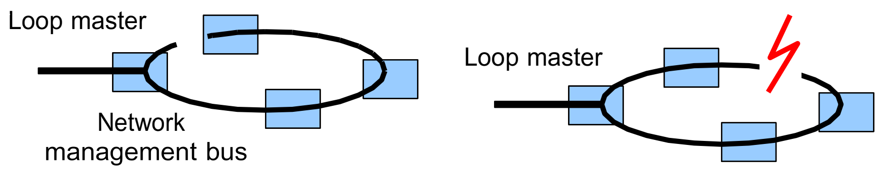


Figure 19. Network management bus circulation prevention

To avoid permanent circulation of Q1 commands and simultaneous polling from two directions, the Q1 loop must be terminated at the master node. This is the recommended way to implement Q1 network management bus protection with PDH loop protection. This termination is used when the loop master is a MetroHub node, UltraSite BTS node, or DN2.

To terminate the loop at the master node:

- LCB (from the last slave node) = 0 → no faults in the network → forced termination towards the last slave node (see above figure).
- LCB (from the last slave node) = 1 → fault in the network → forced termination removed

The loop master is configured so that it sends the network management channel in just one direction. When a fault occurs in that direction (the loop master detects it from the received LCB), it knows to allow the network management channel to propagate in both directions. The Q1 EOC hybrid switch must be set to the OFF state towards the Secondary Port direction in the loop master. In this case, no additional settings to the normal Q1 EOC channel are needed in the slave nodes.

In some cases, where the loop master is an older BTS integrated transmission unit (TRUx or BIUMD), Q1 protection must be done in the first loop slave on the secondary port side of the loop master. In this case, both the Q1 primary port and the secondary port must be defined for the loop slave. MetroHub, UltraSite EDGE BTS, and MetroSite EDGE BTS support Q1 slave protection.

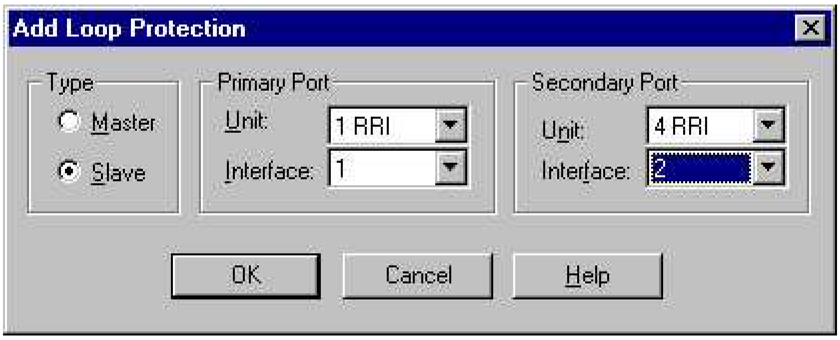


Figure 20. Setting of Q1 protection in the slave (in case of slave protection)

Note

Both the EOC and the MCB/LCB in the secondary port side must be defined in the same 2M interface for the Q1 loop protection to work.

4.3.5 Hints for using a loop network

- Use different FXC units for the protected and protecting ports of a connection to gain the maximum protection in the hardware reliability sense.
- A maximum of 16 synchronisation and network management channel protection loops can be used within a single node.
- When 16 x 2 Mbit/s capacity loops are built, each of the three loop directions require a separate FXC RRI unit.

For a MetroHub situated in a BTS site or UltraSiteHub, it is recommended to use the Q1 BTS as the polling device and not to protect the network management channel explicitly, but to protect the OMUSIG channel of the BTS implicitly.

Depending on the used loop architecture, the number of possible payload protection loops can be higher than 16 within a single node. The above-mentioned limitation of 16 loops is only for synchronisation and network management loops. The pre-condition is, however, that several loop slave nodes share the same synchronisation and/or network management loop or several payload protection loops are terminated in a single node.

For more information and examples, see the *PDH Loop Protection in GSM Networks* document that can be obtained on request.

4.4 Example network configuration: Loop

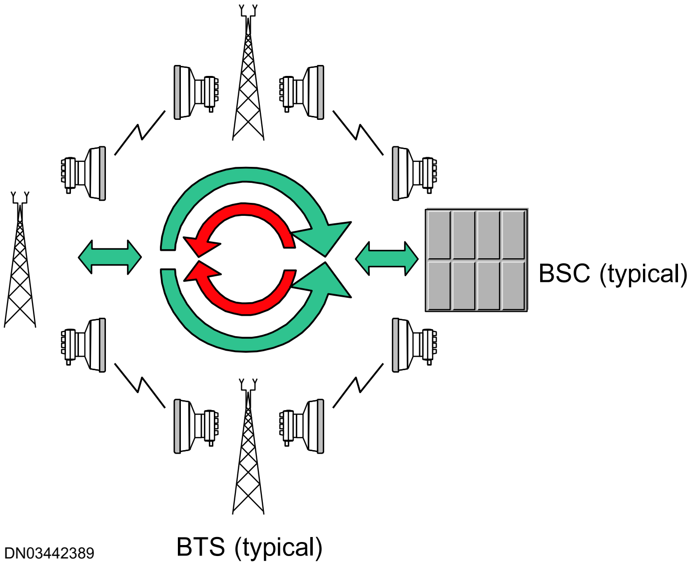


Figure 21. Loop configuration

4.5 Example network configuration: Star

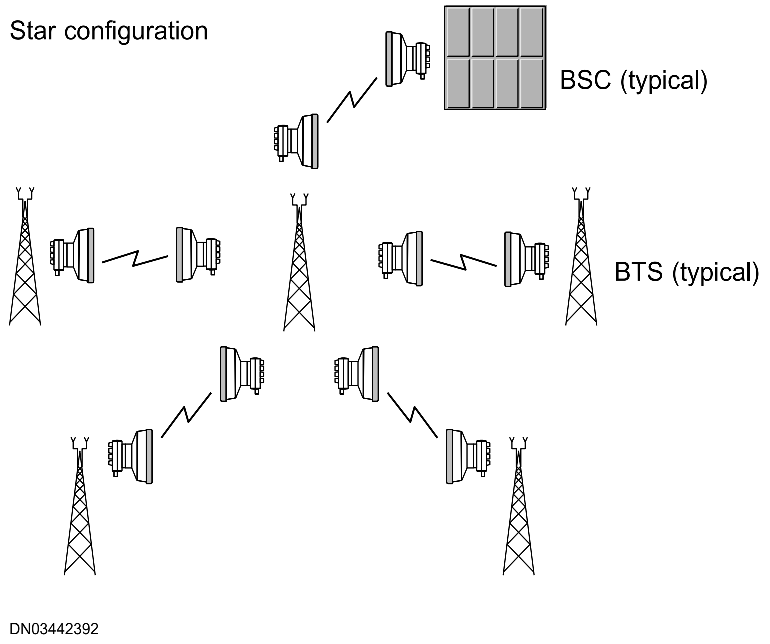


Figure 22. BTS star configuration

4.6 Example network configuration: Chain

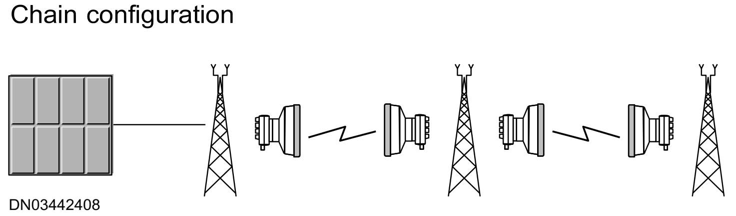


Figure 23. BTS chain configuration

4.7 Example site configuration: with SDH transmission

One of the easiest and most cost-effective solutions to enhance the coverage and expand the network is branching. Branching means add/ dropping digital transmission channels to other transmission paths in chain and tree networks. With FXC STM-1 and FXC Bridge an SDH solution is provided for connecting a base station (BTS) to optical fibre and for the branching of PDH lines. In branching, specific VC-12 channels are separated from the STM-1 frame signal and used for generating a new E1/ Flexbus frame for the subsidiary branch.

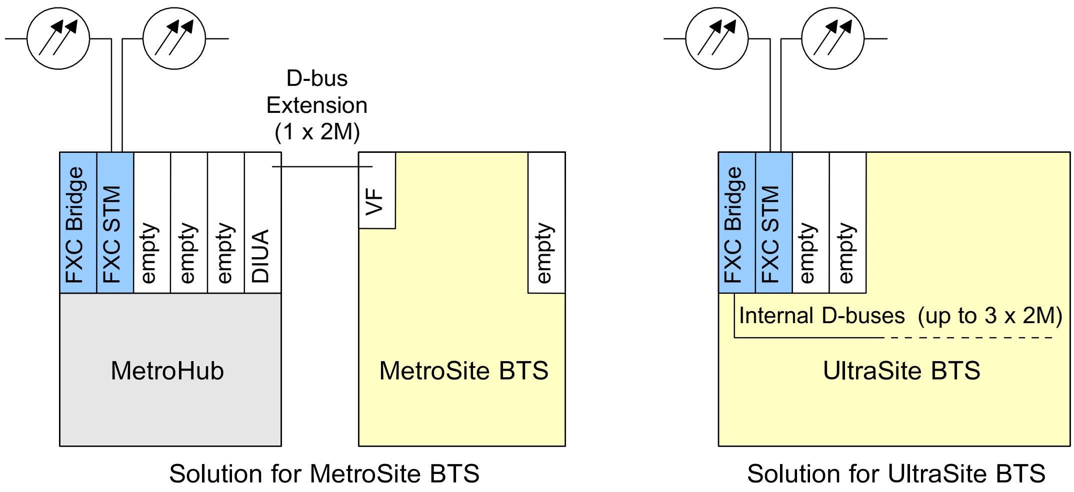


Figure 24. Site solutions for base stations with FXC STM

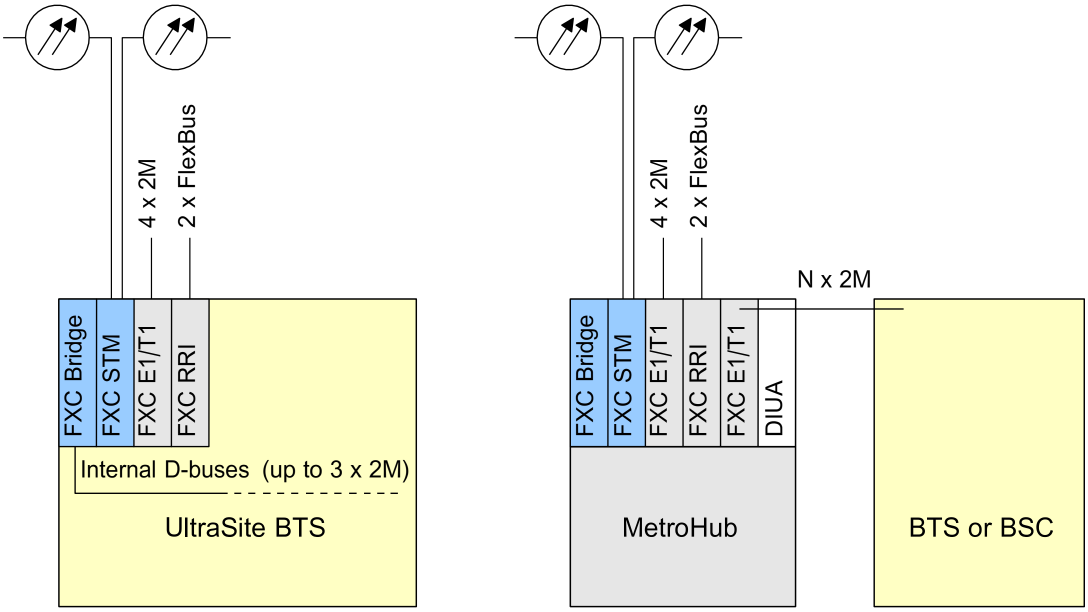
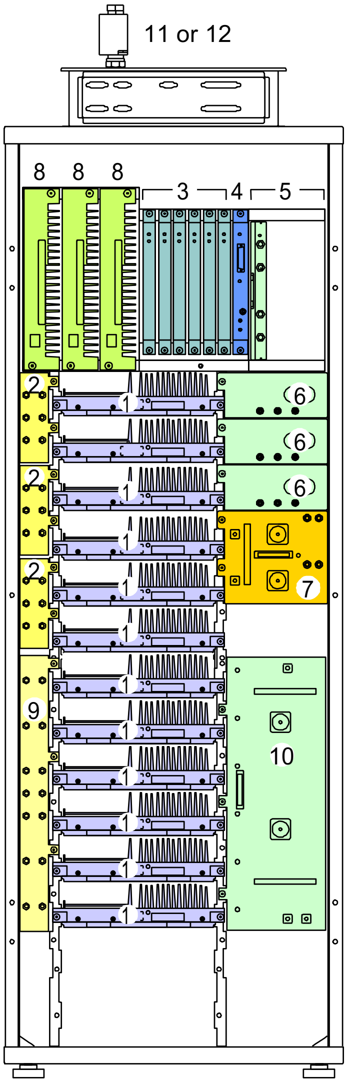


Figure 25. ITN for PDH add/dropping and SDH/PDH conversion

5 BTS units

5.1 Overview of GSM/EDGE unit technical descriptions



DN03420293

1	Transceiver unit (TSxx)
2	2-way Receiver Multicoupler unit (M2xA)
3	Transceiver Baseband unit (BB2x)
4	Base Operations and Interfaces unit (BOIx)
5	Transmission unit (VXxx)
6	Wideband Combiner unit (WCxA/WCxT)
7	Dual Variable Gain Duplex Filter unit (DVxx)

8	DC/DC Power Supply unit (PWSB)
9	6-way Receiver Multicoupler unit (M6xA)
10	Remote Tune Combiner unit (RTxx)
11	Bias Tee unit (BPxx)[1]
12	Dual Band Diplex Filter unit (DU2A)[1]

[1]Items 11 and 12 are not plug-in units.

Figure 26. BTS units (IDCA cabinet shown in the illustration)

The following table shows the required (R) and optional (O) units for each BTS cabinet. N/A indicates that the unit is not applicable for that cabinet.

Table 30. BTS units

Unit	Outdoor	Indoor	Mini Outdoor
UltraSite cabinet			
ODCA/ODCF (Outdoor BTS)	R (1)	N/A	N/A
ODCC (Outdoor BTS)	R (1)	N/A	N/A
IDCA (Indoor BTS)	N/A	R (1)	N/A
IDCC (Indoor BTS)	N/A	R (1)	N/A
ODCM (Mini Outdoor BTS)	N/A	N/A	R (1)
Base Operations and Interfaces (BOIx)			
BOIA (GSM/ EDGE)	R (1)	R (1)	R (1)
Dual Band Diplex Filter (DU2x)			
DU2A (GSM/ EDGE)	O (0 to 6)	O (0 to 6)	N/A
Transceiver Baseband (BB2x)			
BB2A (GSM)	R (1 to 6)	R (1 to 6)	N/A
BB2E (GSM/ EDGE)	R (1 to 6)	R (1 to 6)	R (1 to 2)
BB2F	R (1 to 6)	R (1 to 6)	R (1 to 2)

Table 30. BTS units (cont.)

Unit	Outdoor	Indoor	Mini Outdoor
Dual Variable Gain Duplex Filter (DVxx)[1]			
DVTB (GSM/ EDGE 800 Full Band)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVTC (GSM/ EDGE 800 Co-site)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVTD (GSM/ EDGE 800 Co-site)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVGA (GSM/ EDGE 900 Full Band)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVHA (GSM/ EDGE 900 H Band)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVJA (GSM/ EDGE 900 J Band)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVDA (GSM/ EDGE 1800 A Band)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVDB (GSM/ EDGE 1800 B Band)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVDC (GSM/ EDGE 1800 Full Band)	O (0 to 6)	O (0 to 6)	O (0 to 2)
DVPA (GSM/ EDGE 1900 Full Band)	O (0 to 6)	O (0 to 6)	O (0 to 2)
Masthead Amplifier (MNxx) [2]			
MNTB (GSM/ EDGE 800 Full Band)	O (0 to 12)	O (0 to 12)	N/A
MNTC (GSM/ EDGE 800 Co-site)	O (0 to 12)	O (0 to 12)	N/A
MNGA (GSM/ EDGE 900 Full Band)	O (0 to 12)	O (0 to 12)	N/A

Table 30. BTS units (cont.)

Unit	Outdoor	Indoor	Mini Outdoor
MNDA (GSM/ EDGE 1800 A Band)	O (0 to 12)	O (0 to 12)	N/A
MNDB (GSM/ EDGE 1800 B Band)	O (0 to 12)	O (0 to 12)	N/A
MNPA (GSM/ EDGE 1900 A Band)	O (0 to 12)	O (0 to 12)	N/A
MNPB (GSM/ EDGE 1900 B Band)	O (0 to 12)	O (0 to 12)	N/A
MNPC (GSM/ EDGE 1900 C Band)	O (0 to 12)	O (0 to 12)	N/A
MNPF (GSM/ EDGE 1900 Full Band)	O (0 to 12)	O (0 to 12)	N/A
Bias Tee (BPxx)			
WBNB	O (0 to 12)	O (0 to 12)	O
WBVC (GSM/ EDGE 800/ 900, VSWR)	O (0 to 12)	O (0 to 12)	O
WBVB (GSM/ EDGE 1800/ 1900, VSWR)	O (0 to 12)	O (0 to 12)	O
WBSB (GSM/ EDGE 1800/ 1900, VSWR, sniffer)	O	O	O
Receiver Multicoupler (2-way and 6-way)[3]			
M2LA (2-way) (GSM/EDGE 800/900)	R (1 to 7)	R (1 to 7)	R (1 to 2)
M2HA (2-way) (GSM/EDGE 1800/1900)	R (1 to 7)	R (1 to 7)	R (1 to 2)
M6LA (6-way) (GSM/EDGE 800/900)	R (1 to 2)	R (1 to 2)	N/A

Table 30. BTS units (cont.)

Unit	Outdoor	Indoor	Mini Outdoor
M6HA (6-way) (GSM/EDGE 1800/1900)	R (1 to 2)	R (1 to 2)	N/A
Power Supply (PWSx)			
PWSA (230 VAC)	R (1 to 2)	R (1 to 2)	R (1)
PWSB (-48 VDC)	R (1 to 3)	R (1 to 3)	R (1)
PWSC (+24 VDC)	R (1 to 2)	R (1 to 2)	R (1)
Remote Tune Combiner (RTxx)			
RTGA (GSM/ EDGE 900 Full Band)	O (0 to 2)	O (0 to 2)	N/A
RTHA (GSM/ EDGE 900 H Band)	O (0 to 2)	O (0 to 2)	N/A
RTJA (GSM/ EDGE 900 J Band)	O (0 to 2)	O (0 to 2)	N/A
RTDC (GSM/ EDGE 1800 Full Band)	O (0 to 2)	O (0 to 2)	N/A
RTDA (GSM/ EDGE 1800 A Band)	O (0 to 2)	O (0 to 2)	N/A
RTDB (GSM/ EDGE 1800 B Band)	O (0 to 2)	O (0 to 2)	N/A
RTPA (GSM/ EDGE 1900 Full Band)	O (0 to 2)	O (0 to 2)	N/A
Temperature Control System (TCS)			
Unit cooling fans (included in cabinet core mechanics)	R (11)	R (11)	R (5)
Heater (HETA) (optional)	O (1)	N/A	N/A

Table 30. BTS units (cont.)

Unit	Outdoor	Indoor	Mini Outdoor
Mini Outdoor Cabinet Heater (HETM) (optional)	N/A	N/A	O (1)
Cabinet cooling fan	R (1)	N/A	N/A
Transceiver (TSxx)			
TSGA (GSM 900)	R (1 to 12)	R (1 to 12)	R (1 to 4)
TSDA (GSM 1800)	R (1 to 12)	R (1 to 12)	R (1 to 4)
TSTB (GSM/ EDGE 800)	R (1 to 12)	R (1 to 12)	R (1 to 4)
TSGB (GSM/ EDGE 900)	R (1 to 12)	R (1 to 12)	R (1 to 4)
TSDB (GSM/ EDGE 1800)	R (1 to 12)	R (1 to 12)	R (1 to 4)
TSPB (GSM/ EDGE 1900)	R (1 to 12)	R (1 to 12)	R (1 to 4)
Transmission (VXxx)			
VXTA (FXC E1)	R (1 to 4)	R (1 to 4)	R (1 to 4)
VXTB (FXC E1/T1)	R (1 to 4)	R (1 to 4)	R (1 to 4)
VXRB (FXC RRI)	R (1 to 4)	R (1 to 4)	R (1 to 4)
FXC STM-1 and FXC Bridge	R (1 to 4)	R (1 to 4)	R (1 to 4)
Wideband Combiner (WCxA)			
WCGA (GSM/ EDGE 800/ 900)	O (0 to 9)	O (0 to 9)	N/A
WCDA (GSM/ EDGE 1800)	O (0 to 9)	O (0 to 9)	N/A
WCPA (GSM/ EDGE 1900)	O (0 to 9)	O (0 to 9)	N/A
Triple Wideband Combiner (WCxT)			

Table 30. BTS units (cont.)

Unit	Outdoor	Indoor	Mini Outdoor
WCGT (GSM/ EDGE 800/ 900)	O (0 to 4)	O (0 to 4)	N/A
WCDT (GSM/ EDGE 1800)	O (0 to 4)	O (0 to 4)	N/A
WCPT (GSM/ EDGE 1900)	O (0 to 4)	O (0 to 4)	N/A
Outdoor Kits			
OEKA	0 (0 to 1)	N/A	N/A
OCTU (Optional Co-Site Talk Kit)	O (0 to 1)	N/A	N/A
Outdoor Filter Kit (ODFA)	O (0 to 1)	N/A	N/A
Outdoor Bridge Kit (OBKA)	O (0 to 1)	N/A	N/A
AC Filter Unit (ACFU)	O (0 to 1)	O (0 to 1)	N/A
Air Filter Kit (OFKx)	O (0 to 1)	N/A	N/A

[1]DVxx eliminates RTxx unit for that antenna.

[2]BPxV (with VSWR antenna monitoring) can be used with or without MNxx.

BPxN (without VSWR antenna monitoring) can be used only with MNxx.

[3]M2xA and M6xA can be used together as cabinet space allows.

Note

Each ODCA cabinet is shipped standard with one OEKA included. Additional entry kits my be ordered, if needed.

5.2 Description of hot insertion

This section describes the features and benefits of hot insertion and its use.

Features and benefits of hot insertion

The hot insert feature allows you to remove and install BTS units without powering off the BTS. Use the hot insert feature to:

- Replace a faulty unit.
- Upgrade the BTS (non-hopping, RF hopping, or BB hopping).
- Install additional GSM hardware to increase the capacity of a GSM BTS.
- Install additional GSM/EDGE hardware to add EDGE capacity to a GSM BTS.
- Install additional GSM/EDGE hardware to increase the capacity of a GSM/EDGE BTS.

Using hot insertion

Hot insertion can be used with a BTS when you:

- Replace a faulty unit.
- Add TRXs to upgrade the BTS.

These procedures apply to BTS software CX4.0-3 or later.

Warning

When a plug-in unit is replaced with power on (hot insertion), sparks may occur in the plug-in unit rear connector. To avoid sparking when replacing plug-in units, turn off the mains breaker of the site before replacing the units.

If the connector area is contaminated, an external object exists on the connector, or the backplane/connector is damaged, a short circuit may develop to the connector area. If the mains breaker of the site is not able to break the fault current, this may result in overheating of the backplane. In extremely rare cases, fire may occur in the RFU backplane as a consequence of the overheating.

If fire occurs, close the cabinet door, switch off the mains breaker, and wait for the fire to extinguish at a safe distance (beware of possible smoke development). Make sure that the fire has completely extinguished before leaving the site unattended.

Hot Insert can be used with the following units:

- Transceiver Baseband unit, GSM (BB2A)
- Transceiver Baseband unit, GSM/EDGE (BB2E)
- Transceiver Baseband unit, GSM/EDGE (BB2F)
- Dual Variable Gain Duplex Filter unit (DVxx)
- Receiver Multicoupler unit - 2-way (M2xA)
- Receiver Multicoupler unit - 6-way (M6xA)
- Remote Tune Combiner (RTxx)
- Transceiver RF unit, GSM (TSxA)
- Transceiver RF unit, GSM/EDGE (TSxB)
- Wideband Combiner unit (WCxA)
- Power Supply unit (PWSx)

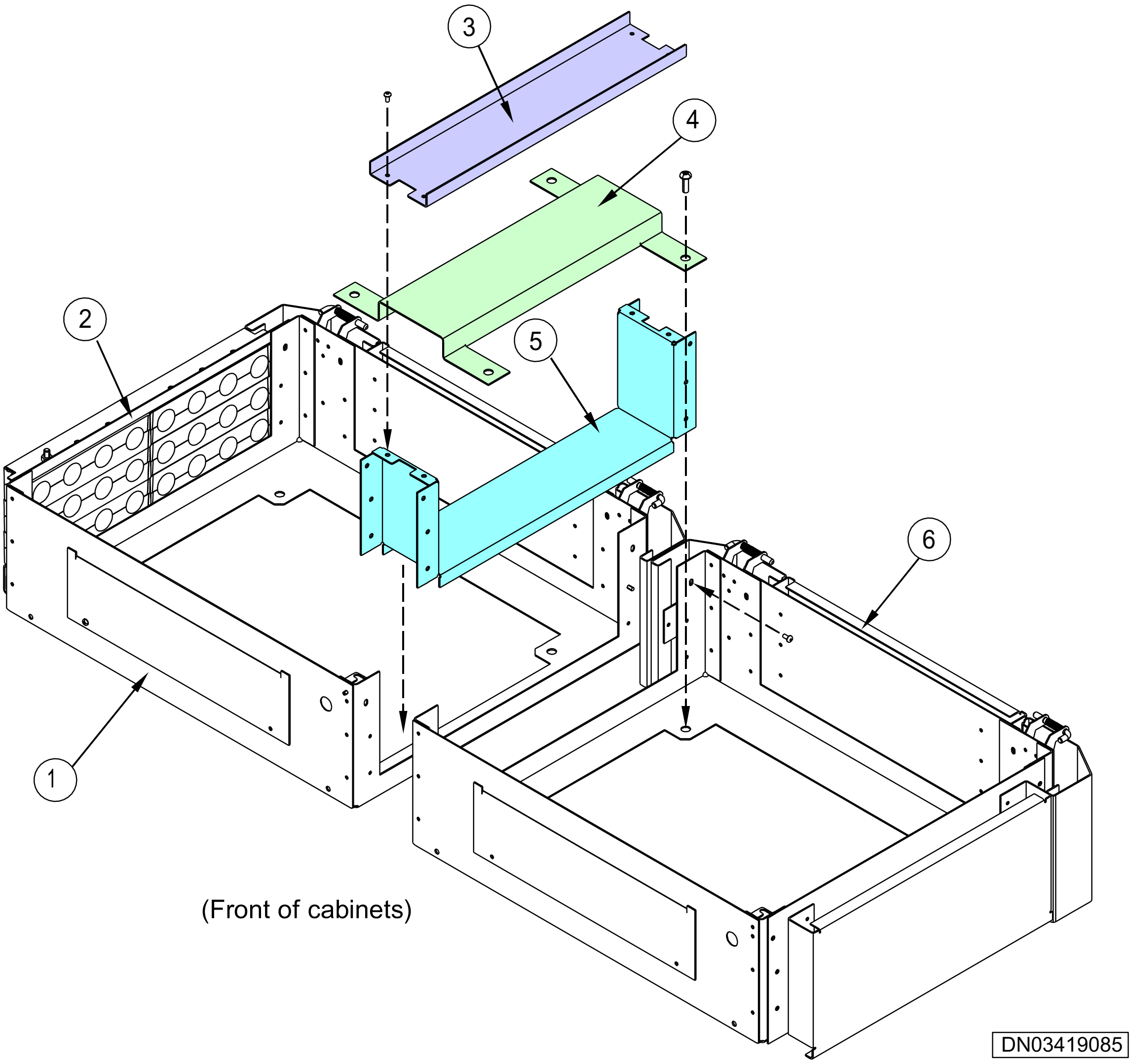
  Additional PWSx units can be hot inserted only when PWSx on/off switch is in off position when inserted.

The BTS only supports the hot insertion feature for the units listed above.

6 BTS kits

6.1 Technical description of outdoor bridge kit (OBKx)

The outdoor bridge kit (OBKx) is a bridge kit for the roof assembly of the BTS outdoor cabinet. The kit provides a protected channel for inter-cabinet cables routed between adjoining outdoor cabinets. For installation instructions, see *Installing the Midi outdoor bridge kit (OBKx)*.



1	Midi to Talk Bridge (OBKB)
2	Cable entry
3	Roof support
4	Dummy cable entry
5	External interface cover panel

Figure 27. Outdoor bridge kit (OBKx)

6.2 Technical description of the outdoor filter kit (ODFA)

Introduction

The outdoor dust filter kit (ODFA) protects the BTS from dust, sand, and other foreign objects that can enter the cabinet during operation. The UltraSite EDGE base station utilizes an open air cooled design where ambient air is drawn in and circulated throughout the cabinet interior. In certain outdoor locations, exposure to the ambient air may present some risks of environmental effects on the components. To provide protection from certain environmental effects, additional protection by air filters is sometimes required to decrease the needed maintenance intervals, or to prevent chemical reactions. The geographical and climatic conditions will determine the degree of protection that must be followed.

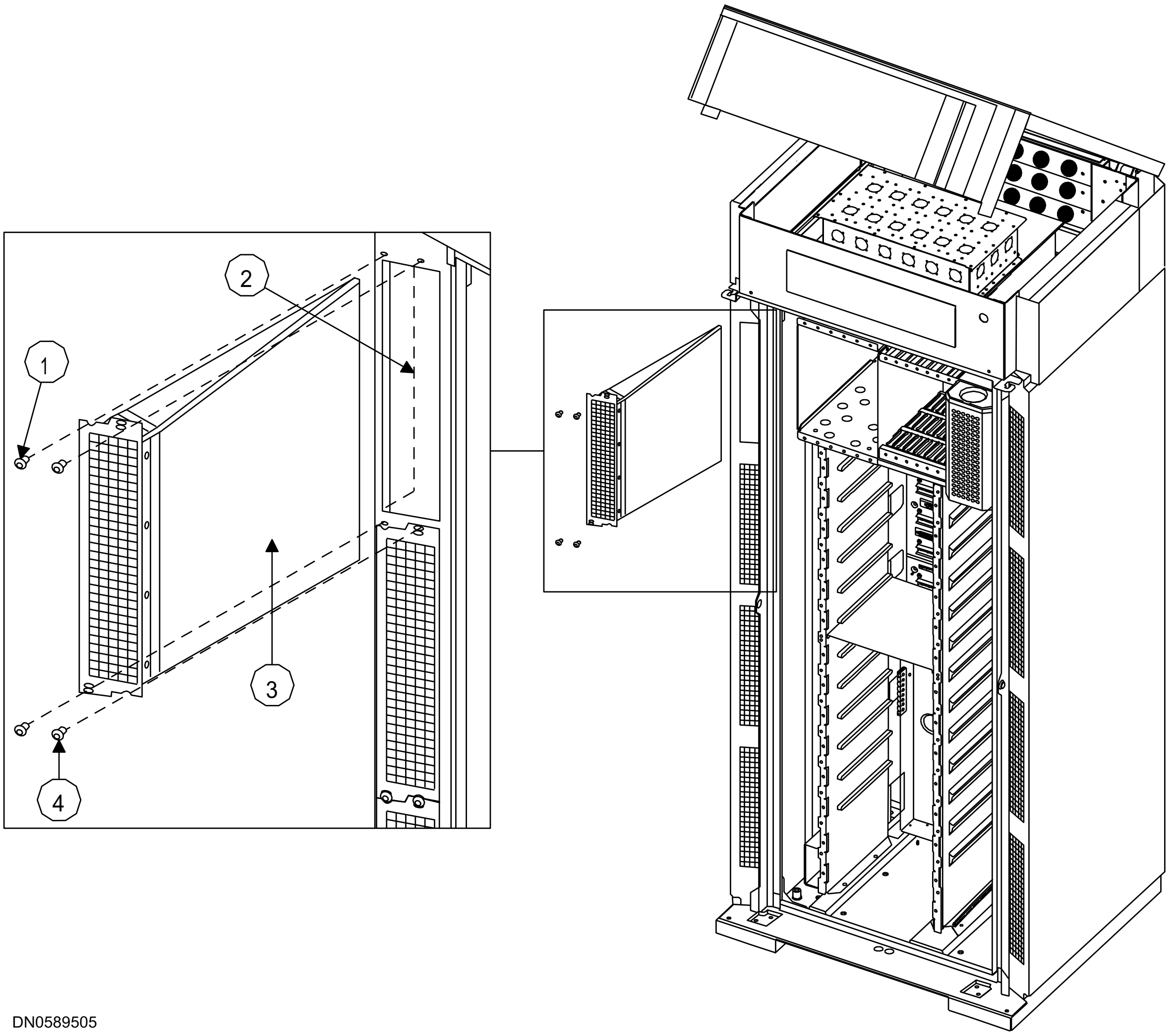
Use of ODFA against corrosion and dust

Moisture in the air or air pollution may condense into a liquid on the surface of small particles (dust, sand, et cetera). If these small particles are removed from BTS cabinet surface, or from the air circulating inside the cabinet, the likelihood of condensation is minimized. The ODFA filter prevents corrosion in UltraSite BTS caused by these physical properties. Thus, the ODFA filter kit can be used to prevent electrolytic corrosion where salt mist does not exist. Furthermore, the ODFA filter kit greatly reduces the need of maintenance in a dusty environment, for instance, near a busy highway or a railway. The ODFA filter is recommended to be used when it is likely that the BTS interior needs to be cleaned more than once in two years.

Definitions

Time of Wetness (TOW) is defined as the hours per year during which the temperature is greater than 0°C (32°F), and the relative humidity is above 80%. Most of the atmospheric corrosion takes place under these conditions. TOW is expressed either in hours per year or a percentage of the hours in a year. There are 8766 hours in a year. If the relative humidity of air is below 40%, electrolytic corrosion is not possible.

Filter's maintenance interval: A default maintenance interval for the filter is 12 months. If the cabinet alarms earlier (unit high temperature alarm), or the cabinet is getting dirty, the filter needs to be changed more often. If the cabinet is clean and there are no alarms, the maintenance interval can be extended to, for instance, 18 months.

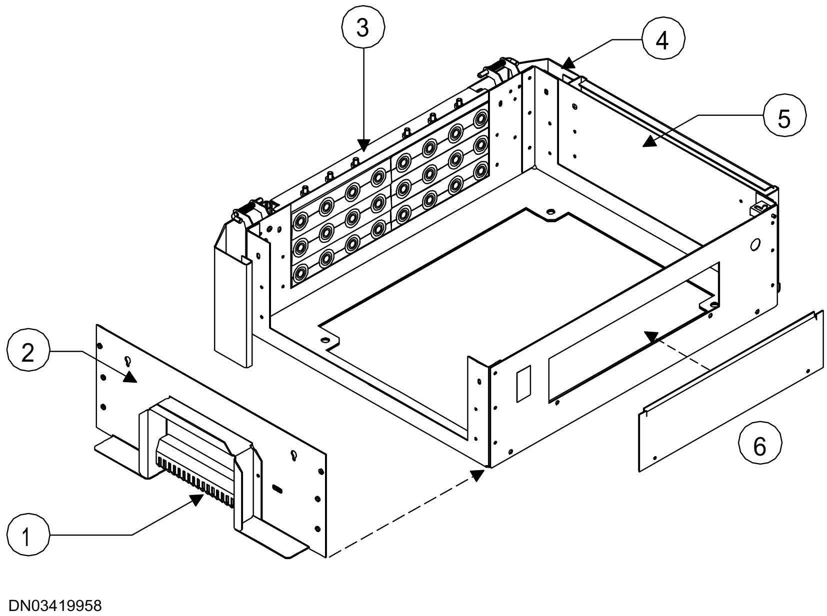


1	Push fastener clip
2	Dust filter slot
3	ODFA
4	Push fashener clip

Figure 28. Outdoor dust filter kit (ODFA)

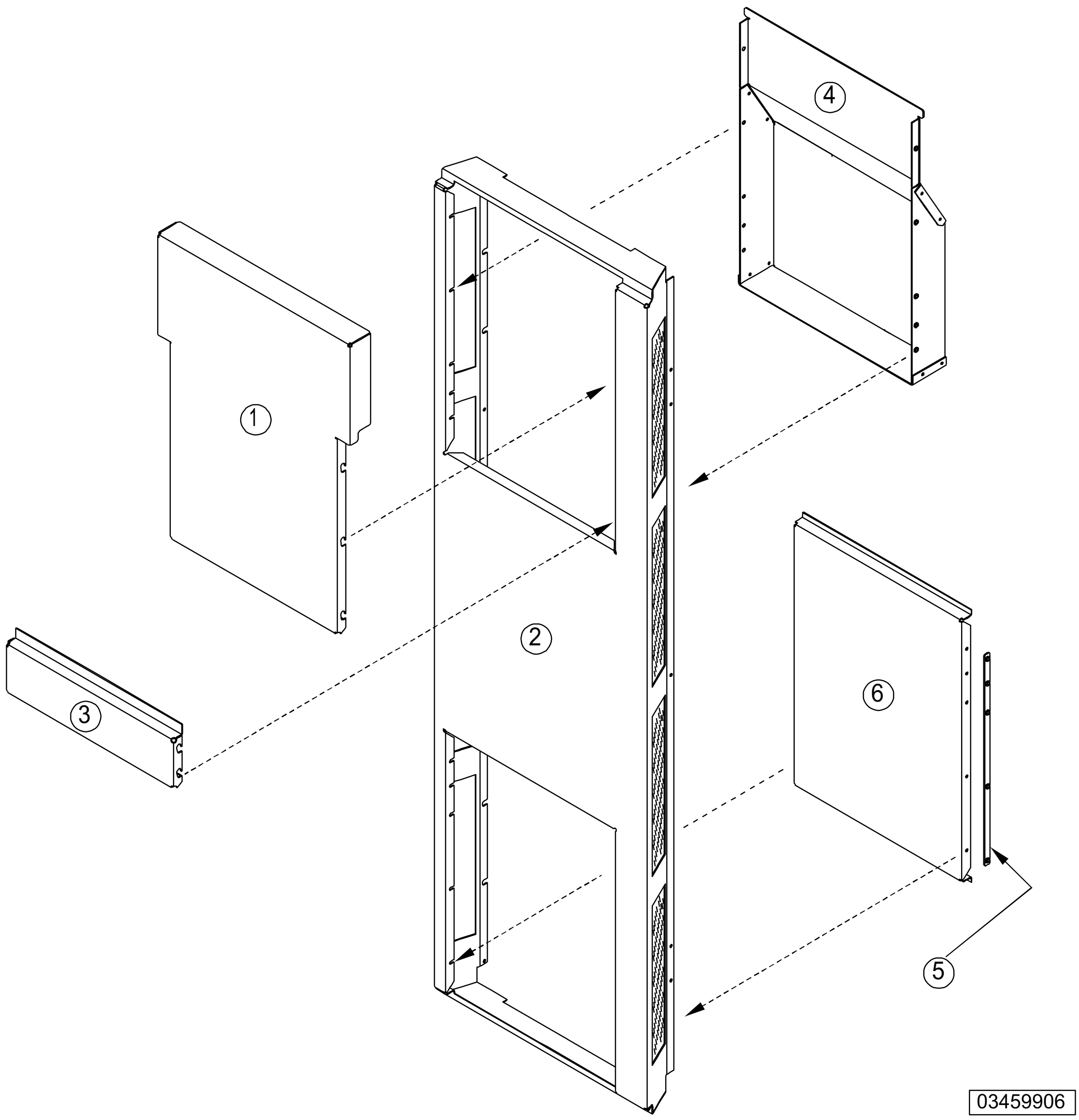
6.3 Technical description of outdoor cabinet co-siting kit (OCTU)

The outdoor cabinet co-siting kit allows an UltraSite BTS cabinet to co-site with a Citytalk cabinet. The kit includes a co-siting side wall that replaces one of the cabinet side walls and a new co-siting cable entry for the roof assembly.



1	Wiring tie-down points
2	Co-siting cable entry
3	Cable entry
4	Roof support
5	Dummy cable entry
6	External interface cover panel

Figure 29. Outdoor cabinet co-siting cable entry



1	Cover
2	Side wall
3	Trim panel
4	Channel
5	Thread bar (2 places)
6	Dummy panel

Figure 30. Outdoor cabinet co-siting side wall

6.4 Technical description of System Extension Cable (SXCA) kit of UltraSite EDGE BTS

The SXCA cable kit provides extended RF diversity cables for signalling between the DVxx units and WCxA units in a 5+5+5 or greater UltraSite EDGE BTS configuration. The kit can be utilized in both indoor and outdoor installations.

The extended SXCA cables included in the SXCA kit are installed in the lower right of the BTS cabinet and each kit includes any additional cables for various configurations, as determined during planning.

6.5 Technical description of Outdoor Side Kit (OSKA)

The OSKA UltraSite Outdoor Side Kit is used to enhance current UltraSite BTSs by adding FlexiBTS modules to it without the need of adding an extra cabinet.

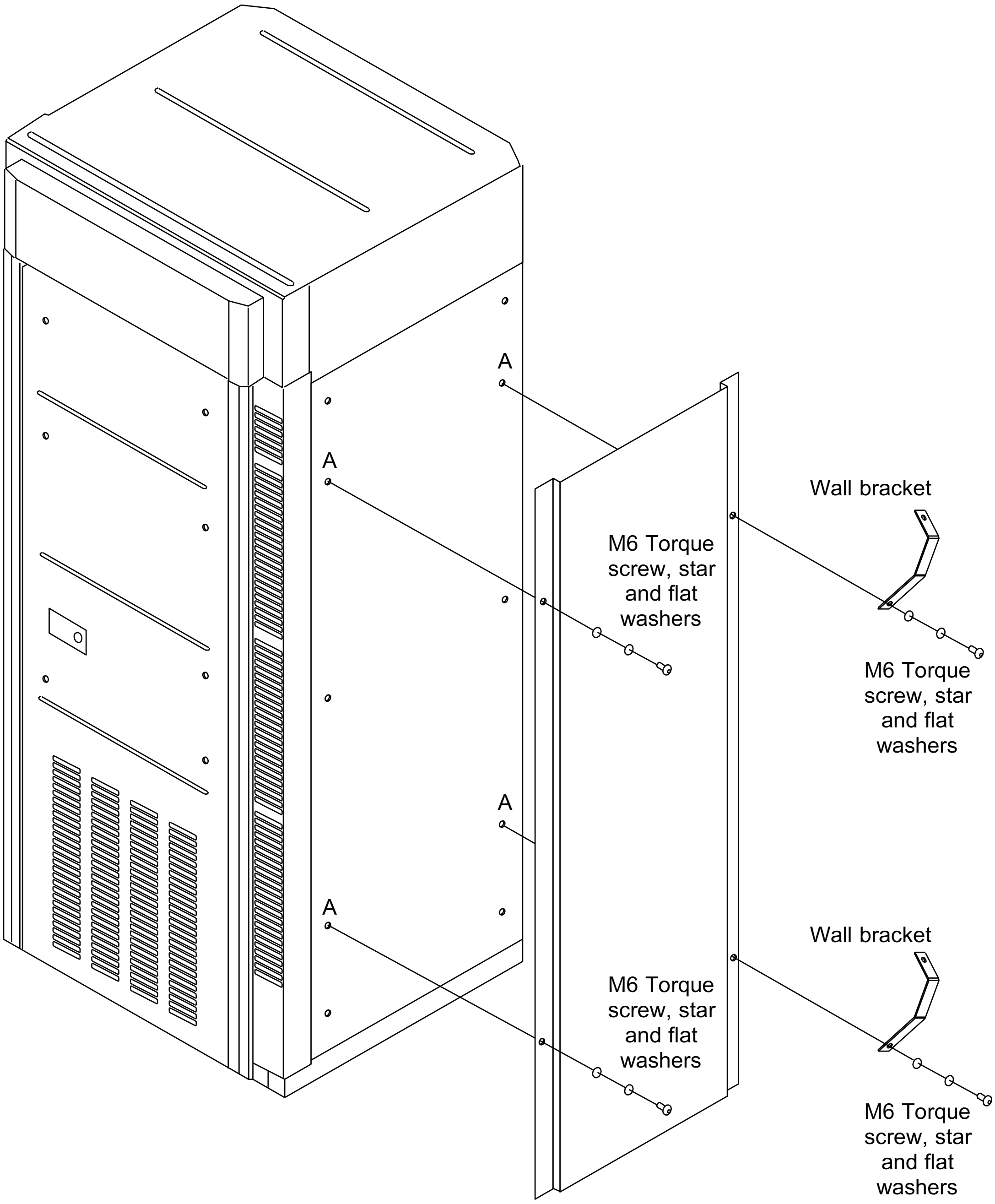


Figure 31. UltraSite Outdoor Side Kit (OSKA)

The side kit allows both WCDMA and GSM/EDGE Flexi modules to be connected to it, with each module being housed within a Flexi housing. The Flexi Rectifier Module (FRMx) can also be mounted directly to the side kit without the need of a Flexi Housing.

The side kit can be fixed to either the left-hand side, right-hand side, or the rear of an Ultrasite Outdoor cabinet. A maximum of two modules can be stacked on top of each other. Note that only two faces of an Ultrasite Outdoor cabinet can be used at any one time, which are left-hand side and rear or right-hand side and rear. Both left-hand side and right-hand-side cannot be used at the same time. For details, see the figure below:

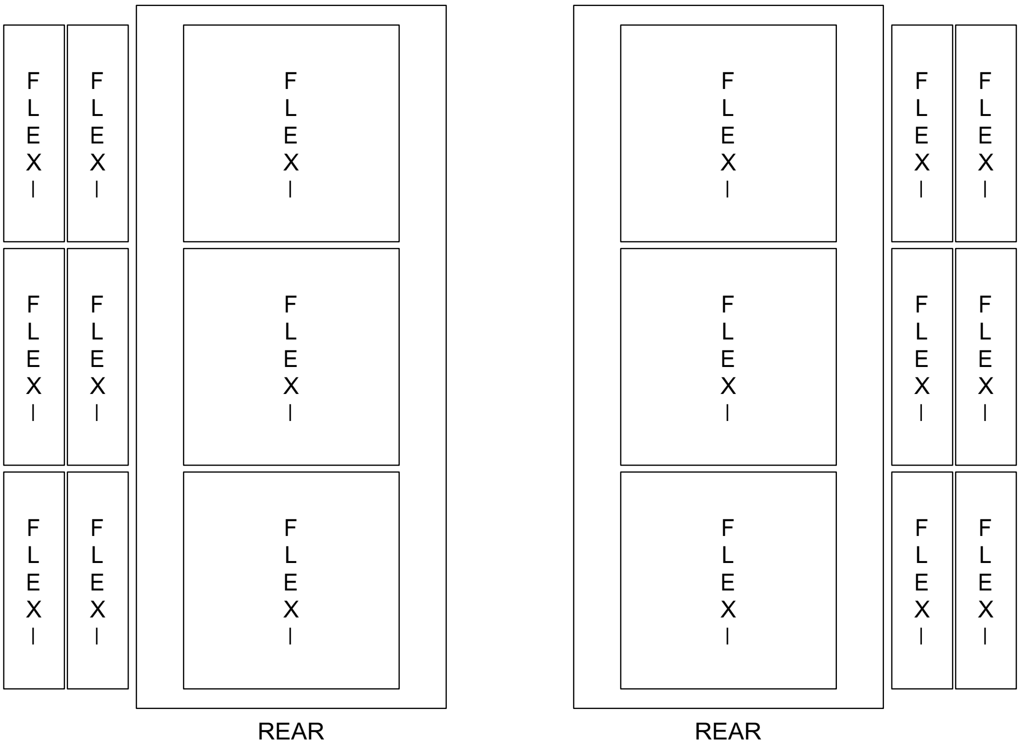


Figure 32. Side kits fixed to the cabinet

For installation instructions, see *Installing UltraSite Outdoor Side Kit (OSKA)*.

6.6 Technical description of IDC_ Roof and Side Kit (IRSA)

The IRSA UltraSite IDC_ Roof and Side Kit is used to install the Flexi Rectifier module (FRMx), or any other Flexi unit, on the roof of an UltraSite Indoor cabinet. For improved access to the Antenna Connections on the IDC_ Antenna Box, the adapter plate of the IRSA Ultrasite IDC_ Roof and Side Kit can be fitted in a forward position. The kit can also be adapted so that it can be used for mounting units on the side of the IDC_ cabinet.

In either configuration, the maximum weight of a single module that can be supported is 27 kg.

The FRMx is configured as part of the respective BTS and forms a fully integrated solution for sites requiring battery backed-up facility.

For this application, either the FRMA or FRMC units can be installed.

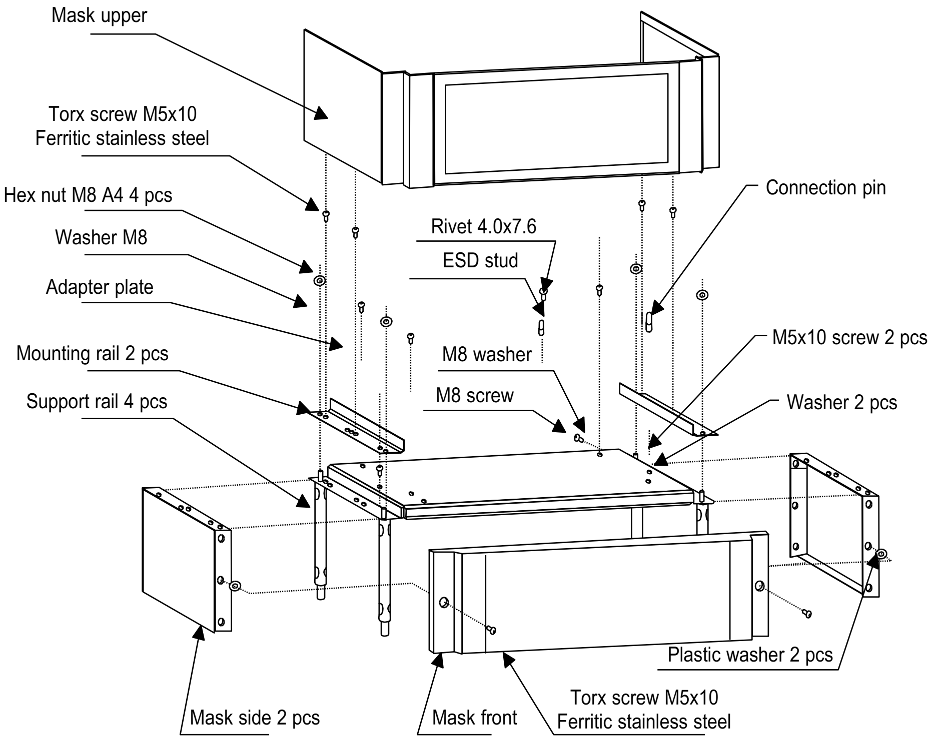


Figure 33. UltraSite IDC_ Roof and Side Kit (IRSA)

For installation instructions, see *Installing UltraSite IDC_ Roof and Side Kit (IRSA)*.

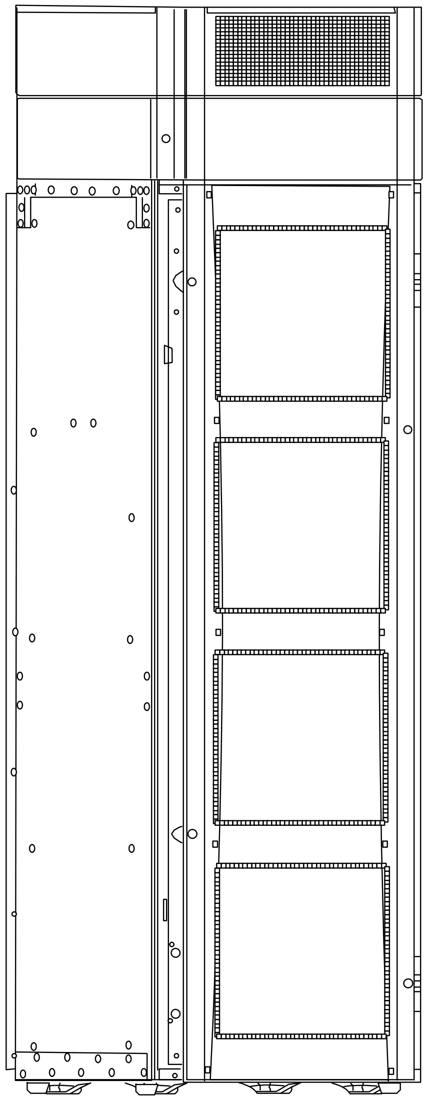


Figure 34. Mounting in normal position

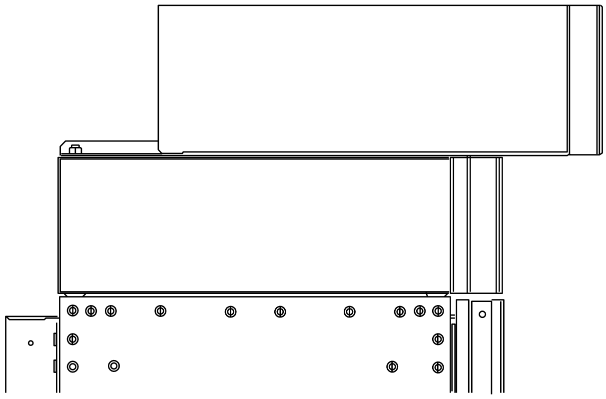


Figure 35. Mounting in forward position

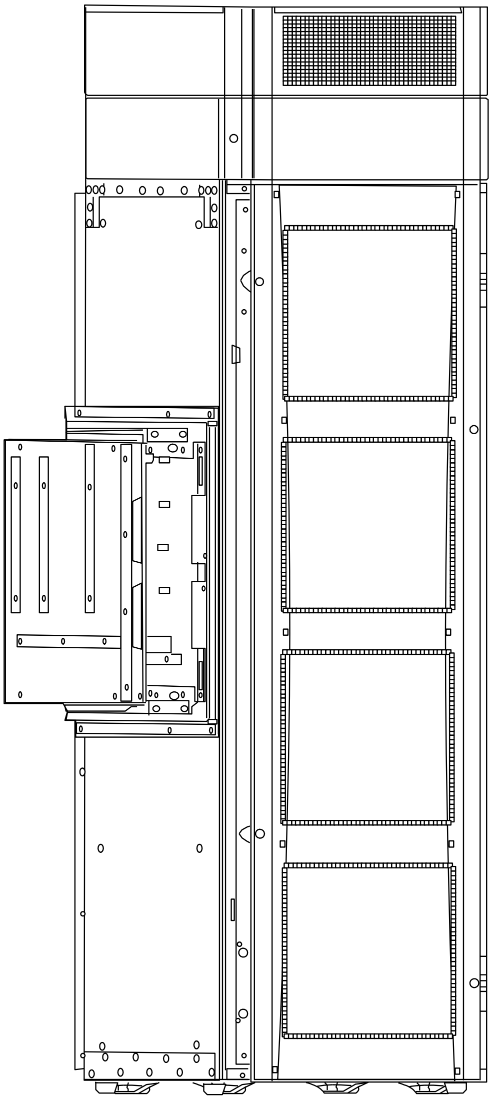


Figure 36. Mounting to the side wall of the cabinet

7 Technical description of BTS Hub

7.1 Technical overview of BTS Hub or MetroHub Manager menus

All BTS Hub and MetroHub Manager functions can be accessed through the application menus. The main functions under the menus are briefly described in the figure below. You can also use the toolbar short-cuts to access the menu items.

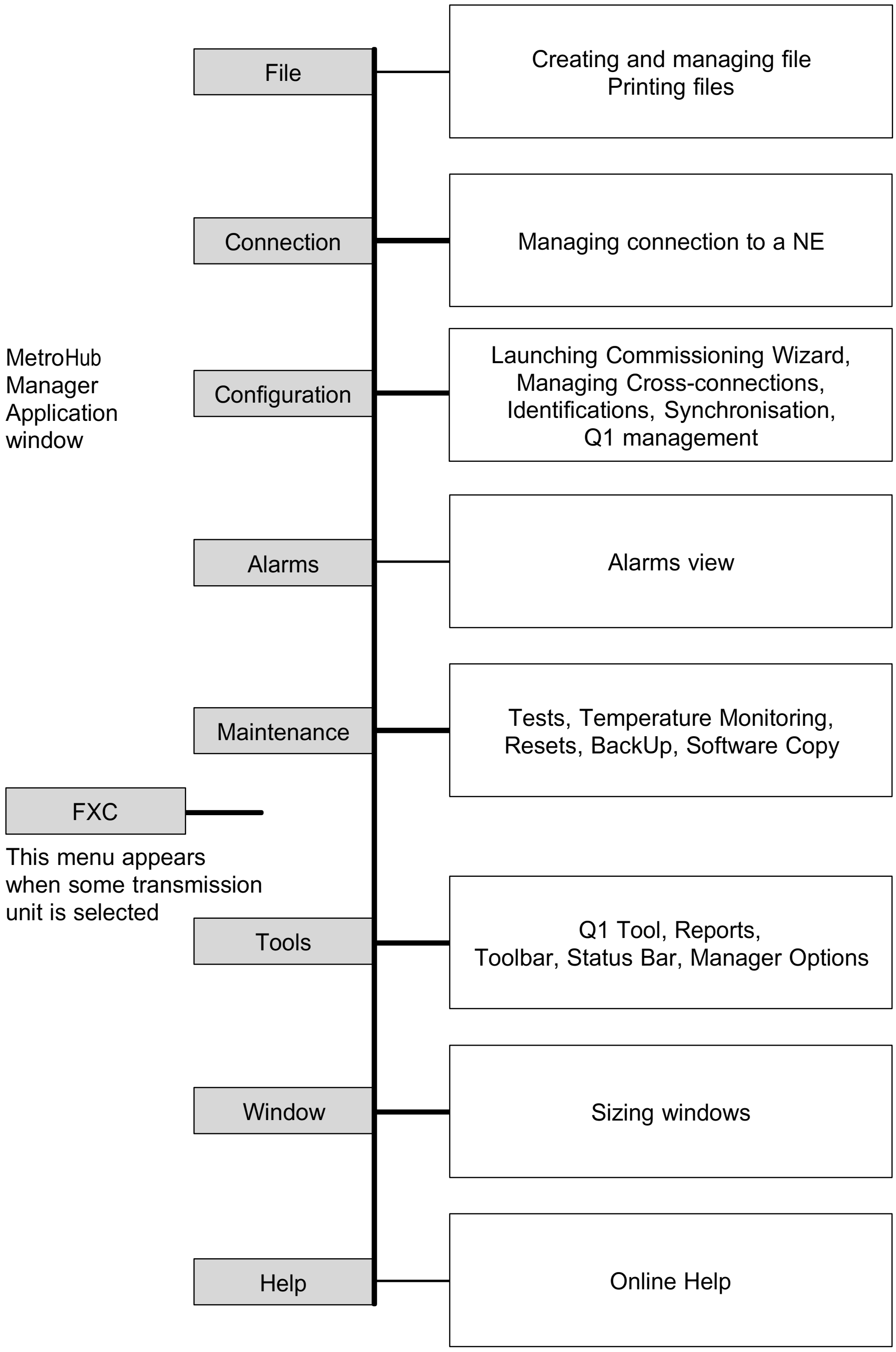


Figure 37. Overview of UltraSite BTS Hub or MetroHub Manager menus

The following tasks are performed under the BTS Hub Manager or MetroHub Manager menus:

- Commissioning the node (Configuration → Commissioning Wizard)
- Managing PDH and SDH synchronisation settings (Configuration → Synchronization)
- Managing Embedded Operations Channel (EOC) settings (Configuration → Q1 Management)
- Making cross-connections (Configuration → Cross-connections)
- Managing service interface settings (Configuration → Service Interface)
- Viewing current alarms (Alarms → View)
- Performing tests (Maintenance → Tests)

If you try to make changes that are not possible, you are notified and the previous settings are restored. To send the changes to the node, click **Apply**. To send the changes to the node, and to close the window or dialogue box, click **OK**. In dialogues with related menu activity, for example, Modify or Refresh, you can use the dialogue button to access the related menus or use the pop-up menus (right-click on the mouse).

7.2 Technical description of transmission interfaces

The transmission interfaces of the transmission node are implemented using FXC transmission units. MetroHub can host up to five FXC transmission units and UltraSite EDGE can host up to four FXC transmission units, and it is possible to cross-connect between any of these units regardless of the physical interface type. A scalable number of transmission interfaces allow the operator to expand the capacity of the network as needed.

The transmission units are connected to each other by the backplane using the non-blocking cross-connection bus with 8 kbit/s granularity. The available interface variants for the PDH transmission units are Flexbus, E1 and T1. The FXC STM-1 transmission unit has two long-haul optical STM-1 interfaces. In addition, the FXC Bridge unit has a test interface. The units do not have separate Q1 management interfaces. Instead, they are managed locally by the Local Management Port (LMP) of the BTS or MetroHub, or remotely through the Q1 bus.

7.3 Technical description of transmission interface measurements

All FXC E1/T1 interfaces (platform interfaces if FXC RRI is used) have statistical error counters (ITU-T G.826) that count errors from incoming signals. For FXC STM-1 and FXC Bridge the performance data is collected according to ITU-T G.828. The statistical error counters start at start up and continue until the counters are reset. Flexbus interfaces have bit error ratio measurement from incoming Flexbus signals. This bit error ratio is equivalent to the bit error ratio in 2M signals passing through the Flexbus. FlexiHopper (Plus) radios have bit error ratio measurement for the air interface before the error correcting algorithm.

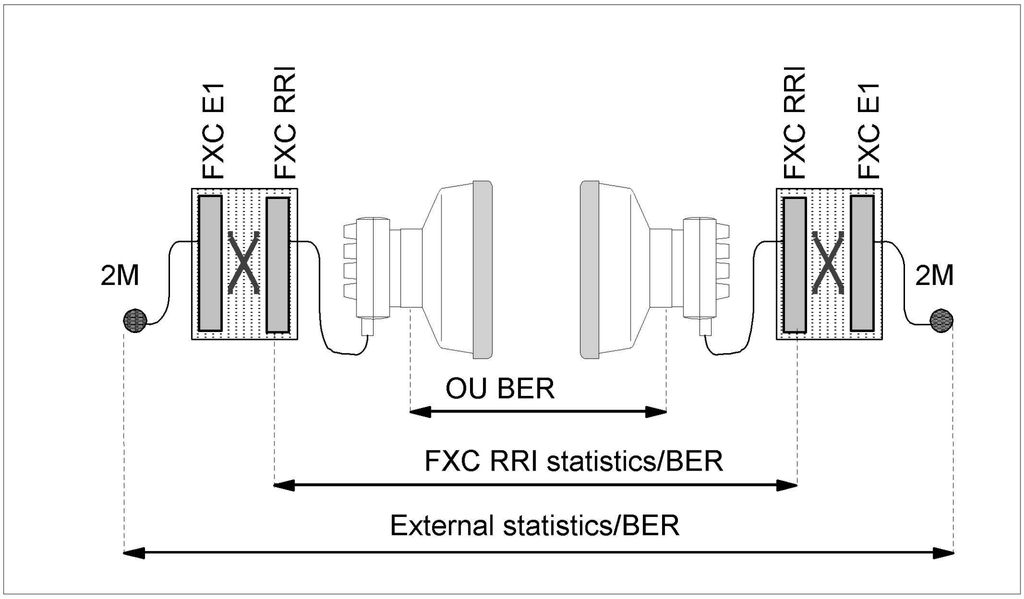


Figure 38. BER and statistics measurement points at unit level

7.4 Technical description of transmission capacity expansion

In addition to being transmission nodes, the BTS transmission Hub or MetroHub serve as flexible transmission capacity reserves in the network, enabling rapid revenue growth by easy and flexible expansion of capacity with minimised implementation time and cost.

The growing amount of traffic in the network requires flexible transmission capacity expansion. This is accomplished by adding transmission units into the transmission node when needed. With these transmission units, the transmission node can be connected, for example, to eight FlexiHopper (Plus) radios, with up to 16 x 2 Mbit/s capacity each, or to eight MetroHopper radios, with 4 x 2 Mbit/s capacity each. The radio connections are made through a single Flexbus cable that carries the payload and the radio power feed.

The maximum interface capacity of MetroHub is 222 x 2 Mbit/s, with 2 FXC STM-1 and 6 x Flexbus interface. Of the total capacity 56 x 2 Mbit/s can be cross-connected between FXC units. In addition, bypass cross-connects are supported for the FXC STM-1 and FXC RRI units to cross-connect additional capacity transparently. The maximum interface capacity of UltraSite BTS Hub is 190 x 2 Mbit/s, with the same cross-connect capacity as MetroHub.

It is also possible to connect the transmission node to other transmission equipment through sixteen E1 or T1 connections. Furthermore, several transmission nodes can be chained using a single coaxial cable.

Table 31. MetroHub transmission capabilities

Cross-connection bus capacity		56 x 2 Mbit/s non-blocking with 8 kbit/s granularity
Basic cross-connection types:		Granularities:
B2	Bi-directional	2M / nx64k / 64k / 32k / nx8k
M2	Bi-directional masked	64k / 32k / 16k
D	Uni-directional fixed	64k / 32k / 16k / 8k
Protected cross-connection type:		Granularity:
P2	Protected bi-directional	nx64k / 64k / 32k / 16k
Max. interface capacity of the node		222 x 2 Mbit/s (with 2 x STM-1 and 6 x Flexbus interface)

Table 32. UltraSite EDGE BTS transmission capabilities

Cross-connection bus capacity		56 x 2 Mbit/s non-blocking with 8 kbit/s granularity
Basic cross-connection types:		Granularities:
B2	Bi-directional	2M / nx64k / 64k / 32k / nx8k

Table 32. UltraSite EDGE BTS transmission capabilities (cont.)

M2	Bi-directional masked	64k / 32k / 16k
D	Uni-directional fixed	64k / 32k / 16k / 8k
Protected cross-connection type:		Granularity:
P2	Protected bi-directional	nx64k / 64k / 32k / 16k
Max. interface capacity of the node		190 x 2M (with 2 x STM-1 and 4 x Flexbus interface)

7.5 Technical description of transmission unit cross-connections

Cross-connections define how signals are routed from an FXC transmission unit to another transmission unit. Cross-connections are created into banks. The banks can be either active or inactive. The cross-connections in the active banks are in use, whereas those in the inactive bank can be used for creating new or editing already existing cross-connections.

The SDH cross-connection block performs cross-connections on the VC-12 level and generation of clock and frame sync signals for the buses.

Cross-connection bus

The transmission units offer dynamic allocation and deallocation of the 56 x 2 Mbit/s cross-connection bus of MetroHub and UltraSite EDGE BTS according to the physical interfaces that are present in the node configuration. The user can create cross-connections between any physical interfaces connected to the cross-connection bus.

When the first cross-connection is created to the interface, the 2M cross-connection block is allocated to it. If there are no free blocks to be allocated, the node gives the alarm *20 Blocked from use*.

Backup

The active cross-connection bank is backed up in the transmission unit's non-volatile memory: if the unit is removed, the cross-connections are restored when the unit is inserted again.

Grooming

The cross-connection feature of the transmission units makes traffic grooming possible.

The FXC transmission units are capable of grooming traffic at 8 kbit/s granularity, which enables fully optimised and flexible use of the available transmission resources. This ensures that the Abis transmission capacity can be used efficiently.

Cross-connection granularities

There are several types of cross-connections available, and each has a different granularity.

Granularity means the bit rate at which a cross-connection is made, that is, the number of bits connected into a specific direction in a cross-connection. In 2 Mbit/s mode, the available granularities are:

- 8k (1 bit)
- nx8k
- 16k (2 bits)
- 32k (4 bits)
- 64k (all 8 bits in a time slot)
- nx64k
- 2M

All 2 Mbit/s platform interfaces are terminated, which means that time slot 0 is regenerated.

Only 2 Mbit/s cross-connections that are made from Flexbus to Flexbus inside a FXC RRI transmission unit are transparent.

Note

SDH cross-connections are possible only at VC-12 level granularity.

Basic cross-connection types

The cross-connections are created into banks. The node contains two cross-connection banks.

The transmission units support all the cross-connection types described below.

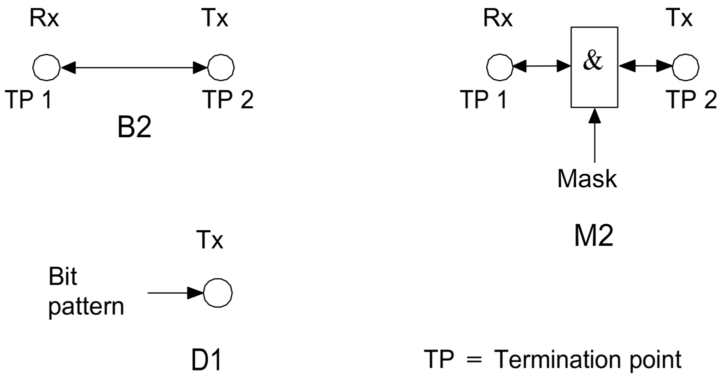


Figure 39. Basic cross-connection types supported

- B2 bi-directional cross-connection

The B2 cross-connection is a bi-directional connection between two termination points. The granularities are 2M, nx64k, 64k, 32k, 16k, 8k and nx8k.

- M2 bi-directional masked cross-connection

The M2 bi-directional masked cross-connection is a bi-directional connection between two termination points. The received data stream is masked bit by bit with fixed data. Masking can be done with a logical AND or OR operation. The masking is made in both directions. The M2 cross-connection supports 64k, 32k and 16k granularity.

- D1 uni-directional fixed cross-connection

The D1 cross-connection is a uni-directional cross-connection where fixed data is sent from the Tx port as shown in the figure above. The user sets the fixed bit pattern used (for example: 01101101) and the time slot where the bit pattern is transmitted. The D1 cross-connection supports 64k, 32k, 16k and 8k granularities.

Cross-connection protection

The B2 cross-connection can be protected. Protection means that the data path through the network element has two alternative routes. The protected bi-directional cross-connection is called the PB2 cross-connection.

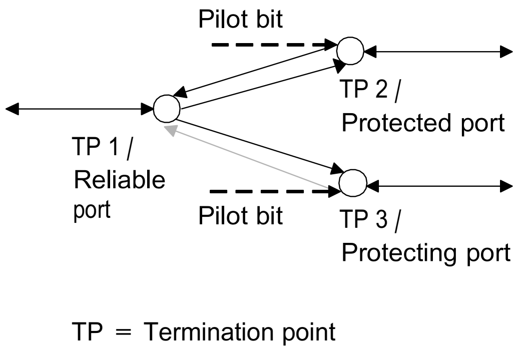


Figure 40. Protected bi-directional cross-connection

Setting up a bi-directional protected cross-connection for SDH is necessary for setting up a SNC/I+ protected VC-12 path.

When a protected bi-directional cross-connection is made, both the switch and data duplicating cross-connections are created. Data received from the reliable port is duplicated and sent to both the protected and protecting port. The switching decision is made according to the incoming value of the selected condition bits (pilot bits).

The granularities for protected cross-connections are n x 64k, 64k, 32k and 16k.

The port selection is called a switch. After creating the switch, the user must define the switching condition. The supported conditions are priority and equal.

For more details on loop protection, see *Technical description of PDH transmission network protection using loop topology*.

7.6 Technical description of the node control unit

When any of the FXC transmission units is inserted into unit slot 1, it automatically starts to function as the node control unit. The role of the unit is thus only determined by the slot position. The node control unit provides a common clock to which all other FXC units synchronise. An FXC unit must always be used in unit slot 1 for the configuration to work.

The FXC STM-1 unit cannot be used as the node control unit and it should never be installed in slot 1.

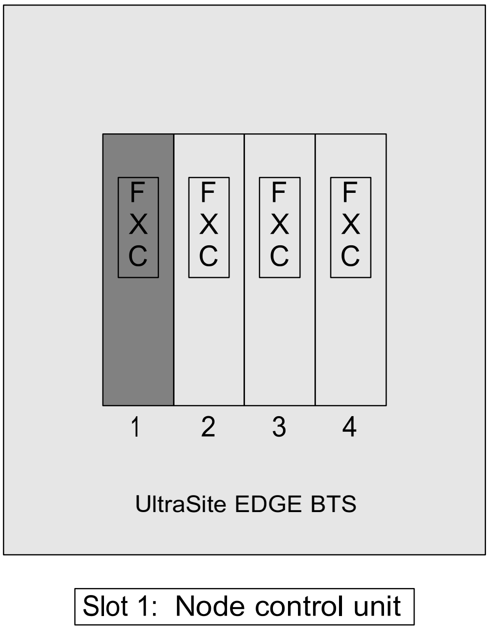


Figure 41. Transmission unit slots in Ultrasite EDGE BTS

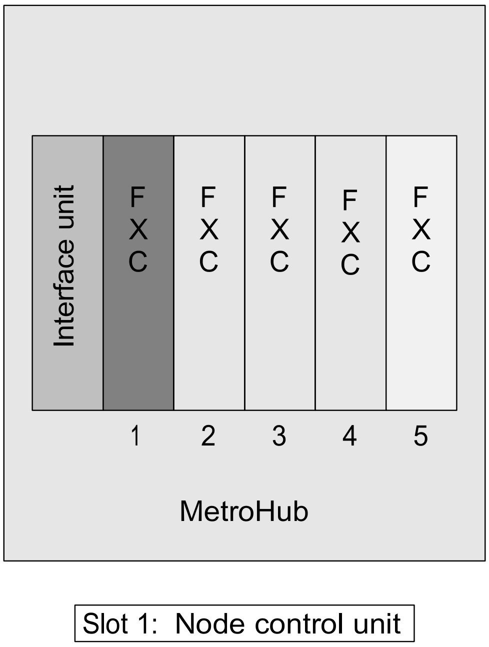


Figure 42. Transmission unit slots in MetroHub

7.7 Technical description of the synchronisation of FXC transmission units

Synchronisation is needed to be able to make cross-connections on sub-2M level without causing slips in transmission. It is recommended that the synchronisation input is taken from an upper network element, typically a base station controller (BSC) in the BSS. Also the synchronisation of base stations (BTS) in the BSS can be done via transmission equipment. If there is an SDH transmission layer used in the BSS, synchronisation of the SDH equipment is also needed.

Therefore an FXC node in the BSS is usually synchronised to a reference provided by the BSC. The BSC head-end transmission node is synchronised via a 2M payload signal or a 2 MHz synchronisation input from the BSC, and distributes the synchronisation further to other network elements in the BSS. In case of an FXC STM node, this is done via STM-1 signals.

Synchronisation functions are configured using management applications.

Synchronisation of transmission nodes equipped with FXC (PDH) units

In a transmission node equipped with only FXC (PDH) units, all platform interfaces can be used as a synchronisation source. The clock is selected based on availability and priority from a four-level priority list, generated by the user according to the current network configuration. If none of the recovered line clocks in the priority list is available, all the FXC units are synchronised to the internal oscillator of the node control unit.

Synchronisation of transmission nodes equipped with FXC (PDH) and FXC STM-1 units

In a transmission node equipped with both FXC (PDH) and FXC STM-1 units, the node clock functionality is split between the PDH node clock and the SDH node clock. In normal operation the PDH node clock is synchronised to the SDH node clock. The BTSs are synchronised to the PDH node clock. Therefore, the BTS synchronisation towards the BSC is established using the SDH network, which is between the BSC and BTS. If the SDH node clock is not available (for example, due to unit fail), the FXC (PDH) node clock master runs on its own internal oscillator.

The FXC STM-1 transmission unit supports the SDH node clock function. The SDH node clock can be synchronised to any external STM-1 interface. If the FXC Bridge is plugged into slot 1, the SDH node clock can also be synchronised to the first E1 signal of an FXC E1 or FXC E1/T1 unit (for exampe at a BSC head-end site) or to an arbitrary E1 signal inside the Flexbus signal of an FXC RRI unit.

The SDH node clock supports three modes: locked, holdover, and free-run. In locked mode, the SDH node clock is synchronised either to an external STM-1 or E1 interface. In holdover mode, the SDH node clock has lost its controlling reference input and is using stored data (acquired while in locked operation) to control its output. In free-run mode, no synchronisation reference has been available and the node clock master runs on its own oscillator clock.

Available synchronisation sources are chosen in the order of importance. In case of the SDH node clock function, the highest quality source is used to synchronise the equipment clock. If several sources of the same quality are available, the source with the higher priority is used. For PDH node clock function, the available reference source with the highest priority is always taken.

Note that if an E1 signal is used as the synchronisation source for a node equipped with both FXC (PDH) and FXC STM units, the FXC Bridge unit must be set up as the master unit and the quality of the E1 signal must fulfil the SDH standard, although it is an PDH signal. This means that the frequency deviation of the E1 signal must be ±4.6ppm (SDH standard). The ±4.6ppm accuracy of the E1 signal used as reference for the SDH node clock must be ensured by the network operator. An inaccuracy of more than ±4.6ppm up to approximately ±15ppm cannot be detected by the SDH node clock function. If the inaccuracy is more than ±15ppm, the node switches to the next entry in the synchronisation list and the alarm *124 Synchronization fault in clock recovery* or *125 Loss of synchronization signal(s)* is raised, although the signal could still be in the valid PDH range.

Behaviour of node synchronisation in case of a frequency shift beyond ±15ppm of the SDH network reference clock

In normal operation the FXC STM node is synchronised to an STM-1 input signal with an accuracy of ±4.6ppm towards the 155 520 KHz STM-1 reference. Due to a failure of transmission equipment, the STM-1 synchronisation input signal may deviate more than approximately ±15ppm towards the 155 520 KHz STM-1 reference, and the signal is still used as a synchronisation source for the node. In this case, the node switches to the next synchronisation source in the priority list. When the quality of the network reference clock gets within a valid range for the synchronisation source, the node automatically takes the synchronisation source into use again. This process can take up to 11 minutes. As long as the node is in a frequency shift state, the message *Do not use* is transmitted as the synchronisation status message in the S1 byte of the STM multiplex section overhead.

The above described case can occur also when using an E1 signal as the synchronisation source and the E1 signal accuracy deviates more than ±15ppm from the 2048KHz reference.

7.8 Technical description of Q1 management

Q1 is an NSN proprietary management protocol and it is backwards compatible with the currently used Q1. In this information set, NSN Q1 is referred to as Q1. Q1 is a polling protocol used for transferring information between a master and a network element. Each network element in a Q1 network has a unique Q1 address. The polling master accesses network elements using the Q1 address. This address has to be in the range 0–3999. In the BSS, the BSC is typically the polling equipment. The Q1 group address is used for broadcasting the Q1 management messages to several pieces of equipment within the same group. This is for future usage. These kinds of broadcasting actions could be, for example, software downloading to several nodes simultaneously.

MetroHub is a Q1 network element. MetroHub is a single network element with one Q1 address. Even if there are radio outdoor units connected to an FXC RRI transmission unit, they do not have their own Q1 addresses.

The interface unit of MetroHub provides the interfaces for local or remote management of the equipment: LMP (local management port) and Q1. Both ports have their own Q1 address and baud rate settings. LMP and Q1 interfaces are independent of each other and the node can be accessed from both of the interfaces at the same time. Two interfaces for LMP and Q1 enable chaining of both interfaces with an easy point-to-point cabling.

LMP-1 and LMP-2 interfaces are used for local access with MetroHub Manager. The LMP port has the general address of 4080. This address can be used if the LMP is not chained. The manager uses this address when the **Connect Locally...** option is selected. If the LMP is chained, a unique Q1 address must be selected for the LMP and the connection to the node is established with the **Connect...** option in the manager.

Q1-1 and Q1-2 interfaces are for remote management of external Q1 equipment. To enable remote management, a transmission channel for Q1 has to be created with the manager. This channel is called EOC, embedded operations channel. The channel can be transmitted either in the radio overhead or in a selected time slot inside a 2 Mbit/s signal. When the radio overhead is used, the sampling rate is always at least 64 kHz. With STM-1 the EOC connection is handled in the exact same way, as you can cross-connect the 2M channel of an STM-1 interface towards FXC Bridge.

The following figure shows examples of Q1 network connections. The NMS forms the user interface. Between the NMS and BSC exists, for example, an X.25 connection. In this example, the BSC is the polling device. The Q1 data is transported inside a 2 Mbit/s signal between the BSC and MetroHub #1. Then Q1 continues towards MetroHub #2. For this there are two options. The first one (A) shows that the Q1 is in the overhead of the radio connection between MetroHub #1 and #2. The second option (B) is that the Q1 is inside a 2 Mbit/s frame between both nodes. In addition, it is possible to extract the Q1 signal from MetroHub #1 and poll another Q1 element, in this example: FIU 19.

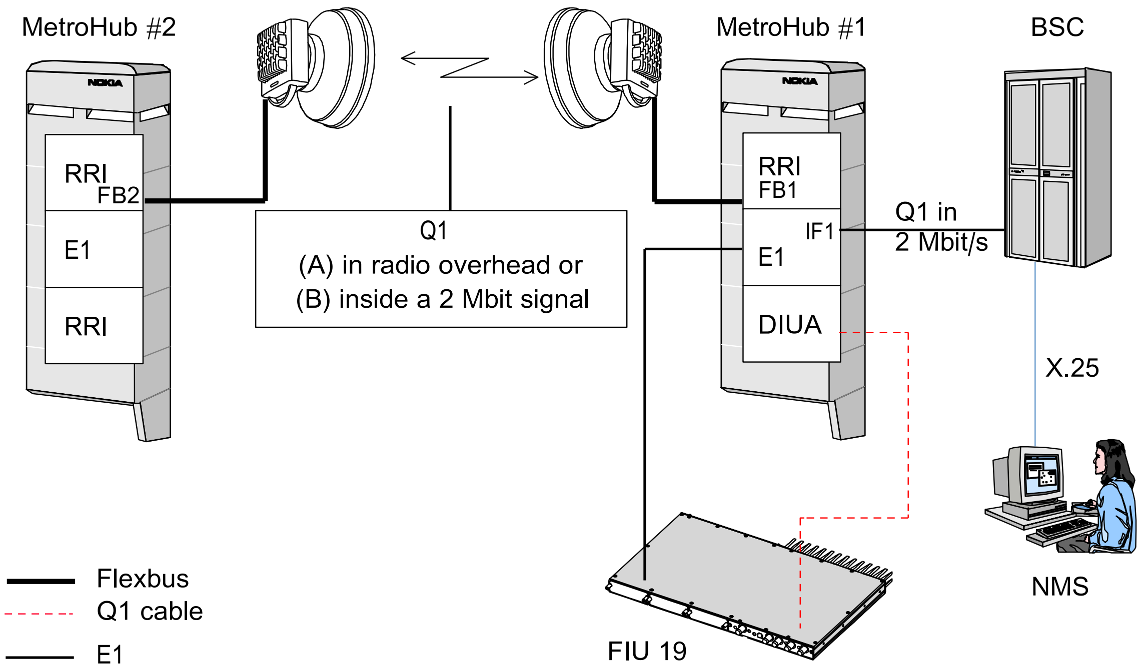


Figure 43. Examples of Q1 network connections

Local management bus

The Local Management Bus (LMB) connects the node control unit to the Local Management Port (LMP).

Q1 buses in a network

Large Q1 networks are sometimes divided into Q1 buses because of reliability and polling time issues. In this case, several Q1 channels are created in the polling equipment, for example, the BSC. These channels are used to divide the network logically into different Q1 networks.

If Q1 buses are used, the Q1 channels must be considered as normal data channels up to the place where the Q1 bus usage starts. In the nodes starting from the polling equipment up to the place where Q1 bus usage starts, the Q1 channels have to be cross-connected as normal data. In the nodes that are in the Q1 bus, the EOC is used for dropping the Q1 channel to the node control unit processor, as well as for forwarding the channel to the next network element.

7.9 Technical description of the performance management of FXC transmission units

7.9.1 Performance data for FXC E1/T1, FXC E1, and FXC RRI

FXC E1/T1 and FXC E1 line interfaces, FXC RRI platform interfaces, FXC RRI Flexbus interfaces, and the connected outdoor unit(s) support the following performance measurements:

Table 33. Interface performance measurements

ID text	Infinite counter	24 h counter	15 min counter	Current value	Measuring unit	Description
G.826 TT	X**)	X	X		seconds	Total time as specified in G.826
G.826 AT	X**)	X	X		seconds	Available time as specified in G.826
G.826 ES	X**)	X	X		seconds	Errored seconds as specified in G.826
G.826 SES	X**)	X	X		seconds	Severely errored seconds as specified in G.826
G.826 BBE	X**)	X	X		counter	Background block errors as specified in G.826
G.826 EB	X**)	X	X		counter	Errored block as specified in G.826
Frame sync lost	X**)				counter	Number of FSL errors since the counter was last cleared
Line attenuation				X	dB	Current line attenuation*)

Table 33. Interface performance measurements (cont.)

ID text	Infinite counter	24 h counter	15 min counter	Current value	Measuring unit	Description
Line code violations	X					Linecode violations at E1/T1 interfaces as specified in ANSI T1.403*)
Controlled slip event	X					Controlled slip events at E1/ T1 interfaces as specified in ANSI T1.403 *)
RX level Min/ Max				X	dB	RX level at the air interface of the connected outdoor unit
RX level Min/ Max records		X	X		dB	RX level in the air interface of the connected outdoor unit
Block error ratio				X		BER measured in the Flexbus interface
Forward error correction				X		Number of bit errors detected by the FEC decoder in the connected outdoor unit for the received air signal

*) Measurement is only supported for FXC E1 and FXC E1/T1 line interfaces

**) An infinite counter is not available for the FXC RRI Flexbus interfaces and connected outdoor units

Table 34. Unit performance measurement

ID text	Infinite counter	24 h counter	15 min counter	Current value	Measuring unit	Description
CPU reset	X				counter	Number of unit CPU resets since the counter was last cleared
Timeslot monitoring				X	data	Data of selected timeslot

ITU-T G.826 defines error performance events for SDH/PDH based networks that are intended as basis for the error performance parameter calculations and provide information about the status and quality of a transmission link.

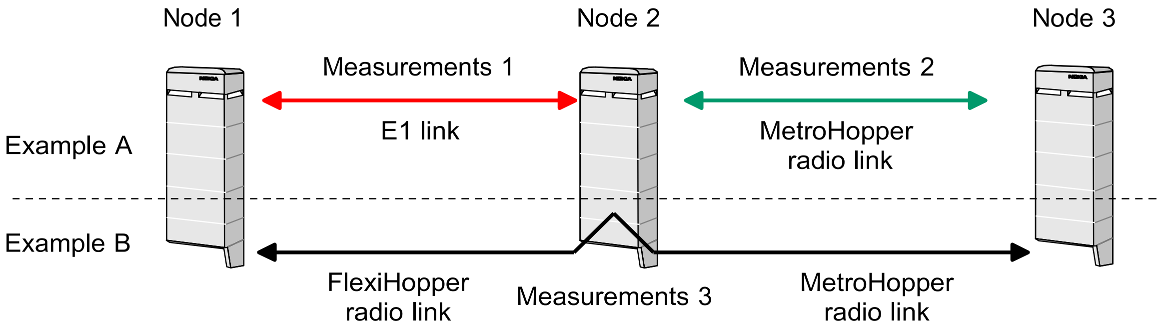
The following error performance events are collected with ITN transmission interfaces according to G.826:

- errored blocks
- errored second
- severely errored second
- background block error

In the use of a leased line, end-to-end performance measurement for the quality of the leased line is only possible if the leased line provider does not terminate and re-generate the signal framing over the path of the leased line.

Performing a unit reset clears all counters, except the CPU reset counter, the value of which is saved to flash memory. You can clear all counters with the node manager. Performance monitoring data can be read with the node manager and with the BSC.

The BSC has TRE (G.826) and TRE_SEL (G.826 and RX-input level Max_Min from radio outdoor units) measurements. The measurement period with TRE is always 24h. For the TRE_SEL measurement, the intervals of 15, 30 or 60 minutes, or 2, 3, or 24 hours are available.



Node = UltraSite, MetroSite or MetroHub

Figure 44. Measurements

Note that the G.826 performance measurements done with ITN rely on checksums that are part of the framing of an E1/T1, Flexbus, or STM-1 signal. As a result, the performance can be measured from the point where the signal framing is created up to the point where the signal framing is terminated.

Example A

Measurements 1 are carried out between Node 1 and Node 2, where the connection is set up through an E1 line. Measurements 2 are made between Node 2 and Node 3 along a connection created with MetroHopper.

The line attenuation measurement available in FXC E1 and FXC E1/T1 line interfaces are intended to give an indication about the current line attenuation. For accurate attenuation measurements of an E1 line, a dedicated measurement equipment should be used.

Example B

Measurements 3 are carried out between Node 1 and Node 3, where the cross-connections in Node 2 are implemented by using the traffic bypass feature. In this case, the signal is not terminated in Node 2, since cross-connections made through traffic bypass are transparent on the 2 Mbit/s level. The connection between Node 1 and Node 2 is set up using FlexiHopper (Plus) and the connection between Node 2 and Node 3 is set up using MetroHopper.

7.9.2 Performance data for FXC STM-1 and FXC Bridge

Performance data for the FXC STM-1 and FXC Bridge units is collected for the multiplex section (MS), regenerator section (RS), virtual container 4 (VC-4), and virtual container 12 (VC-12) as 15 min history records, 24 h history records, and 24 h current records.

The FXC Bridge platform interfaces:

- have no performance data collection.
- do not support timeslot monitoring.
- do not support a frame synchronisation lost counter.

FXC STM supports optical power level measurement due to the sensitivity of the measurement circuitry, only the following values are shown when the power level crosses the following thresholds:

- Rx power level with -30 dBm and below is shown as < -30 dBm.
- Rx power level with -10 dBm and above is shown as > -10 dBm.
- Tx power level with -6 dBm and below is shown as < -5 dBm.

The table below lists the statistics for STM-1 interfaces and SDH-PDH channels and the statistical error counters that are used for the STM-1 interfaces and the SDH-PDH channels.

Table 35. Statistics for STM-1 interfaces and SDH-PDH channels and statistical error counters

Counter	Value	Description
TT	seconds	Total Time: all seconds in one time period
AT	seconds	Available Time AT = TT - UAS (where UAS = Unavailable Seconds)
ES	seconds	Errored Seconds: seconds with one or more errored blocks

Table 35. Statistics for STM-1 interfaces and SDH-PDH channels and statistical error counters (cont.)

SES	seconds	Severely Errored Seconds: a subset of ES. G.826 gives two definitions for SES. In Q1, the definition of SES as ≥ 30% errored blocks in one second period is adopted.
BBE	counter	Background Block Errors as specified in G.826

The G.826 statistics can be viewed as either counts or ratios.

Counts are either seconds or blocks:

- VC-4 = 8000 blocks/s
- VC-12 = 2000 blocks/s
- MS = 192 000 blocks/s (One block has only one bit.)
- RS = 8000 blocks/s

Ratios are calculated with the following rules:

- AT ratio = AT / TT
- ES ratio = ES / AT
- SES ratio = SES / AT
- BBE ratio = BBE / [ABBE x (AT – SES)] where ABBE =Available Blocks in one second

Note that the SES counter is incremented, when more than 30% of the blocks measured in one second are errored, except for the Multiplex Section layer, where the SES counter is incremented according to G.829 (when more than 15% of the blocks measured in one second are errored).

8 Traffic protection

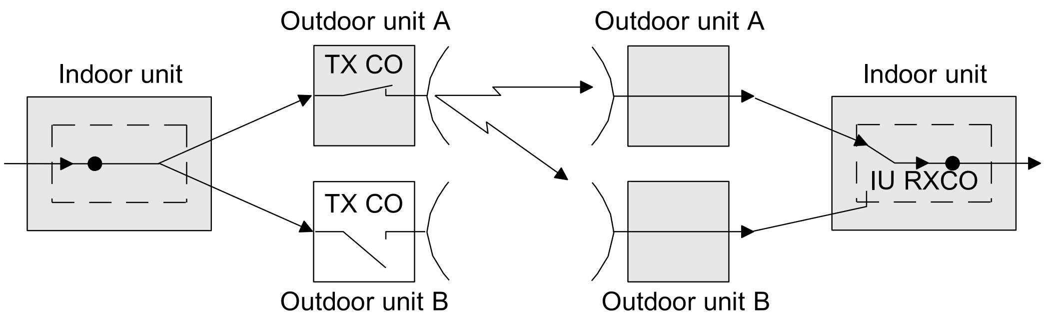
8.1 Technical description of hot standby with the FXC RRI transmission unit

8.1.1 Introduction to hot standby

Hot standby (HSB) is a method of equipment protection in which two radio transmitters are kept ready (switched on), so that if one fails, the other one immediately picks up where the first one left off.

In single mode use, the signal is not protected against equipment or propagation faults. If there is a fault, the connection remains broken until the equipment fault has been repaired or the cause for the propagation fault disappears. Hot standby provides protection against faults in the equipment.

The supported hot standby setup of one FXC RRI transmission unit with two FlexiHopper (Plus) outdoor units is shown in the following figure. Active units are shown in grey and passive units in white.



IU RXCO   Indoor unit hitless changeover switch (In ASIC)
TX CO   Transmitter changeover switch (transmitter mute control)

Figure 45. FlexiHopper (Plus) radios with FXC RRI, 1IU/2OU hot standby (only one direction shown)

In hot standby mode, the transceivers of both radios are on but the transmitter of the protecting radio is in mute state. The changeover criteria are divided into three cases: (OU) receiver changeover for HSB, (OU) receiver changeover for diversity, and (OU) transmitter changeover for HSB. These are independent of each other.

Note

Connecting a Flexbus cable to a passive outdoor unit of an operative protected hot standby unit may cause bit errors to the transmitter and receiver of the active outdoor unit.

8.1.2 Hot standby and space diversity (HSB + SD)

HSB + SD protects against both equipment faults and propagation fading. The setup is similar to HSB, except that the antennas of the radios are placed so far apart that the same propagation problem is unlikely to occur simultaneously at both antennas.

HSB is equipment protection in which switching very rarely - if ever - occurs, whereas with space diversity, receiver data is taken on a frame by frame basis, based on the Forward Error Correction (FEC) Bit Error Ratio (BER).

8.1.3 Outdoor unit transmitter changeover switches

Outdoor unit transmitter changeover switches are controlled by the processor of the indoor unit. The active outdoor unit is changed if a hardware fault is detected in the unit or if the far-end radio cannot receive the signal. Changeover can also be performed when the reception quality at the far-end has been degraded.

Possible transmitter faults are:

- Flexbus cable is disconnected or broken.
- Flexbus power is off.
- Flexbus 'in use' setting is turned off.
- Flexbus loop to interface or loop to equipment is set active.
- Outdoor unit is not capable of transmitting for one or more of the following reasons:
  - Tx lock is lost in Flexbus cable interface.
  - MWU lock is lost.
  - Tx power setting is off.
  - Tx frequency has not been set.
- Both far-end outdoor units have lost their lock to the Rx signal (R-bit is sent from the far-end)
- Outdoor unit defect.

Tip

Tx changeovers are disabled and the traffic is cut during protected hop fading margin measurement. For more information, see *Fading margin measurement*.

The FXC RRI unit also supports Lazy (OU) transmitter changeover, in addition to the instant (OU) transmitter changeover, see *Lazy transmitter changeover*.

8.1.4 Indoor unit changeover switch

The indoor unit Rx changeover switch is located in the ASIC, and it is hardware controlled. The changeover is based on the detected and corrected FEC (forward error correction) errors. The Rx changeover is also possible by the control of the indoor unit's processor. In receiver changeover, depending on the received radio signal quality and available receivers, the system tries to minimise the errors in the received data via selecting the outdoor unit with the lower bit error ratio. When the active receiver receives a serious fault, a receiver changeover is made. During the changeover, bit errors occur and synchronisation is momentarily lost.

Possible serious receiver faults are:

- Flexbus cable is disconnected or broken.
- Flexbus power is off.
- Flexbus 'in use' setting is turned off.
- Flexbus loop to interface or loop to equipment is set active.
- Flexbus Rx signal frame lock has been lost.
- Outdoor unit Rx signal lock has been lost.
- Outdoor unit defect.

8.1.5 Alarms that occur with changeovers

After the changeover, the system activates the alarm *128 Fault in equipment* including information about which unit is faulty. Other alarms of the faulty unit show the actual reason for the fault. After the fault has been corrected (for example, the unit has been replaced and commissioned) the system activates the hot standby protection method and clears the alarms.

If the passive transmitter breaks down, the system activates the *128 Fault in equipment* alarm and Tx changeover is not possible until the fault has been fixed.

Note that when an outdoor unit of a hot standby protected hop is replaced, the outdoor unit settings of the new outdoor unit should be checked (it may be in the default state) with the node manager. The Tx frequency and interleaving settings must be the same in both outdoor units of the hot standby protected hop. If the settings are different, the *143 Fault in changeover function* alarm is activated. In that case, the changeover is still possible, but after the Tx changeover, the frequency may be invalid.

8.1.6 Frequency diversity

In frequency diversity, there are two parallel microwave radio links utilising different frequencies. The drawback of frequency diversity is that the operator needs two separate radio channels for which the license has to be obtained. Frequency diversity can be used predominately to combat atmospheric multipath fading.

Figure *Configuration for frequency diversity with one indoor unit* shows principles for a frequency diversity hop. In the figure there is one indoor unit, but the indoor unit can also be protected. This figure describes the principles when two antennas per site are used. In the one-antenna frequency diversity scheme a circulator is used to connect two outdoor units with the antenna (Figure *Configuration for one-antenna frequency diversity*).

For more information on the protection methods, see *Application Note - Protection Methods in FlexiHopper and FlexiHopper Plus Microwave Radios*, which is available in Nokia Online Services (NOLS).

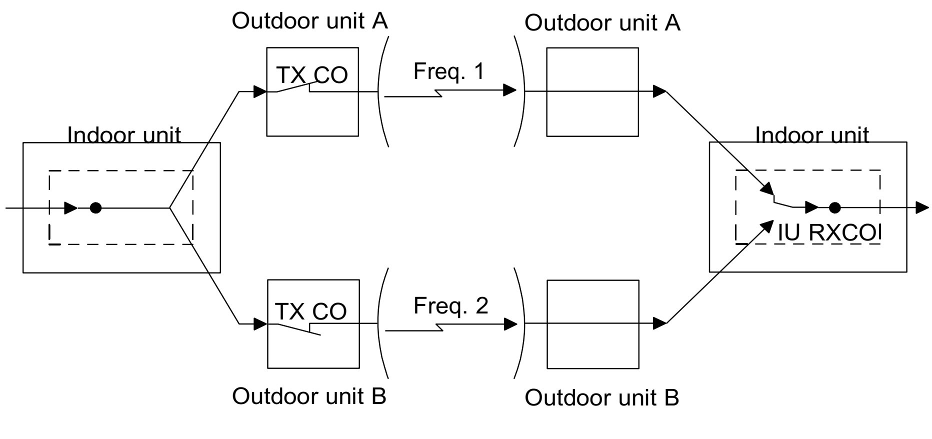
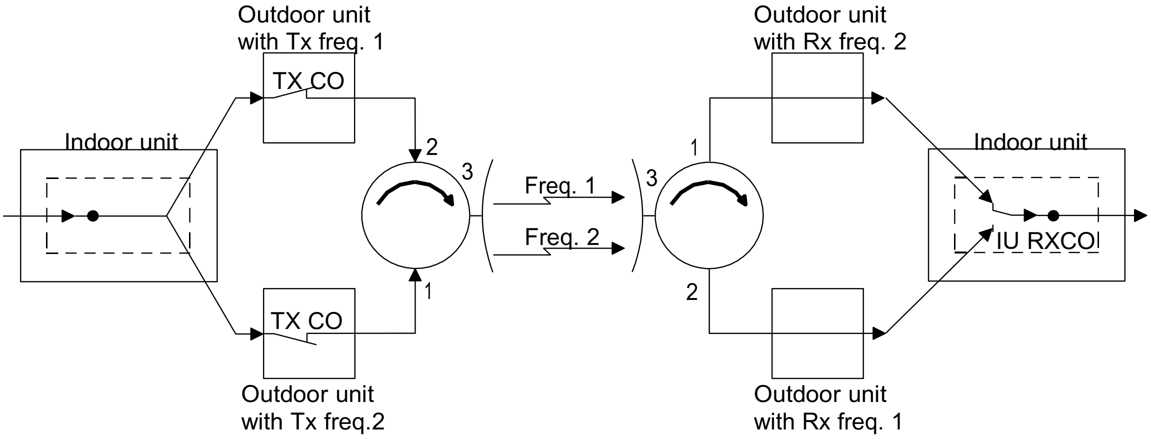


Figure 46. Configuration for frequency diversity with one indoor unit



1 = circulator port 1
2 = circulator port 2
3 = circulator port 3 (antenna port)

Figure 47. Configuration for one-antenna frequency diversity

8.2 Technical description of PDH transmission network protection using loop topology

8.2.1 Introduction

Loop protection is considered the most efficient way to protect traffic in a transmission network such as a base station subsystem (BSS). In a live telecommunications network it is important to secure, in addition to the actual payload traffic, the network synchronisation and the centralised network management during any period of abnormal circumstances.

For these reasons, loop protection protects:

- payload traffic
- network synchronisation
- network management connections.

A transmission loop formed with Nokia Siemens Networks (NSN) elements consists of a loop master and one or more loop slaves. Usually the loop master is a transmission node, whereas the loop slaves can be either transmission nodes, BTSs or a combination of both inside one loop.

The loop principle is that the transmitted signal is always sent in both directions, but the received signal is selected from one direction only. The loop master sends pilot bits on the basis of which the switching decision is made. Each individually protected slave station needs one pilot bit.

Network synchronisation must also be ensured in a loop network and it follows the loop principle in a similar way. The synchronisation switching takes place independently from the pilot bits by having Master Clock Bit (MCB) and Loop Control Bit (LCB).

Based on the configured priorities, each network element decides individually from which direction the signal and the synchronisation will be received, and, thus, it does not require any external or additional supervision for its decision.

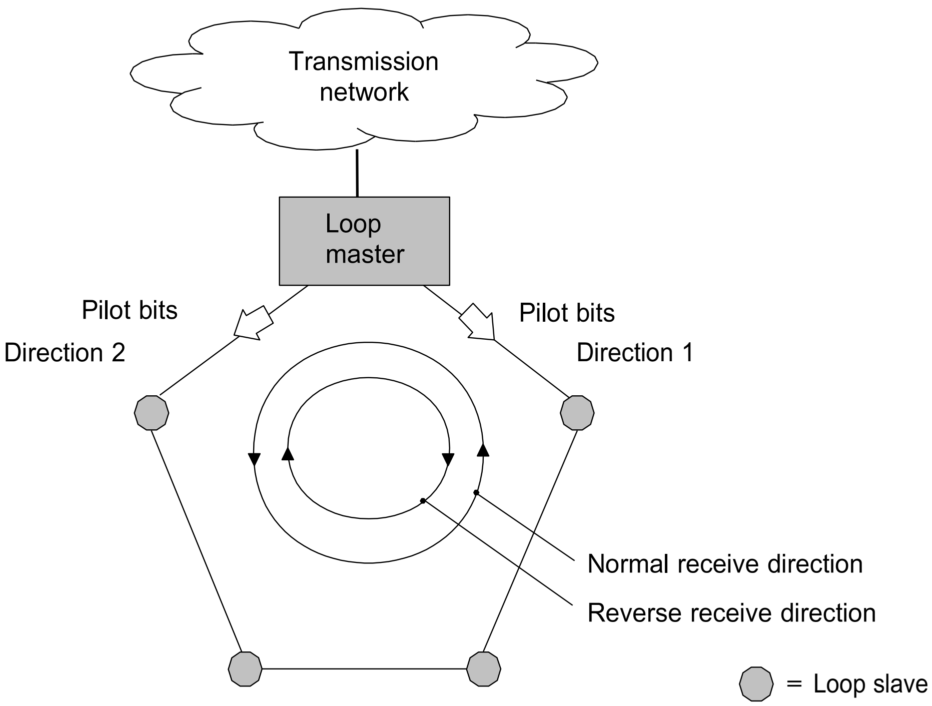


Figure 48.   Loop principle

NSN's way of implementing loop protection is ultimately secure, providing very fast route switching that recovers the transmission connections instantly. Loop protection is embedded and thus very fast. Loop protection protects against failures, such as cable-cuts, equipment failures, heavy rain and multipath fading, and against obstacles in the line-of-sight, such as cranes and growing trees.

Compared to an unprotected wireless network, loop protection increases site availability at least tenfold and prevents end-of-chain availability degradation.

Loop protection is an easily activated system feature where MetroHub and UltraSite EDGE BTS can act as the master node. In addition, several MetroHub nodes and base stations can be looped together.

The protection functionality is compatible with the existing BSS transmission.

For more information refer to the *PDH Loop Protection in GSM Networks* document that can be obtained upon request.

8.2.2 Protecting payload traffic

A pilot bit is a special kind of bit with a preset value (zero), and it is sent among the protected traffic in a known position. For example, protecting a 2 Mbit/s link requires one bit out of the 2 Mbit/s stream to be reserved for this purpose. Similarly, if the traffic is protected at a partial 2 Mbit/s level, for example, because two different base stations share one 2 Mbit/s line, one pilot bit is required for each slave station.

The location of the pilot bit is defined in the network plan, and it is often within one of the last time slots of the 2 Mbit/s frame. In principle, the location can be selected freely, but a harmonised practise in the network may be advisable for easy site commissioning and network documentation.

The state of a pilot bit is set to 0 (zero) at the sending station, which sends identical digital streams (payload and the pilot bit protecting it) in directions 1 and 2 in the loop.

Any failure in the connection between the sending station and the intended destination causes the pilot bit to change from zero to one (based on AIS). Thus the target station, receiving a 'one' instead of a 'zero' knows that the connection is faulty.

The following figure shows the loop principle between the loop master and one slave. The traffic in the other slave stations is bypassed.

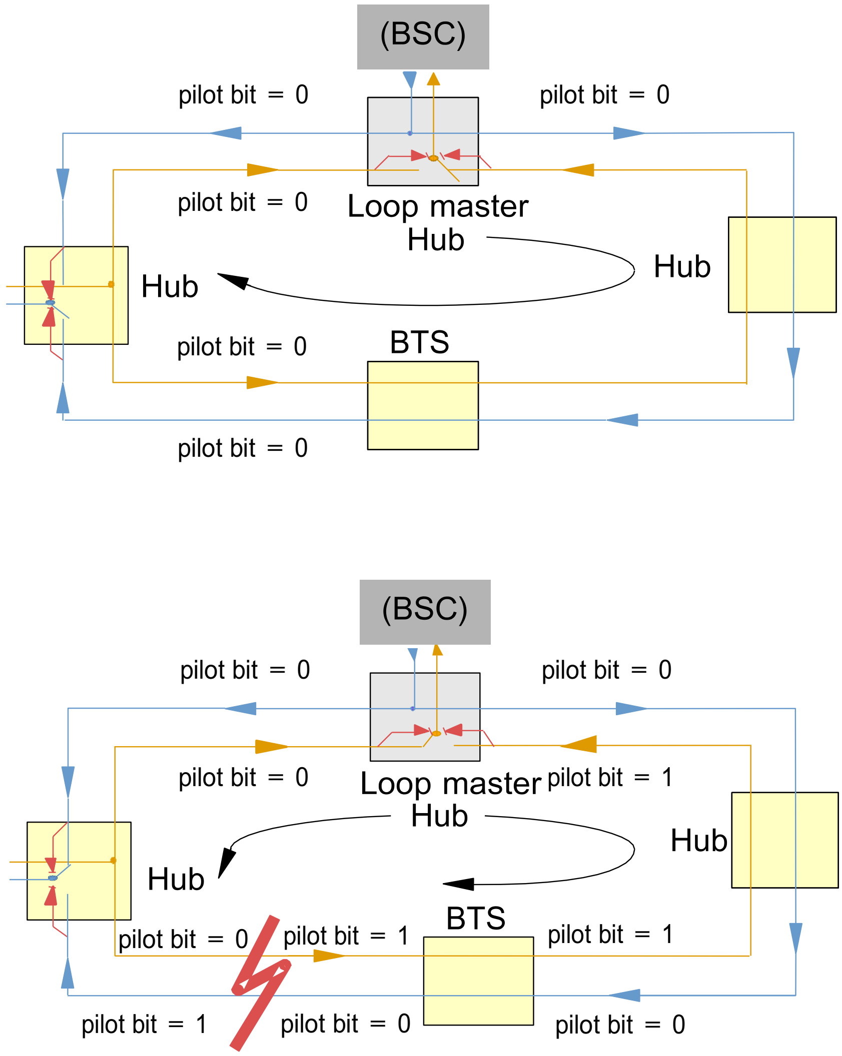


Figure 49. Traffic protection guided by pilot bit monitoring

The pilot bit is sent at the loop master MetroHub site for all the slave stations as zero with 'Uni-directional fixed data' or 'Bi-directional masked' types of cross-connections. You can reduce the amount of connections from two uni-directional to one bi-directional if you use the bi-directional masked type of cross-connection.

Masking pilot bits

The principle of masking in the loop network is to use the logical 'AND' operation with '0', when the result is always '0', and masking with '1' when the output is the same as the input signal (either unchanged '0' or '1').

In the example in the following figure, the pilot bits are sent from the loop master node to eight slave nodes in the loop. The view is from a cross-connection termination point setting.

Note that all bits are masked as '0' because they are all used in the master node.

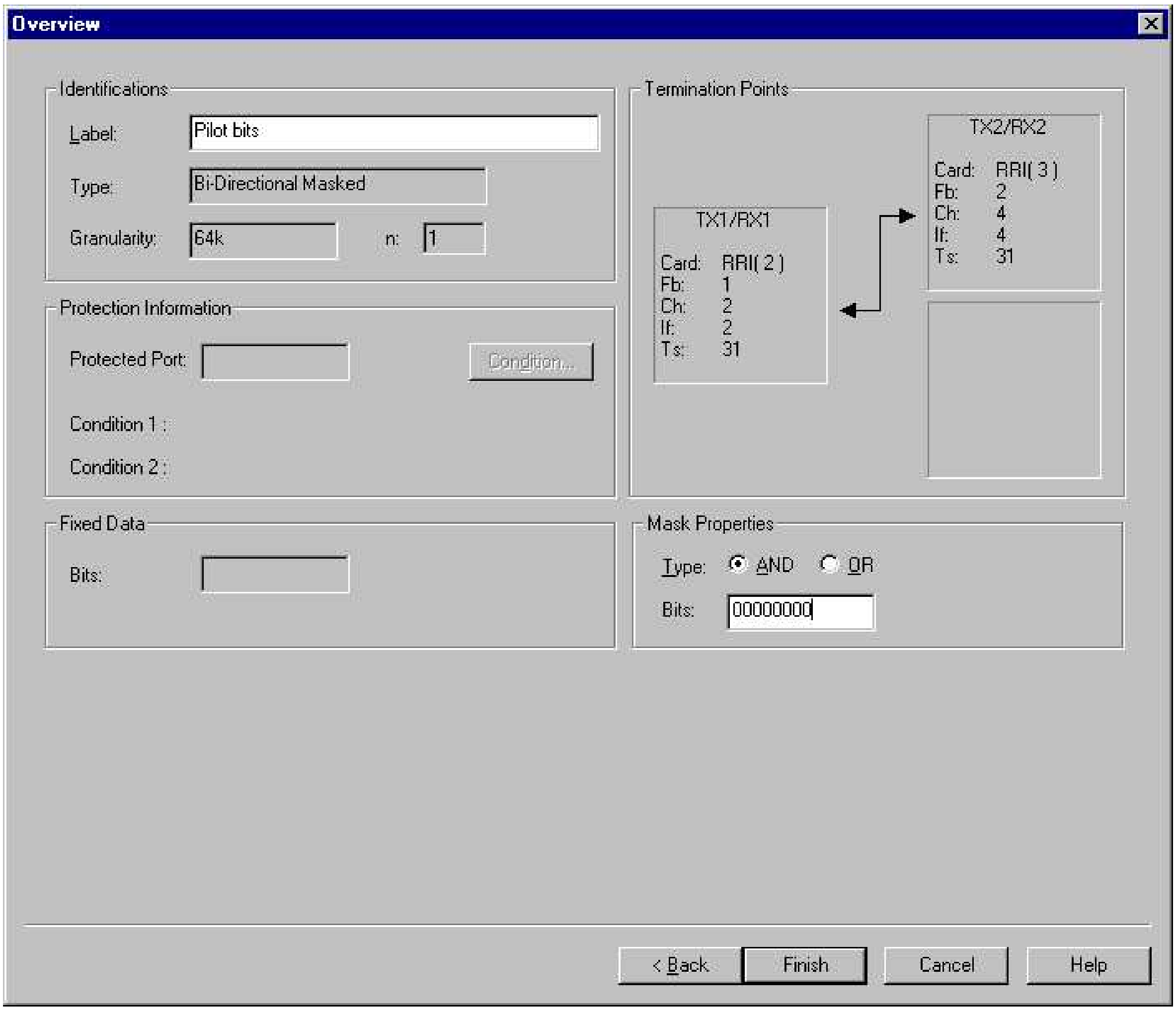


Figure 50. Pilot bit sent from a loop master

At loop slave sites, each node must forward the pilot bits from other slave stations unchanged and send its own pilot bit as zero in both loop directions. This is done with the bi-directional masked type of cross-connections. The following figure presents the pilot bit masking of the second slave node (bit 2) and other pilot bits forwarding in the loop. The view is from a cross-connection termination point setting.

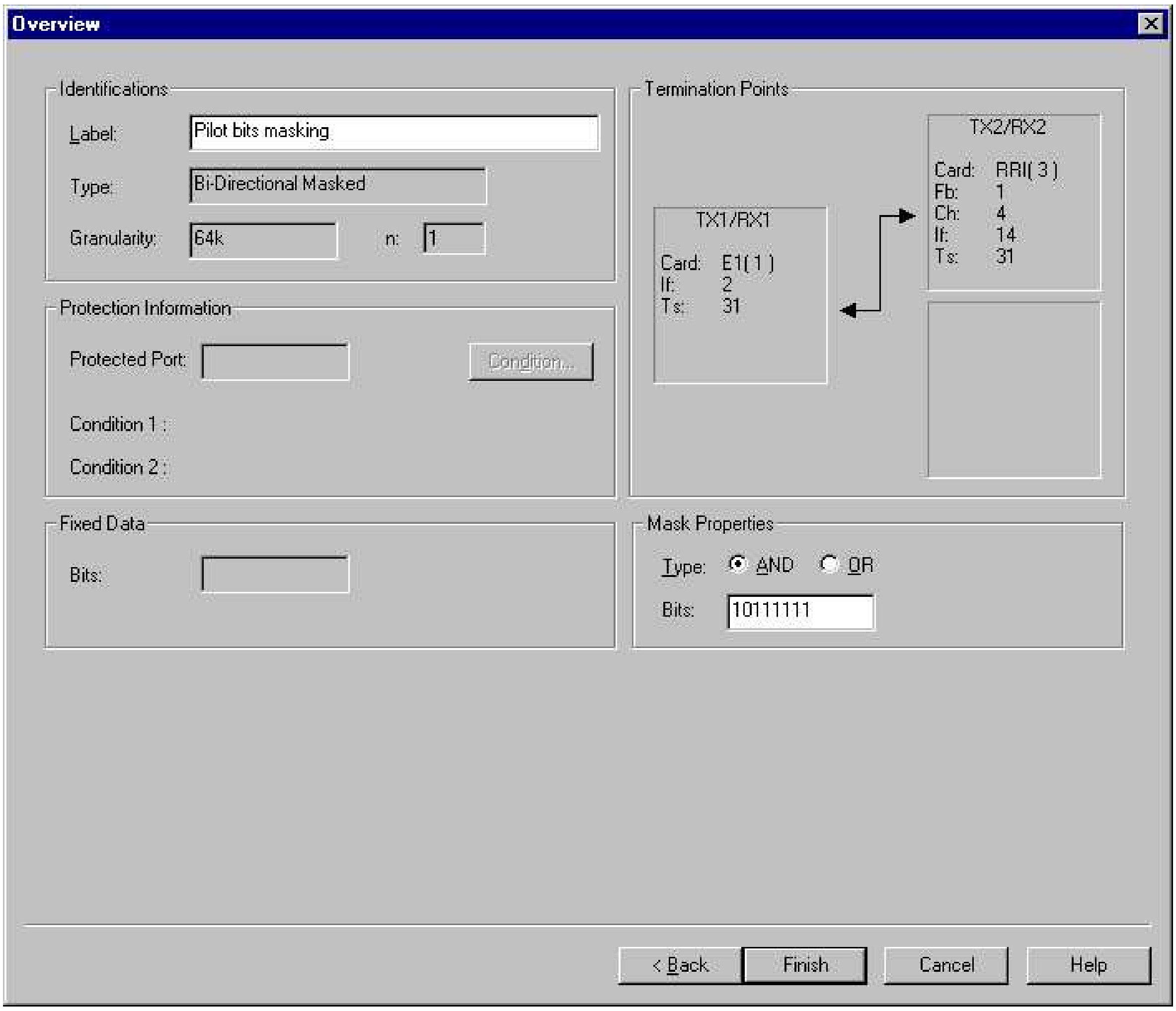


Figure 51. Pilot bit masking in the second loop slave

Loop protection can be configured either as equal switching or priority switching. The difference between these is that in priority switching the connection returns to the initial route as soon as the problem on that link is solved, whereas with the equal switching the system stays on the selected link until it gets faulty. Equal switching provides better stability for the connection, and it is therefore the recommended choice for BSS networks.

8.2.3 Protecting network synchronisation

The implementation mechanism for an automatic detection and recovery of missing or looped network synchronisation is based on loop network clock control bits carried within the protected 2 Mbit/s stream:

- one bit for detecting if the incoming signal is synchronised to the original network synchronisation master or not (master clock bit, MCB), and
- one bit for detecting any breaks or for avoiding loopbacks in the synchronisation chain (loop control bit, LCB).

The loop master sets the MCB and LCB to '0' (zero) state in both directions. Any station using a certain received signal for synchronisation sends the LCB back as '1' (see the following figure), so that the counterpart knows that the synchronisation of the incoming stream is inherited in such a way that it must not be used for synchronisation, to avoid a loopback or otherwise faulty synchronisation. The same applies to all slaves to make sure the synchronisation remains intact.

Similarly, faulty transmission replaces MCB and LCB with '1' so that the affected stations know they are not receiving a valid source signal from that direction.

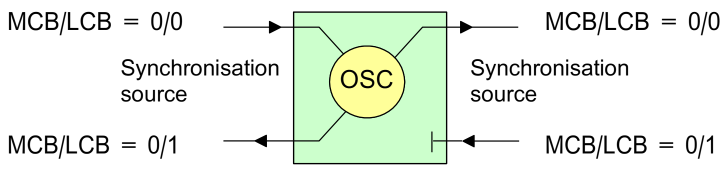


Figure 52. Manipulating synchronisation loop control bit

Based on the following information, the transmission node recognises if it is defined as the master or slave:

- if the interfaces containing the MCB and LCB bits are missing from the synchronisation list, the transmission node is a master
- if the interfaces containing the MCB and LCB bits are in the synchronisation list, the transmission node is used as a slave

The following figure presents the setting of MCB/LCB bits in two directions in different FXC RRI units.

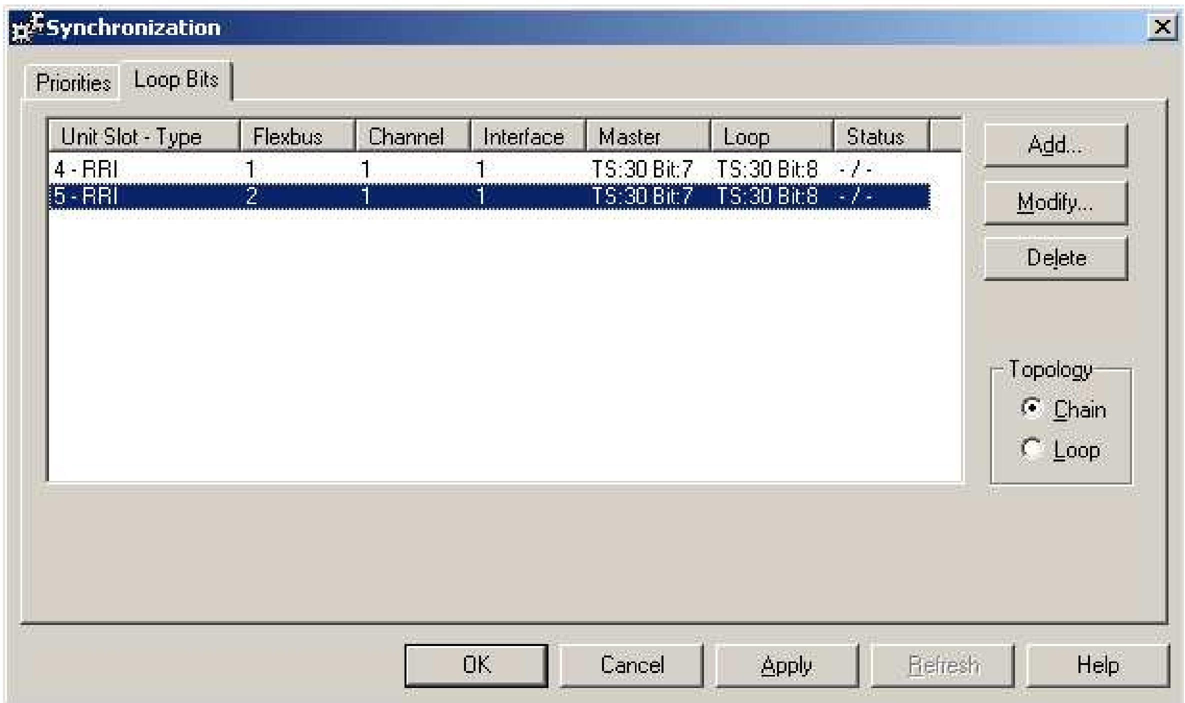


Figure 53. Setting of loop control bits

Note that node synchronisation is always based on priority. The synchronisation always returns to a higher priority route whenever the problem in that link is solved. This does not cause any problems in the traffic, as the synchronisation is coming from the same loop master.

The location of the MCB and LCB is defined in the network plan. In principle, the location can be selected freely, but a harmonised practise in the network is advisable for easy site commissioning and network documentation.

8.2.4 Protecting remote network management channel

This section is only applicable to a BTS integrated transmission node when managed by a dedicated Q1 channel. In most occasions the O&M channel of the BTS is also used to transfer management data for the transmission node, in which case the payload loop protection concept can be applied.

The Q1 network management channel used to manage PDH transmission elements is a bus, and therefore it must not be looped.

Q1 loop protection is based on switching into a faultless direction when there is a break somewhere in transmission. The direction is changed according to an LCB bit.

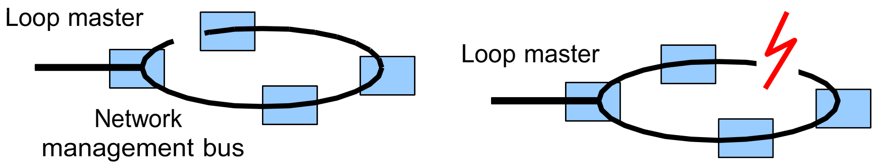


Figure 54. Network management bus circulation prevention

To avoid permanent circulation of Q1 commands and simultaneous polling from two directions, the Q1 loop must be terminated at the master node. This is the recommended way to implement Q1 network management bus protection with PDH loop protection. This termination is used when the loop master is a MetroHub node, UltraSite BTS node, or DN2.

To terminate the loop at the master node:

- LCB (from the last slave node) = 0 → no faults in the network → forced termination towards the last slave node (see above figure).
- LCB (from the last slave node) = 1 → fault in the network → forced termination removed

The loop master is configured so that it sends the network management channel in just one direction. When a fault occurs in that direction (the loop master detects it from the received LCB), it knows to allow the network management channel to propagate in both directions. The Q1 EOC hybrid switch must be set to the OFF state towards the Secondary Port direction in the loop master. In this case, no additional settings to the normal Q1 EOC channel are needed in the slave nodes.

In some cases, where the loop master is an older BTS integrated transmission unit (TRUx or BIUMD), Q1 protection must be done in the first loop slave on the secondary port side of the loop master. In this case, both the Q1 primary port and the secondary port must be defined for the loop slave. MetroHub, UltraSite EDGE BTS, and MetroSite EDGE BTS support Q1 slave protection.

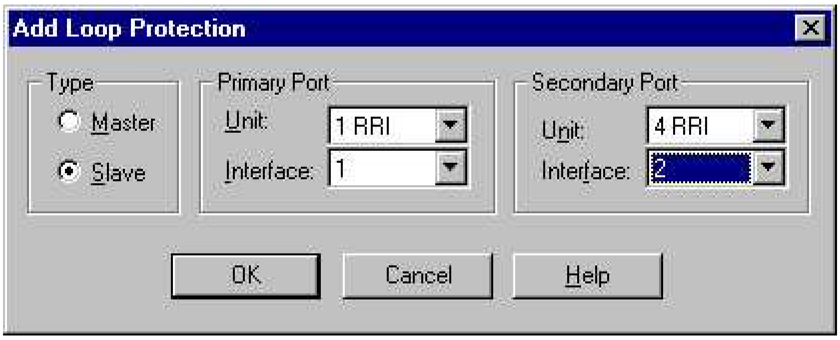


Figure 55. Setting of Q1 protection in the slave (in case of slave protection)

Note

Both the EOC and the MCB/LCB in the secondary port side must be defined in the same 2M interface for the Q1 loop protection to work.

8.2.5 Hints for using a loop network

- Use different FXC units for the protected and protecting ports of a connection to gain the maximum protection in the hardware reliability sense.
- A maximum of 16 synchronisation and network management channel protection loops can be used within a single node.
- When 16 x 2 Mbit/s capacity loops are built, each of the three loop directions require a separate FXC RRI unit.

For a MetroHub situated in a BTS site or UltraSiteHub, it is recommended to use the Q1 BTS as the polling device and not to protect the network management channel explicitly, but to protect the OMUSIG channel of the BTS implicitly.

Depending on the used loop architecture, the number of possible payload protection loops can be higher than 16 within a single node. The above-mentioned limitation of 16 loops is only for synchronisation and network management loops. The pre-condition is, however, that several loop slave nodes share the same synchronisation and/or network management loop or several payload protection loops are terminated in a single node.

For more information and examples, see the *PDH Loop Protection in GSM Networks* document that can be obtained on request.

8.3 Technical description of SDH transmission protection enabled by the FXC STM transmission unit

Subnetwork Connection (SNC) protection, ring protection scheme

The FXC STM node supports SDH ring protection by using the subnetwork connection protection scheme (SNC 1+1) on the VC-12 layer. Each path can be individually selected to be protected or unprotected. In a Multiplex Section Protection (MSP) scheme, the entire STM-1 signal is protected at all times. Using SNC 1+1 protection, the required transmission capacity can be optimised by protecting only the VC-12 paths that need to be protected.

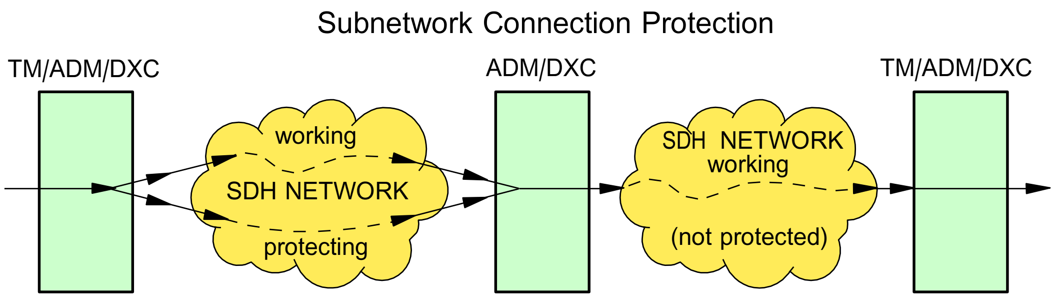


Figure 56. Subnetwork Connection Protection

The SNC 1+1 protected traffic is broadcasted at the entry point of the ring and transmitted in both directions. At the add/drop points of the ring, one of the two received signals is selected depending on the signal quality. Ring protection protects against propagation faults, fibre cuts (if fibres are used within the ring), and network element faults.

FXC STM supports inherent monitored subnetwork connection protection plus (SNC/I+). The plus means that in addition to the standard switching criteria, 'unequipped' is used as the switching criteria. This means that if the protected path gets the signal label unequipped due to a misconfiguration, the FXC STM unit initiates a protection switch.

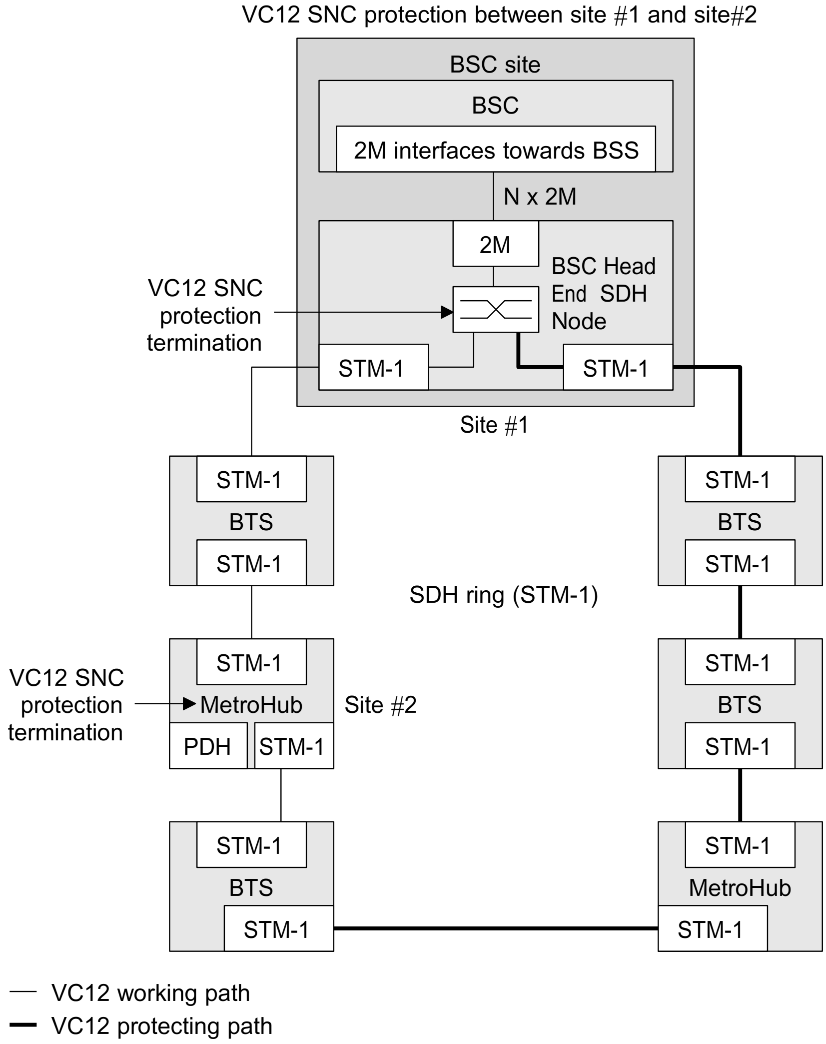


Figure 57. SNC ring protection scheme

8.4 Technical description of fading margin measurement in FlexiHopper (Plus)

Fading margin is the margin, which is designed into a radio communication circuit to ensure that the required grade of service is provided, despite fading, during normal propagation conditions for a given percentage of the time. FlexiHopper (Plus) can execute fading margin measurement automatically during radio relay commissioning. The measured fading margin can be used to verify the quality of the radio link in network planning. In addition, it can be used for defining a sensible ALCQ / ATPC Rx-level set-point. The measurement is carried out without the aid of any additional tools or measurement equipment.

The automatic fading margin measurement (FMM) is based on four different measurements: The BER 10-3 threshold signal levels at each capacity and receiver's (capacity dependent) noise floor are measured in NSN production for each radio. Moreover, the noise floor together with received interference signal level and the normal (maximum) received power level are measured with commissioned radio relay in the actual environment. Consequently, it is straightforward to calculate the fading margin from these measurement results. Generally, the fading margin is defined here as the difference between the normal received signal level and the required signal level for 10-3 BER in the actual operation conditions over the commissioned radio hop.

More detailed information about fading margin can be found in the *ALCQ and Automatic Fading Margin Measurement in FlexiHopper Microwave Radio Application Note* that can be obtained upon request.

8.5 Technical description of lazy transmitter changeover

Lazy transmitter changeover is a protection method against transmitter faults that cannot be detected by the equipment itself, for example, a faulty antenna. The FXC RRI transmission unit sends periodical notifications to the far-end about the radio signal quality. Lazy transmitter changeover is performed, if there are errors in the transmitted data over a specified interval (see lazy changeover timing below) that are caused by the near-end transmitter.

Lazy transmitter changeover is performed when the system experiences bit errors for a longer period. Lazy transmitter changeover is possible only when both transmitters are available. It is based on analyses of the current and past events. The system minimises the number of lazy transmitter changeovers, because each time the changeover is made the synchronisation is lost.

Other factors in the lazy transmitter changeover are:

- If one of the outdoor units becomes unavailable, the system makes an instant transmitter changeover and generates the *128 Fault in equipment alarm*.
- If the bit error ratio (BER) after the changeover is 1000 times higher than before the changeover, the system makes another changeover back to the previous transmitter.

8.5.1 Lazy changeover timing

Quality classes 1-5 are supported.

The BER value presented in the table below is based on the far-end BER, which is the result of the radio's internal processes and cannot be measured. The BER value is calculated from the better receiver.

Table *Signal quality factors for lazy transmitter changeover* gives an overview of the current lazy changeover quality class settings. The signal quality factor indicates the transmitter protection level: the higher the value, the higher the transmitter protection level. The best transmitter protection level is achieved with class 1.

Table 36. Primary and secondary periods for lazy transmitter changeover class 1

Class	BER	Primary period (h: min:s)	Secondary period (h: min:s)
1	10^{-9}	24 days 20:31:24 [1]	24 days 20:31:24 [1]
	10^{-8}	10:00:00	18:00:00
	10^{-7}	0:30:00	3:00:00
	10^{-6}	0:03:00	0:30:00
	10^{-5}	0:00:30	0:10:00
	10^{-4}	0:00:10	0:05:00
	10^{-3}	0:00:05	0:02:00

[1] 24 days 20:31:24 is the maximum value in the SW counter.

Table 37. Primary and secondary periods for lazy transmitter changeover class 2

Class	BER	Primary period (h:min:s)	Secondary period (h:min:s)
2	10^{-9}	24 days 20:31:24 [1]	24 days 20:31:24 [1]
	10^{-8}	10:00:00	24 days 20:31:24 [1]
	10^{-7}	0:30:00	18:00:00
	10^{-6}	0:03:00	3:00:00
	10^{-5}	0:00:30	1:30:00
	10^{-4}	0:00:10	0:30:00
	10^{-3}	0:00:05	0:03:00

[1] 24 days 20:31:24 is the maximum value in the SW counter.

Table 38. Primary and secondary periods for lazy transmitter changeover class 3

Class	BER	Primary period (h:min:s)	Secondary period (h:min:s)
3	10^{-9}	24 days 20:31:24 [1]	24 days 20:31:24 [1]
	10^{-8}	24 days 20:31:24 [1]	24 days 20:31:24 [1]
	10^{-7}	24 days 20:31:24 [1]	24 days 20:31:24 [1]
	10^{-6}	24 days 20:31:24 [1]	24 days 20:31:24 [1]
	10^{-5}	12:00:00	24 days 20:31:24 [1]
	10^{-4}	0:20:00	12:00:00
	10^{-3}	0:02:00	0:05:00

[1] 24 days 20:31:24 is the maximum value in the SW counter.

Table 39. Primary and secondary periods for lazy transmitter changeover class 4

Class	BER	Primary period (h:min:s)	Secondary period (h:min:s)
4	10^{-9}	---	---
	10^{-8}	---	---
	10^{-7}	---	---
	10^{-6}	---	---
	10^{-5}	---	---
	10^{-4}	0:20:00	48:00:00
	10^{-3}	0:05:00	0:40:00

[1] 24 days 20:31:24 is the maximum value in the SW counter.

Table 40. Primary and secondary periods for lazy transmitter changeover class 5

Class	BER	Primary period (h:min:s)	Secondary period (h:min:s)
5	10^{-9}	---	---
	10^{-8}	---	---
	10^{-7}	---	---
	10^{-6}	---	---
	10^{-5}	---	---
	10^{-4}	0:20:00	24 days 20:31:24 [1]
	10^{-3}	0:05:00	48:00:00

[1] 24 days 20:31:24 is the maximum value in the SW counter.

Table 41. Signal quality factors for lazy transmitter changeover

Setting	Behaviour	Signal quality factor
Class 1	This is the default class. This setting gives the best protection against undetectable transmitter faults, but in the case of deep fading e.g. heavy rain the bit error ratio is increased with a factor of 1000.	Over 1000

Table 41. Signal quality factors for lazy transmitter changeover (cont.)

Setting	Behaviour	Signal quality factor
Class 2	Less protection against undetectable transmitter faults than in Class 1.	100
Class 3	Less protection against undetectable transmitter faults than in Class 2.	10
Class 4	Less protection against undetectable transmitter faults than in Class 3. This class is not as sensitive to the propagation disturbances as classes 1 to 3.	About 2
Class 5	Weakest protection against undetectable transmitter faults, but this class is not sensitive to the propagation disturbances.	About 1.1
Off	No protection against undetectable transmitter faults. Decision for transmitter changeover is based only on the faults detected in the active transmitter or on the loss of the received signal in the far-end radio.	1

8.5.2 Lazy transmitter changeover examples

Example 1

If the BER value stays over the BER level for the time period specified in the quality class for that BER level, a Tx changeover is made.

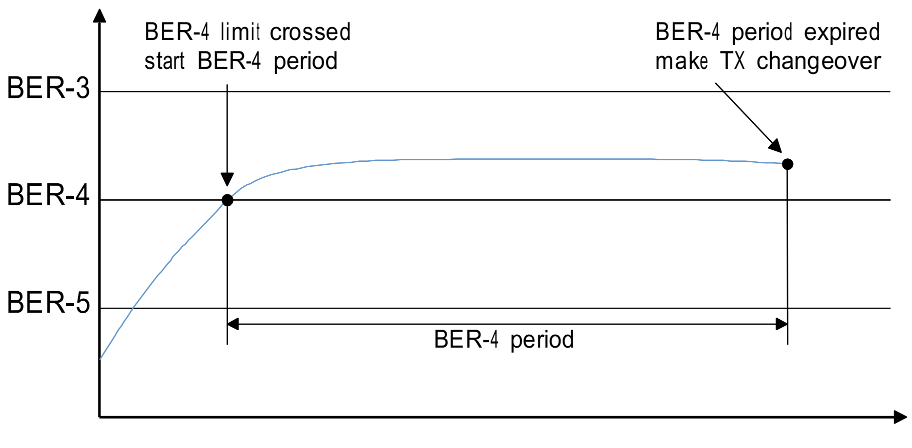


Figure 58. BER stays over the threshold for the primary period

Example 2

If the BER value drops to the previous level, the period timer is continued at the time spent since the level was crossed for the first time.

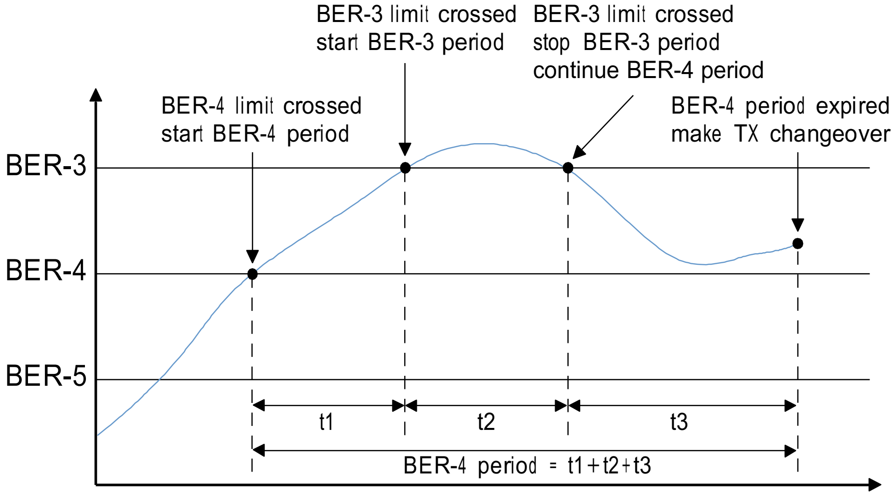


Figure 59. BER drops to the previous level and stays over threshold for the primary period

Example 3

If the BER value drops to the previous level and after that crosses over to the upper level again, the period timer is restarted from zero.

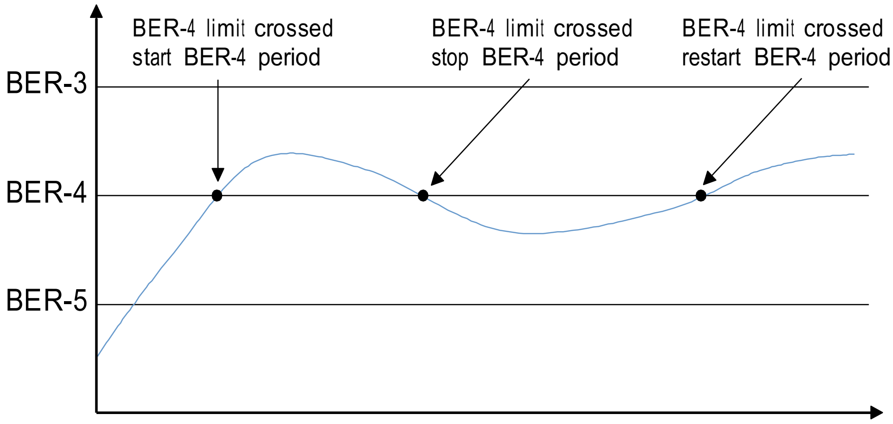


Figure 60. BER drops temporarily under the threshold and the primary period is restared

Example 4

When BER value crosses over to the upper level, but the time period left from the lower BER level is shorter than the new period, the old period is continued.

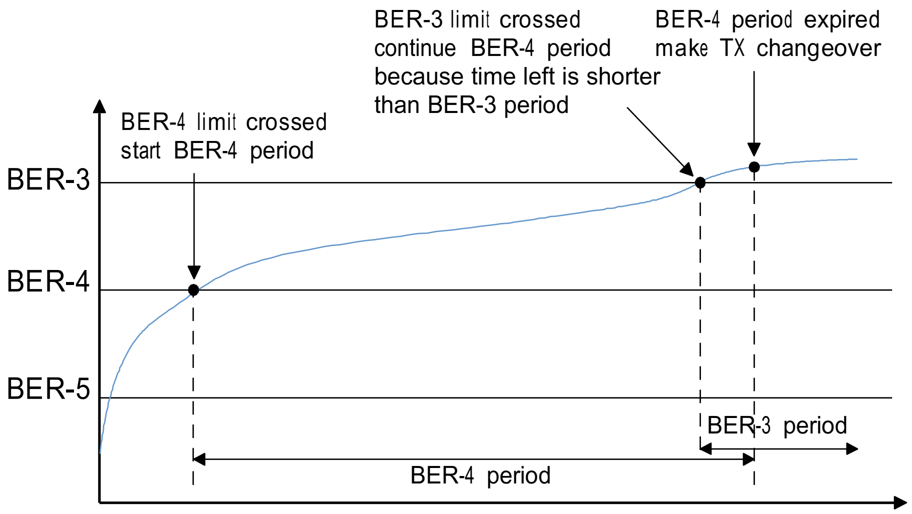


Figure 61. Lower BER primary period is continued

Example 5

If BER is over the threshold after the first changeover, then the secondary period is used for the next changeover.

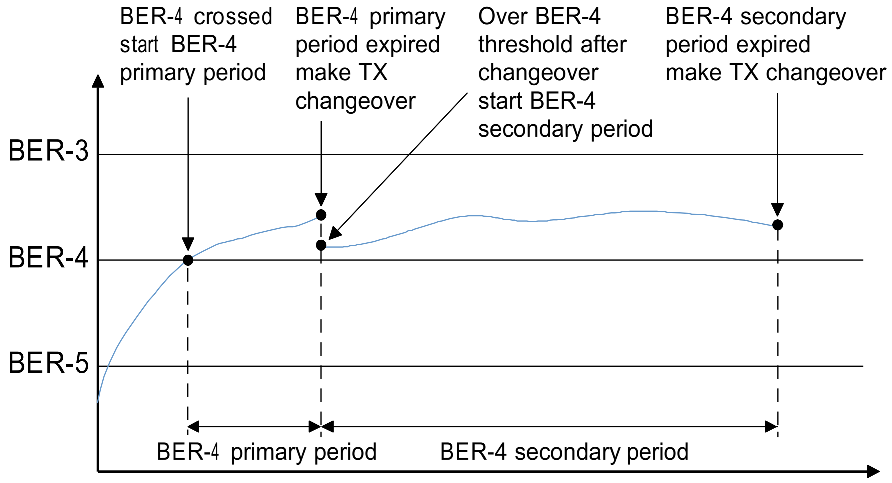


Figure 62. After the first changeover the secondary period is used

9 Manager software

9.1 Technical description of software licensing

The UltraSite EDGE BTS supports software licensing. The features under licences are modulation and Flexbus capacity.

The optional feature allows the operator to use the following features with FlexiHopper Plus:

- 16-state modulation
- Flexbus capacity of 8x2M
- Flexbus capacity of 16x2M

To activate the features, the user needs to order a secure licence file from Nokia Siemens Networks (NSN), and install the licence. The file is delivered through NSN software delivery channels, and can easily be installed either locally or remotely over the Q1 management channel using the Hopper Manager version C4.7 or newer.

The licence is implemented using secure plain text files generated and authorised by NSN. In case the licence file is lost or corrupted, the valid licensed user can get a replacement from NSN without paying for the feature twice. The licence is bound to the unit's serial number and cannot be used in another unit. If radio hardware is swapped by NSN in a hardware failure case, a new licence file is generated.

Using the **Licence Manager** dialogue box, you can maintain software feature licences in the network element. For more information, see Section *Using the licence manager*. The dialogue box contains a list of all licensable features in the network element. A list of features contained in the licence file is displayed for each licence file.

There are short-term and long-term licences. If the licence installed is time-limited, the remaining time is displayed in the **Licence Manager** dialogue box.

Short-term licence is an introductory, time-limited licence (60 days) for FlexiHopper family customers. During that time customers can test, for example, the 16-state modulation in practice. When taken into use, the short-term licence generates a warning when the licence is about to expire, and an alarm when it has expired.

Long-term licences are permanent and once installed, they do not expire. If you buy a long-term licence, it can be activated or deactivated as often as needed.

9.2 Technical description of user access levels

In Windows XP, Windows 2003 server, and Windows 2000, ITN C3 or later element managers offer two access levels, 'Read only' and 'Read/write' when remotely connected to a MetroHub or an UltraSite BTS Hub. The feature can be enabled when the managers are installed by using SiteWizard, in which case a User Access Level Control (UALC) user group is added to the Windows operating system.

The user group determines a user's access rights. When the application starts up, if the feature is enabled, the membership of the current user is checked. Based on the access rights, certain application actions are restricted.

A user must have Windows administration rights to add users to the UALC user group, or to alter current privileges.

The user access level functions can be disabled when re-installing the element manager applications with SiteWizard.

Note

It is not possible to enable the read/write mode when a user with read-only access rights is logged into the system.

9.2.1 NetAct and user access level control function

When launching UltraSite BTS Hub Manager through the NetAct Top Level user interface, the application is started in the node manager server. NetAct uses an internal service user for authenticating itself to the node manager server. For being able to differentiate between different users in the node manager server, it is necessary to add an additional service user and a user group to the NetAct management system.

Afterwards, it is possible to assign one of the service users to the *BTS_Admins* user group. All users belonging to the user group bound to this service user, get 'Full Control' rights. All users belonging to the user group bound to the second service user, get 'Read Only' rights.

For information on how to add a service user and a user group, see the NetAct documentation in Nokia Online Services (NOLS).

Related Topics

Technical description of the outdoor filter kit (ODFA)

Installing the outdoor filter kit (ODFA)

Technical description of outdoor cabinet co-siting kit (OCTU)

Installing the outdoor cabinet co-siting wall

Installing the co-siting cable entry

Technical description of System Extension Cable (SXCA) kit of UltraSite EDGE BTS

Reference

Delivery content of UltraSite EDGE BTS SXCA transportation package

Technical description of transmission interfaces

Reference

Interfaces of the FXC E1 transmission unit

Interfaces of the FXC E1/T1 transmission unit

Interfaces of the FXC RRI transmission unit

Interfaces of the FXC STM-1 and FXC Bridge transmission units

Technical description of transmission unit cross-connections

Instructions

Overview of managing cross-connections

Reference

20 Blocked from use

Descriptions

Technical description of PDH transmission network protection using loop topology

Technical description of the synchronisation of FXC transmission units

Instructions

Overview of adjusting node synchronisation settings

Adjusting synchronisation loop bit settings

Adjusting PDH synchronisation settings

Adjusting SDH synchronisation settings

Reference

124 Synchronization fault in clock recovery

125 Loss of synchronization signal(s)

Technical description of the performance management of FXC transmission units

Instructions

Monitoring transmission unit performance

Descriptions

Technical description of transmission interface measurements

Technical overview of BTS Hub or MetroHub Manager menus

Technical description of transmission capacity expansion

Technical description of transmission unit cross-connections

Technical description of the node control unit

Technical description of the synchronisation of FXC transmission units

Technical description of Q1 management

Technical description of hot standby with the FXC RRI transmission unit

Instructions

Setting FlexiHopper and FlexiHopper Plus settings

Reference

128 Fault in equipment

143 Fault in changeover function

Descriptions

Technical description of fading margin measurement in FlexiHopper (Plus)

Technical description of lazy transmitter changeover

Technical description of fading margin measurement in FlexiHopper (Plus)

Instructions

Setting FlexiHopper and FlexiHopper Plus settings

Technical description of lazy transmitter changeover

Reference

128 Fault in equipment alarm

Descriptions

Technical description of hot standby with the FXC RRI transmission unit

Technical description of user access levels

Instructions

Administering user access level control