NOKIA

C33525.90_H0
Nokia MetroHub Transmission Node Rel. C3

Product Description for Nokia MetroHub

Hereby, Nokia Corporation, declares that these Transmission Node units measured in Nokia MetroHub are in compliance with the essential requirements of the Directive 1999/5/EC (R&TTE Directive) of the European Parliament and of the Council.

Complies with UL 1950, CSA 22.2 NO. 950 Information Technology Equipment. This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions. (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Contents

1 Technical description of applications

1.1 Technical description of integrating Nokia MetroHub into the Nokia MetroSite EDGE Capacity Solution

Nokia MetroHub is an essential element of Nokia MetroSite EDGE Capacity Solution for mobile networks. It connects the microcellular elements to each other and to the core mobile network. In combination with Nokia FlexiHopper, Nokia FlexiHopper Plus and Nokia MetroHopper, wireline E1/T1 interfaces, optical STM-1 interfaces and Nokia MetroSite base station (BTS), Nokia MetroHub provides a unique solution for building mobile transmission networks.

Nokia MetroHub together with microwave radios forms a stand-alone hub site or it can be located at some microcellular Nokia MetroSite Base Station site, for example, close to the BTS on a roof top, or at a macrocell base station site. Base station connections and the last-kilometer access can be implemented with wireless or wireline connections or both.

Nokia MetroHub can be installed as an interface between macrocellular and microcellular networks when an operator starts building capacity with microcells. Using Nokia MetroHub as the interface, the microcellular network can be implemented faster, less equipment is needed, the trunking efficiency is improved and the quality of the transmissions can be enhanced.

In addition to these features, transmission operating expenditures are decreased due to smaller site costs, including rent and less expensive outdoor installation.

1.2 Technical description of the typical applications of Nokia MetroHub

Nokia MetroHub provides an optimal integrated mobile transmission solution for base station subsystem networks. It supports various transmission network topologies and media change by providing different combinations of E1/T1, STM-1 and Nokia Flexbus radio interfaces. Nokia MetroHub is optimised for but not limited to usage in mobile networks. This chapter describes the most common of these applications on both network and site level.

Typical applications where Nokia MetroHub can be used are:

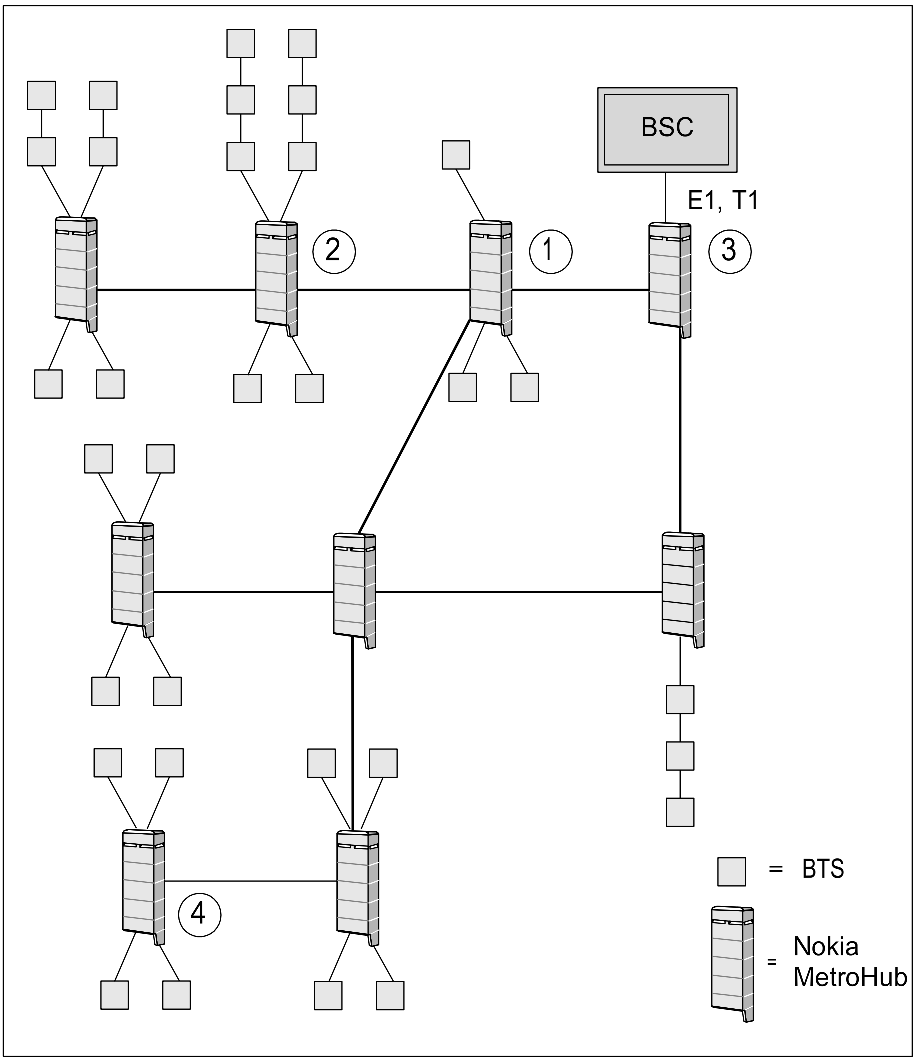
- as a head-end node at a BSC site,
- for increasing trunking efficiency by grooming,
- in chain, star, and loop topologies in a transmission network,
- for transmission media change.

Nokia MetroHub has been especially designed to act as a master node in Nokia loop networks.

1.3 Technical description of the network applications of Nokia MetroHub

Due to the increasing capacity needs of mobile networks, transmission networks have to carry more and more traffic. Nokia MetroHub is constructed to support fast roll-out, making it easy to add transmission network capacity as needed. As a result of high integration, it is possible to implement the media change from wireless to wireline in the same cabinet without additional converters.

The figure below shows some network applications of Nokia MetroHub.



1. *Hub site 1*
2. *Traffic bypassing; Hub site 2*
3. *BSC site, capacity 16 x 2M; Hub site 3*
4. *MetroHub and FIU 19(E) at a BSC site*

Figure 1. Network applications of Nokia MetroHub (numbers refer to the different kinds of Nokia MetroHub sites)

Nokia MetroHub grooms the traffic from several base stations. Partially filled connections are thus combined and trunk efficiency is increased. In order to ensure transmission availability, several Nokia MetroHub transmission nodes are combined into a loop. In case a transmission link in the loop breaks down, the traffic is instantly re-routed to the redundant path.

2 Configurations for Nokia MetroHub

2.1 Overview of configurations for Nokia ITN

ITN is the abbreviation for Integrated Transmission Node. It is a synonym for the use of FXC transmission units within Nokia BTSs and Nokia 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 FXC RRI is being used as the master unit (the left-most slot position) within a BTS transmission Hub, the add/drop capacity is 12 - 15 x 2M depending on the configuration.
  - When FXC RRI is being used as the master unit (the left-most slot position) within a MetroHub, which is chained to a BTS, the add/drop capacity is 14 - 15 x 2M depending on the configuration.
- the FXC STM-1/FXC Bridge units provide an add/drop capacity towards the cross-connection bus of 20 x 2M.

2.1.1 ITN unit configurations for Nokia base stations

The ITN units FXC STM-1, FXC Bridge, FXC E1, FXC E1/T1 and FXC RRI can be installed as follows:

- in UltraSite EDGE BTS
  - four freely selected ITN transmission units or one FC E1/T1 unit
  - master unit in the left-most position in the chassis
- in MetroSite EDGE BTS
  - single transmission unit: ITN transmission unit, FC E1/T1 or FC STM-1

The FC E1/T1 and FC STM-1 units are not part of the ITN release, since they form an independent, single-unit transmission node. They cannot be used together with ITN units in the same chassis.

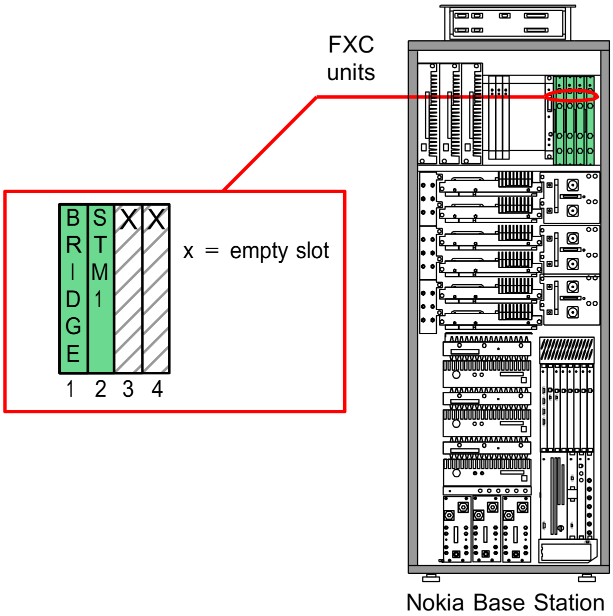


Figure 2. Example of ITN unit installation: FXC STM-1 and FXC Bridge units in UltraSite EDGE BTS

Note

UltraSite and MetroSite EDGE BTSs require CX(M) 4.1 software for SDH support.

2.1.2 ITN unit configurations for Nokia MetroHub

The following figure shows examples of how different FXC transmission units can be combined inside Nokia MetroHub. Unused slots require FXC shielding units. The interface unit (DIUx), which is always required, is also shown.

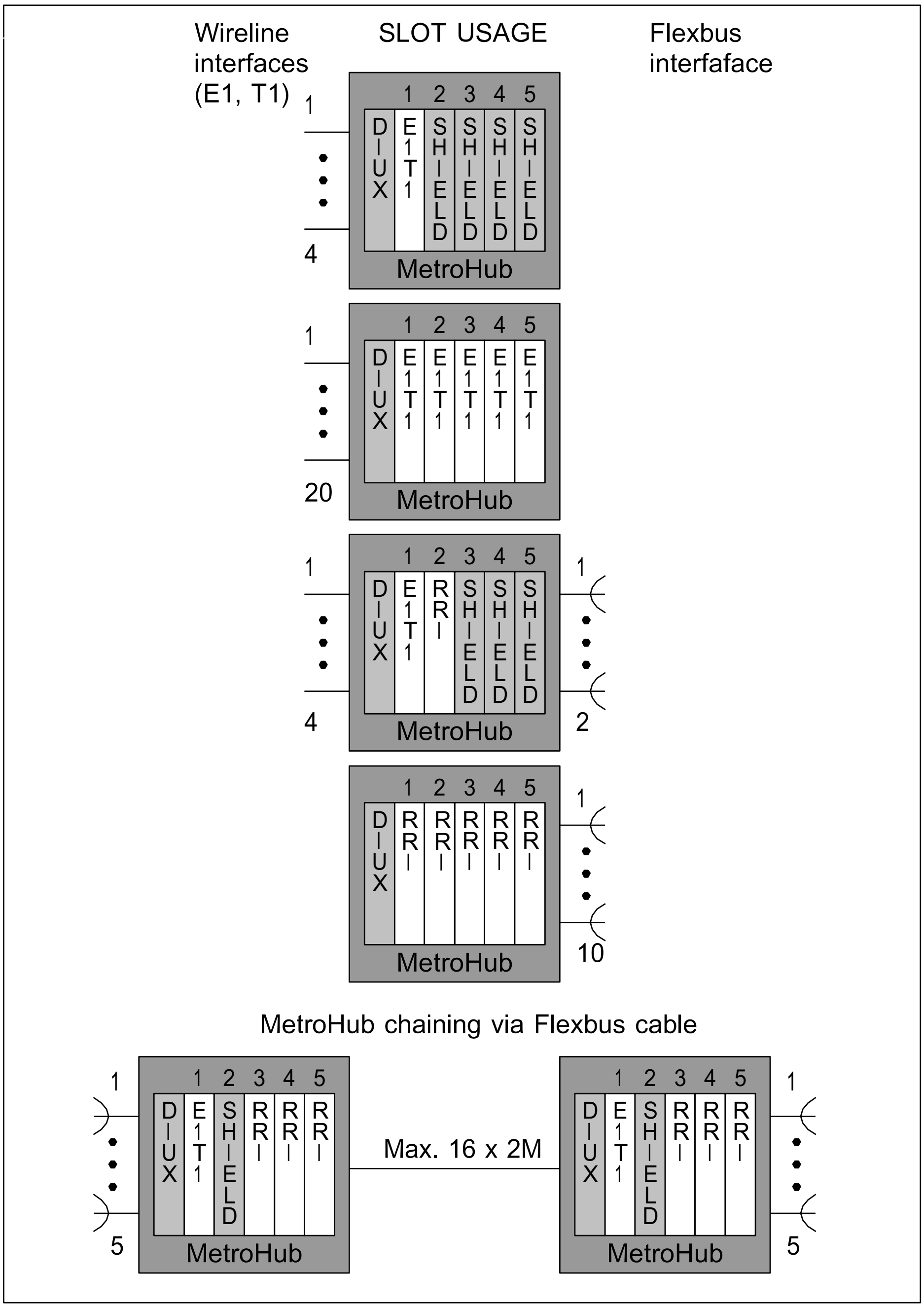


Figure 3. Node configuration examples with FXC transmission units, FXC shielding units and interface units (DIUx)

The following figure shows the available power protection options: the redundant power supply and the internal battery unit.

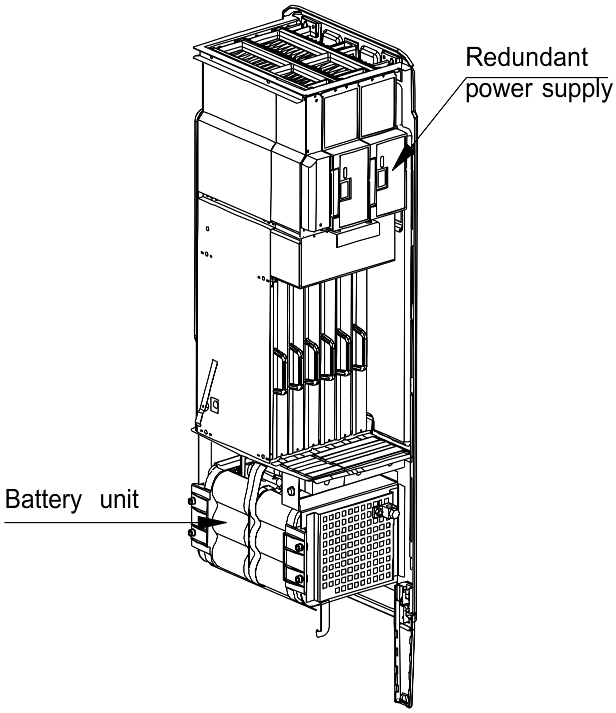


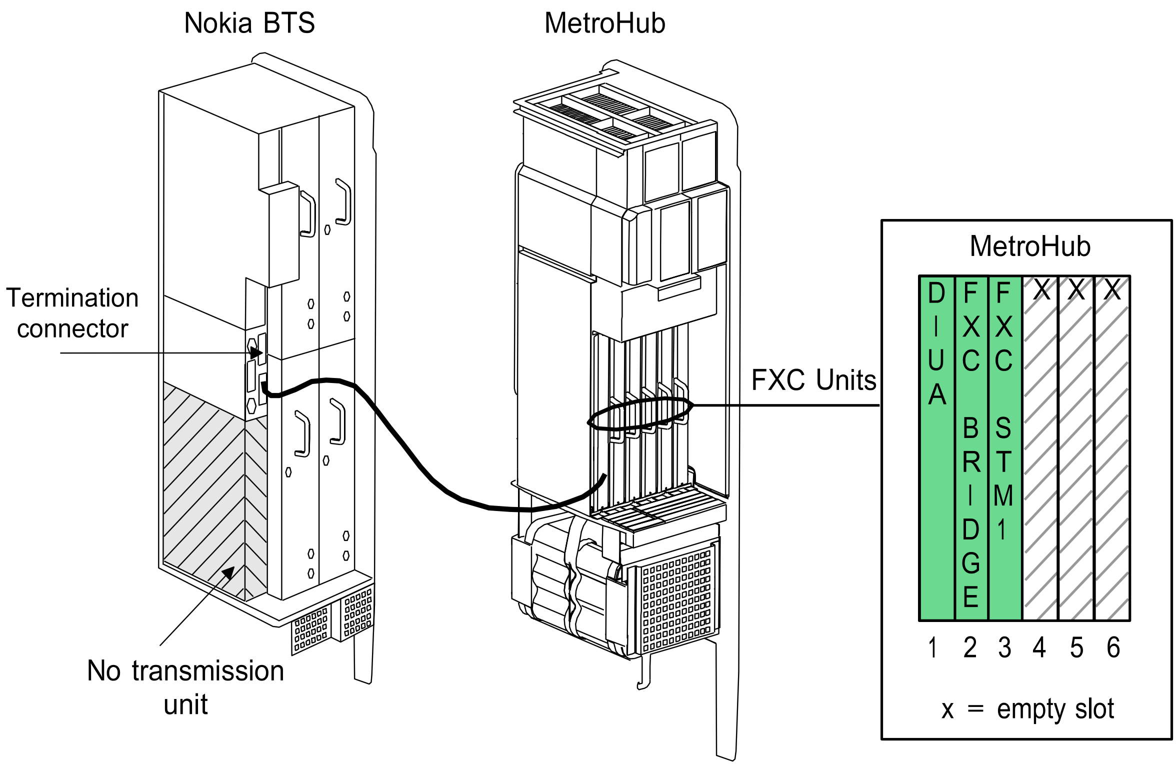
Figure 4. Power protection options

2.1.3 ITN unit configurations for Nokia MetroHub chaining to a BTS

The Nokia BTS transmission capacity can be expanded via connecting the BTS to a Nokia MetroHub with a chaining cable. When the chaining cable is connected between the interface unit (DIUx) of Nokia MetroHub and the interface unit (VIFA) of the Nokia BTS, the Hub is used as transmission node of the BTS cabinet. The FXC units are installed in the Hub and the BTS transmission slot is empty (and covered by a VXSA transmission unit shield).

The use of Nokia BTS and Nokia MetroHub chaining separates the power protection of the Air interface and transmission (Abis interface) by offering separate battery backup units for the BTS and the hub. In case of a power failure, it is more important to protect the transmission hub than a single site. Separate battery backup units guarantee a longer backup time for the transmission.

The branching application with Nokia MetroHub chained to a Nokia BTS is presented in the figure:



Nokia MetroHub Transmission Node chained with a MetroSite BTS

Figure 5. Nokia MetroHub chained to a Nokia BTS (MetroSite EDGE)

Note

In the figure the empty slots of the MetroHub cabinet are shielded by a FXC shield. The empty transmission unit slot of the Nokia BTS is shielded by a VXSA transmission unit shield.

Note

MetroSite EDGE BTS requires CXM 4.1 software for SDH support.

2.2 Example site configuration: conventional hub site

Nokia MetroHub supports up to ten radio outdoor units (Nokia FlexiHopper, Nokia FlexiHopper Plus or Nokia MetroHopper) or twenty E1/T1 lines. It is also possible to have any mixture of those by installing up to five transmission units into Nokia MetroHub.

Note

In the graphics, E1/T1 denotes both FXC E1 and FXC E1/T1.

The figure illustrates a conventional hub site. The compact size of the cabinet, the integrated radio indoor units and the easy connections to the radio outdoor units via one single coaxial cable minimise site requirements.

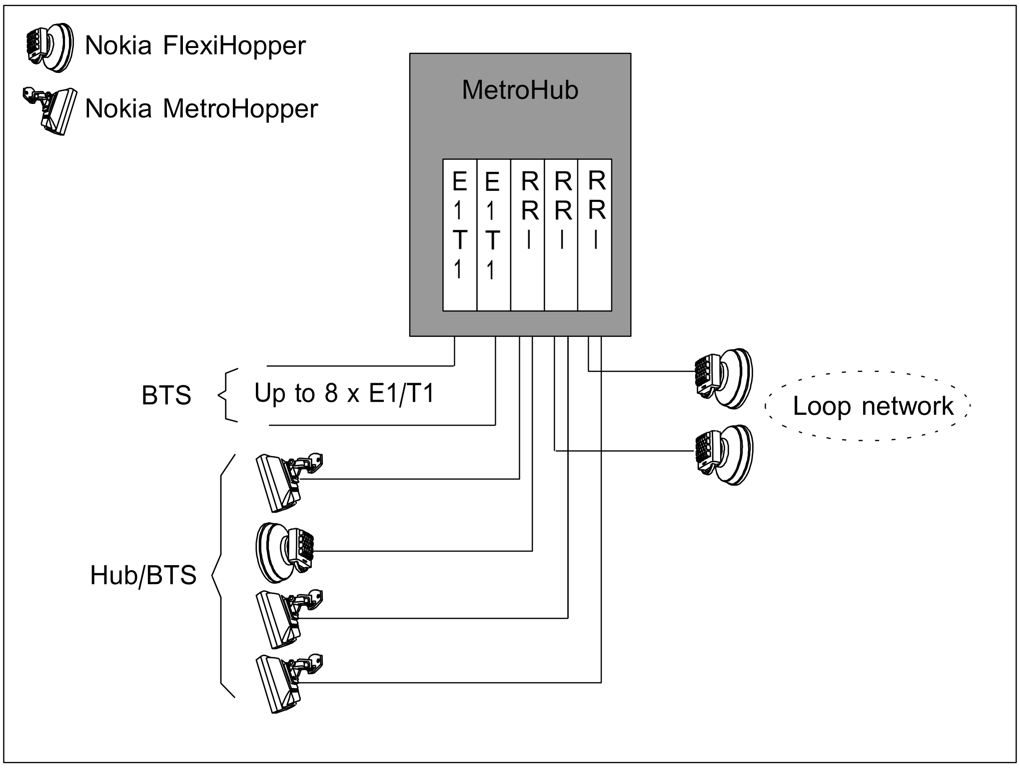


Figure 6. Hub site 1 (example)

2.3 Example site configuration: traffic bypassing

Traffic bypassing is the solution needed when the total cross-connection bus capacity of the unit interface is exceeded. The figure below illustrates such an application. Two Nokia FlexiHopper (Plus) radios are connected to one FXC RRI transmission unit. The incoming capacity of the first radio is 16x2Mbit/s. Only 6 x 2 Mbit/s is routed to the 8k cross-connection field and the remaining capacity (here 10 x 2 Mbit/s) is bypassed via the 2M cross-connection field to the second radio. The payload traffic is split up between several wireless, for example, Nokia MetroHopper, and wireline connections.

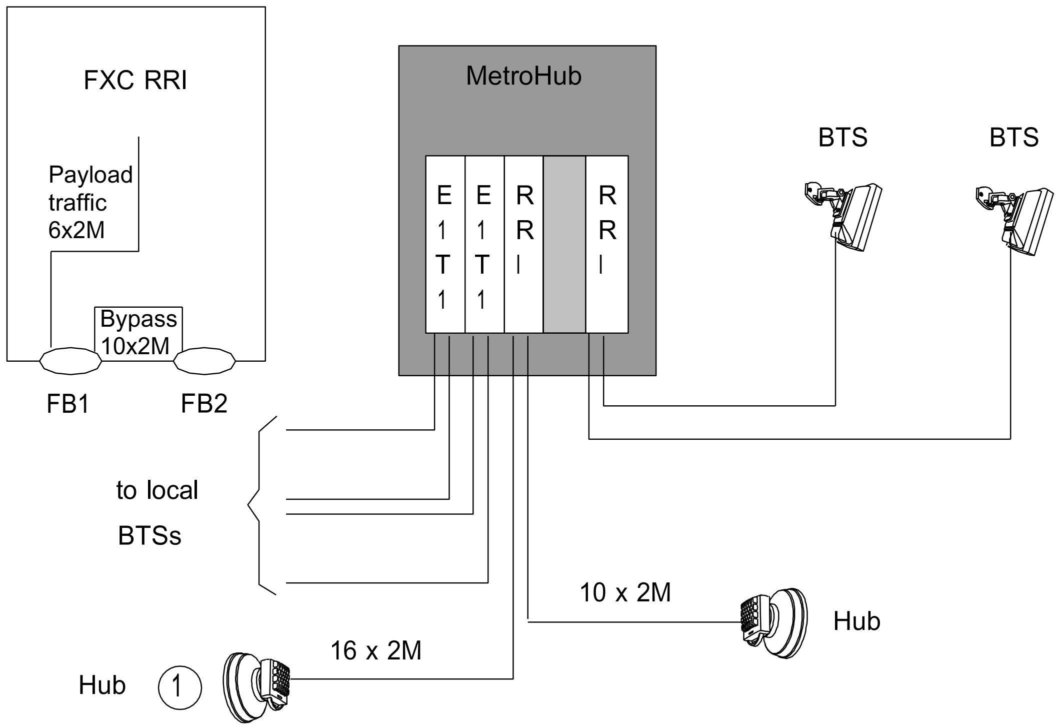


Figure 7. Traffic bypassing; Hub site 2 (example)

2.4 Example site configuration: with SDH transmission

One of the easiest and most cost efficient 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.

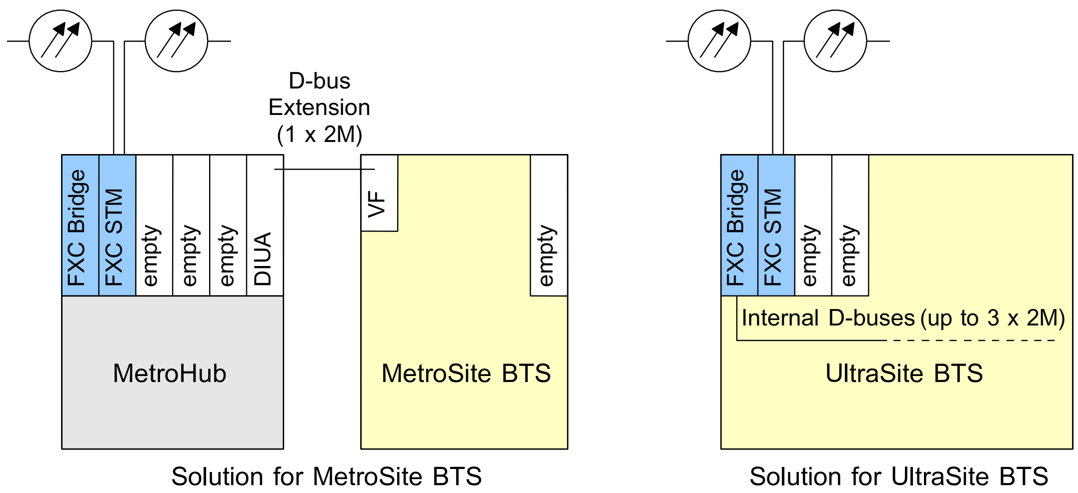


Figure 8. Site solutions for Nokia base stations with FXC STM

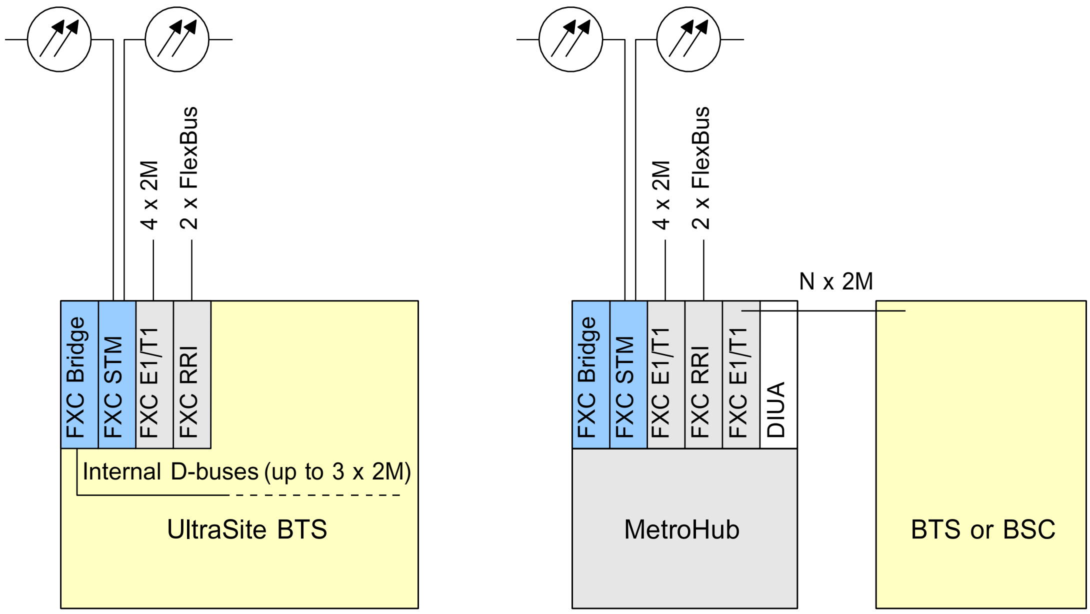


Figure 9. ITN for PDH add/dropping and SDH/PDH conversion

2.5 Example site configuration: at a BSC site

The figure illustrates a possible Nokia MetroHub configuration at a BSC site.

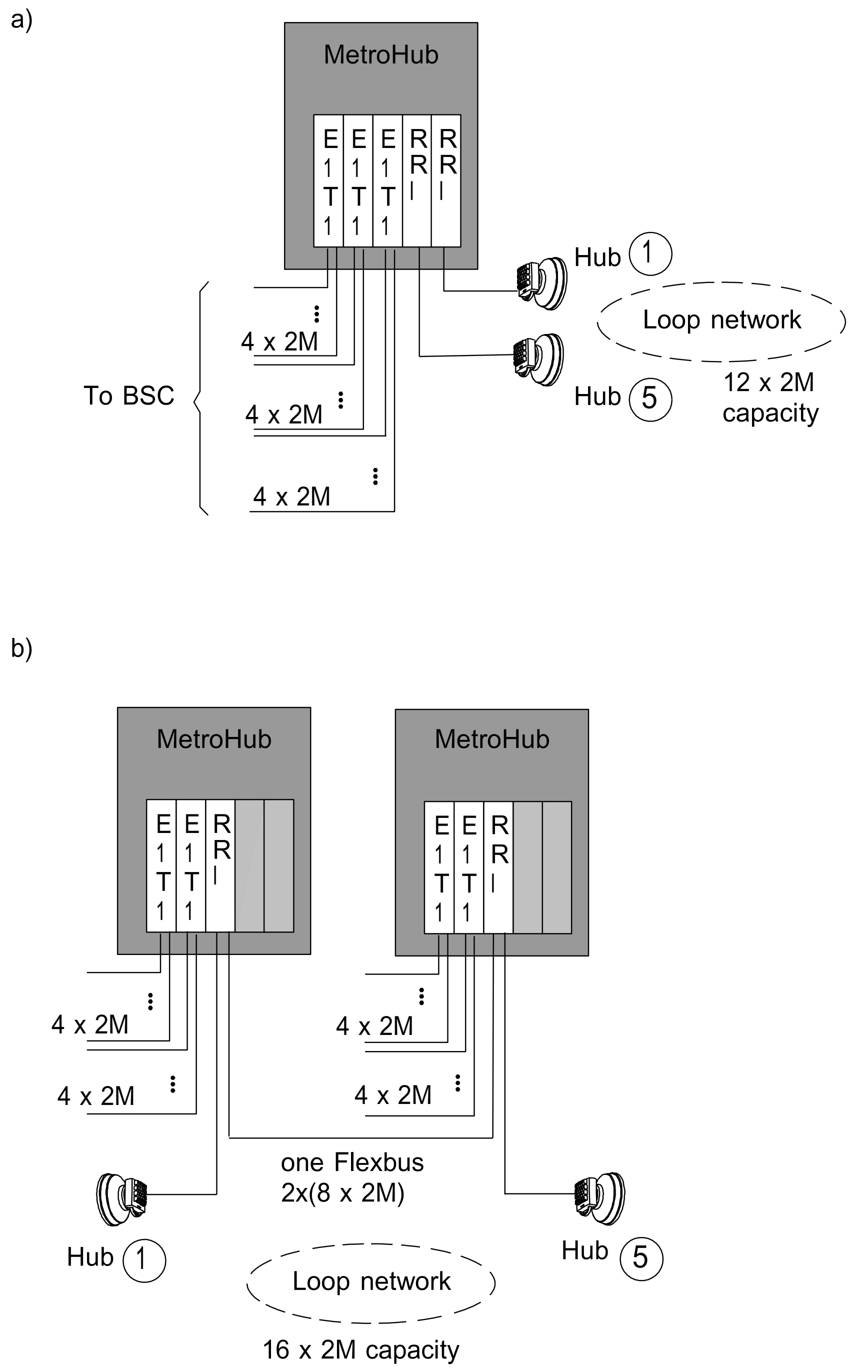


Figure 10. BSC site, Hub site 3 (example)

In example a), the drop capacity to the BSC is 12 x 2 Mbit/s. Both radios are connected to one radio indoor unit (FXC RRI).

In example b), a second MetroHub is used in order to obtain a higher drop capacity. The total capacity of the two MetroHubs is split into two, with each MetroHub having a drop capacity of 8 x 2M to the BSC. This is achieved via using two FXC E1 or FXC E1/T1 transmission units in each of the MetroHubs. Further, each of the MetroHubs is connected to a Nokia FlexiHopper (Plus) radio outdoor unit via an FXC RRI unit. There is one FXC RRI unit per MetroHub. The MetroHubs are connected to each other with a Flexbus cable.

Traffic from the BSC is duplicated and sent over two paths. One path goes directly to the nearest radio and causes a traffic load of 8 x 2M. Traffic on the other path (the redundant path) is routed via a Flexbus cable to the other MetroHub, causing a traffic load of 8 x 2M. Incoming traffic over the Flexbus cable is bypassed via the FXC RRI unit to the second radio outdoor unit. The traffic load of this redundant path is the same as before: 8 x 2M.

The principle is the same regardless of which of the MetroHubs received the traffic. Thus, at any time a radio outdoor unit can receive a maximum of 8 x 2M of primary traffic (from the MetroHub to which it is connected) as well as 8 x 2M of redundant traffic (from the other MetroHub). Thus, the traffic to each radio outdoor unit can reach 2 x 8 x 2M.

2.6 Example site configuration: at a BSC site with FIU 19(E)

If the number of physical 2 Mbit/s interfaces is not sufficient, one easy way to extend MetroHub is to use the FIU 19(E) radio indoor unit in addition, as illustrated in the figure below. FIU 19(E) provides a larger number of physical 2 Mbit/s interfaces. The connection between FIU 19(E) and FXC RRI inside a MetroHub is made via a Flexbus cable.

It is possible to build loop networks with 16 x 2M capacities using the combination of FIU 19(E) and one MetroHub.

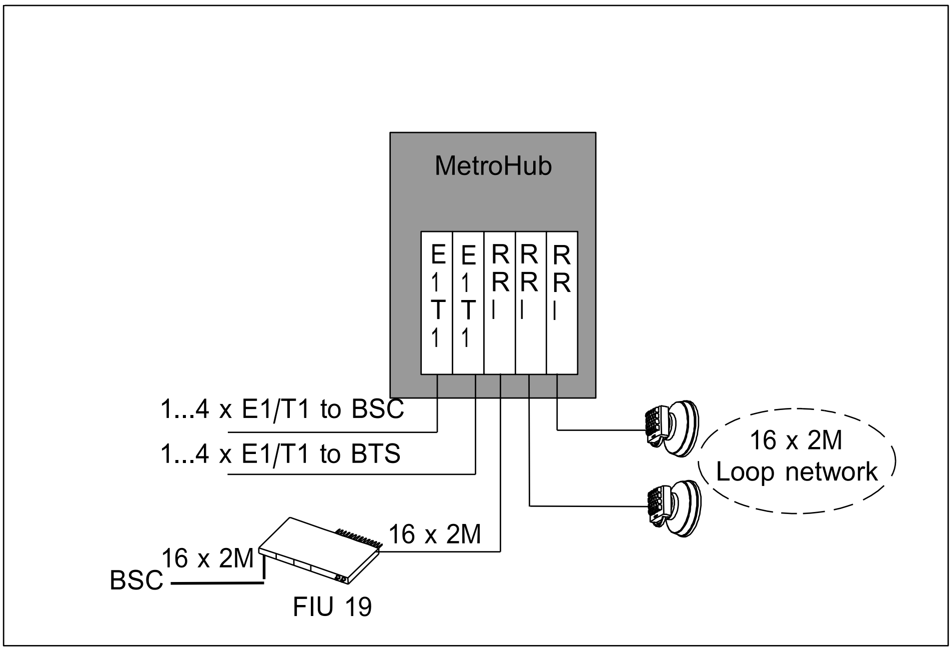


Figure 11. MetroHub and FIU 19(E) at a BSC site

2.7 Example site configuration: at a BSC site with FXC STM

With PDH/SDH integration and the possibility to synchronise the SDH node to an E1 signal, MetroHub can be used as a head-end node at a BSC site.

The figure illustrates a possible configuration at a BSC site. The add-drop capacity to the BSC can be a maximum of 12 x E1 and if that is not sufficient, up to 20x E1 can be obtained with the FIU 19E unit.

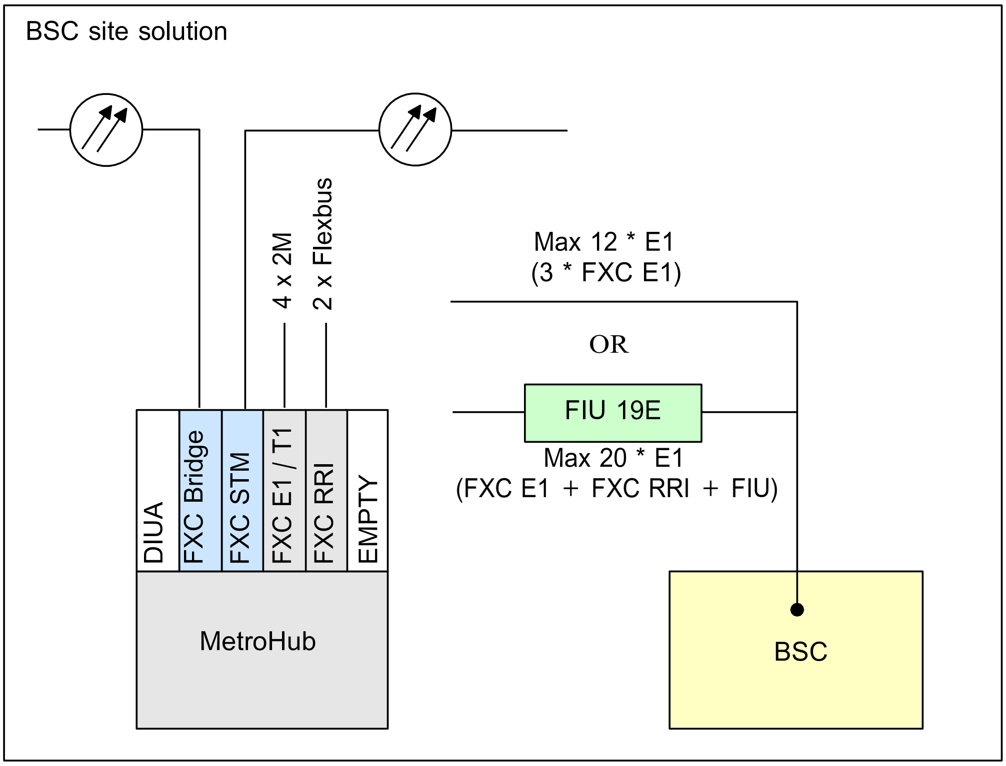


Figure 12. BSC site solution

3 Technical description of features

3.1 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 Nokia FlexiHopper (Plus) radios, with up to 16 x 2 Mbit/s capacity each, or to eight Nokia 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 Nokia 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 1. Nokia MetroHub transmission capabilities

Cross-connection bus capacity	56 x 2 Mbit/s non-blocking with 8 kbit/s granularity
Basic cross-connection types:	Granularities:

Table 1. Nokia MetroHub transmission capabilities (cont.)

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 2. Nokia 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
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)

3.2 Technical description of site deployment of Nokia MetroHub

Compact design

Nokia MetroHub is a stand-alone transmission node in a single housing into which Nokia transmission units and power protection can be installed.

New site locations

Unlike many other transmission nodes, Nokia MetroHub can be installed outdoors as well as indoors. The only requirement for the installation is that electricity is available. MetroHub can be installed either vertically or horizontally. Nokia MetroHub is designed to be easy to install on a wall or a pole, making new site locations possible, such as bus stops, promotional signs, lamp posts, etc. Thanks to the compact design and the fact that it can be painted, MetroHub blends well into the city environment. Site hunting and acquisition are thus made easier.

Straightforward site deployment

Due to the compact and integrated design of Nokia MetroHub, the overall implementation time and cost of the microcellular network is minimised.

Highly integrated system elements provide straightforward site deployment. Total site cost is minimised by reduced planning and site acquisition cost, reduced implementation and integration costs, as well as minimised operation and maintenance costs. Site rental cost are minimised and high trunking efficiency keeps transmission costs in check.

Integrated transmission units

Nokia MetroHub fully integrates a digital cross-connect with electrical and optical interfaces. These interfaces provide connections to Nokia radios, E1/T1 lines or optical fibre.

Nokia MetroHub can be connected to and power up to ten Nokia MetroHopper and Nokia FlexiHopper (Plus) radios via a single coaxial cable, Flexbus between Nokia MetroHub and each radio outdoor unit. One transmission unit acting as a radio indoor unit supports two radio units.

In addition to the benefits of integration, the new innovative product concept provides a compact solution for the evolving needs of radio access: one unit supports all capacities, one platform supports all frequencies, radio and cross-connect are integrated, and interconnections are via the Flexbus cable.

Flexbus − single cable interconnections

Flexbus gives high flexibility to PDH networks without any external multiplexers. Flexbus carries payload, Q1 and internal radio communication signals, and all on-site cabling is made within cross-connections.

The bi-directional Flexbus cable connects all system elements together. Flexbus carries 2 - 16 x 2 Mbit/s signals and control data between elements, from a radio indoor unit to an outdoor unit, as well as to another radio indoor unit. It also takes care of the outdoor unit power feed.

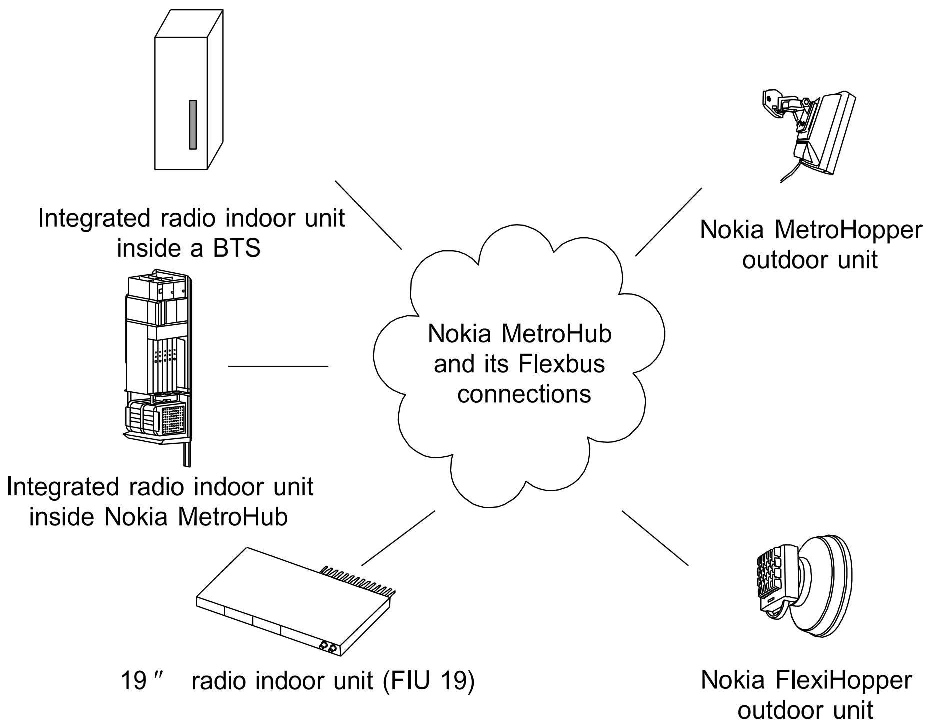


Figure 13. Nokia MetroHub and its Flexbus connections

4 Technical description of traffic protection

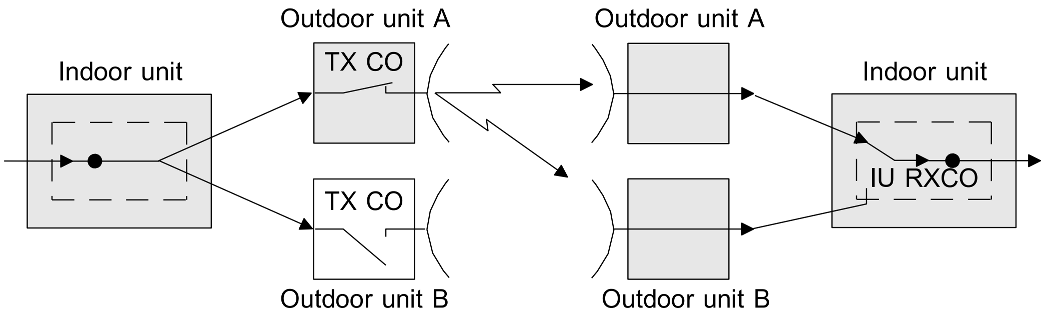
4.1 Technical description of hot standby with the FXC RRI transmission unit

4.1.1 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 Nokia 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 14. Nokia 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 hop may cause a few bit errors to the transmitter and receiver of the active outdoor unit.

4.1.2 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).

4.1.3 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.

Note

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*.

4.1.4 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.

4.1.5 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

When an outdoor unit of a hot standby protected hop is replaced, the outdoor unit settings of the new outdoor unit should be checked (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 changeover is still possible, but after the Tx changeover the frequency may be invalid.

4.2 Technical description of PDH transmission network protection using loop topology

4.2.1 Introduction

Nokia 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, Nokia loop protection protects:

- payload traffic
- network synchronisation
- network management connections.

A transmission loop formed with Nokia 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.

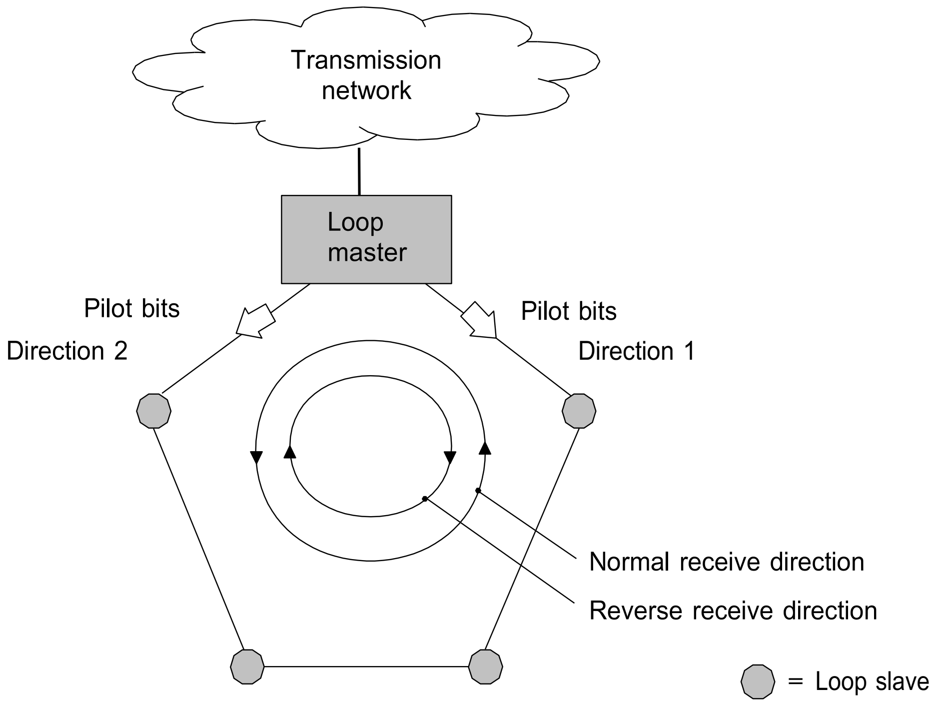


Figure 15. Loop principle

Nokia's way of implementing loop protection is ultimately secure, providing very fast route switching that recovers the transmission connections instantly. Nokia loop protection is embedded and thus very fast. Nokia 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, Nokia loop protection increases site availability at least tenfold and prevents end-of-chain availability degradation.

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

The protection functionality is compatible with the existing Nokia BSS transmission.

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

4.2.2 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.

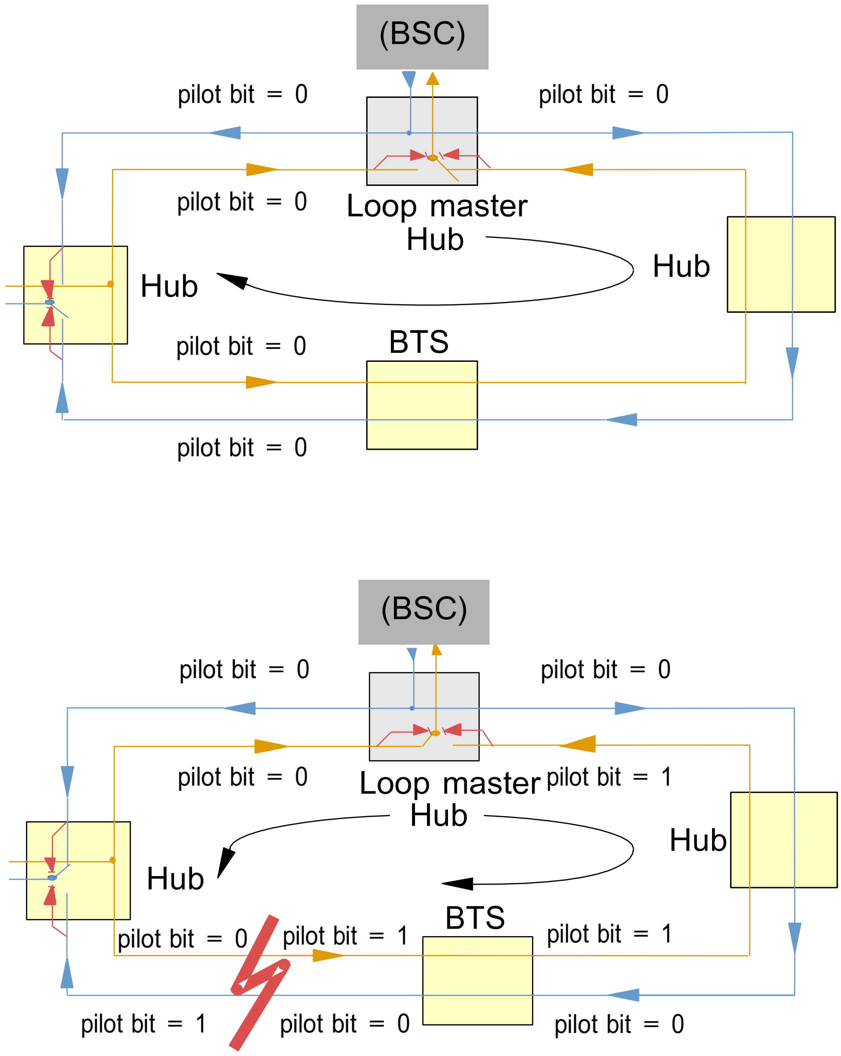


Figure 16. Traffic protection guided by pilot bit monitoring

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.

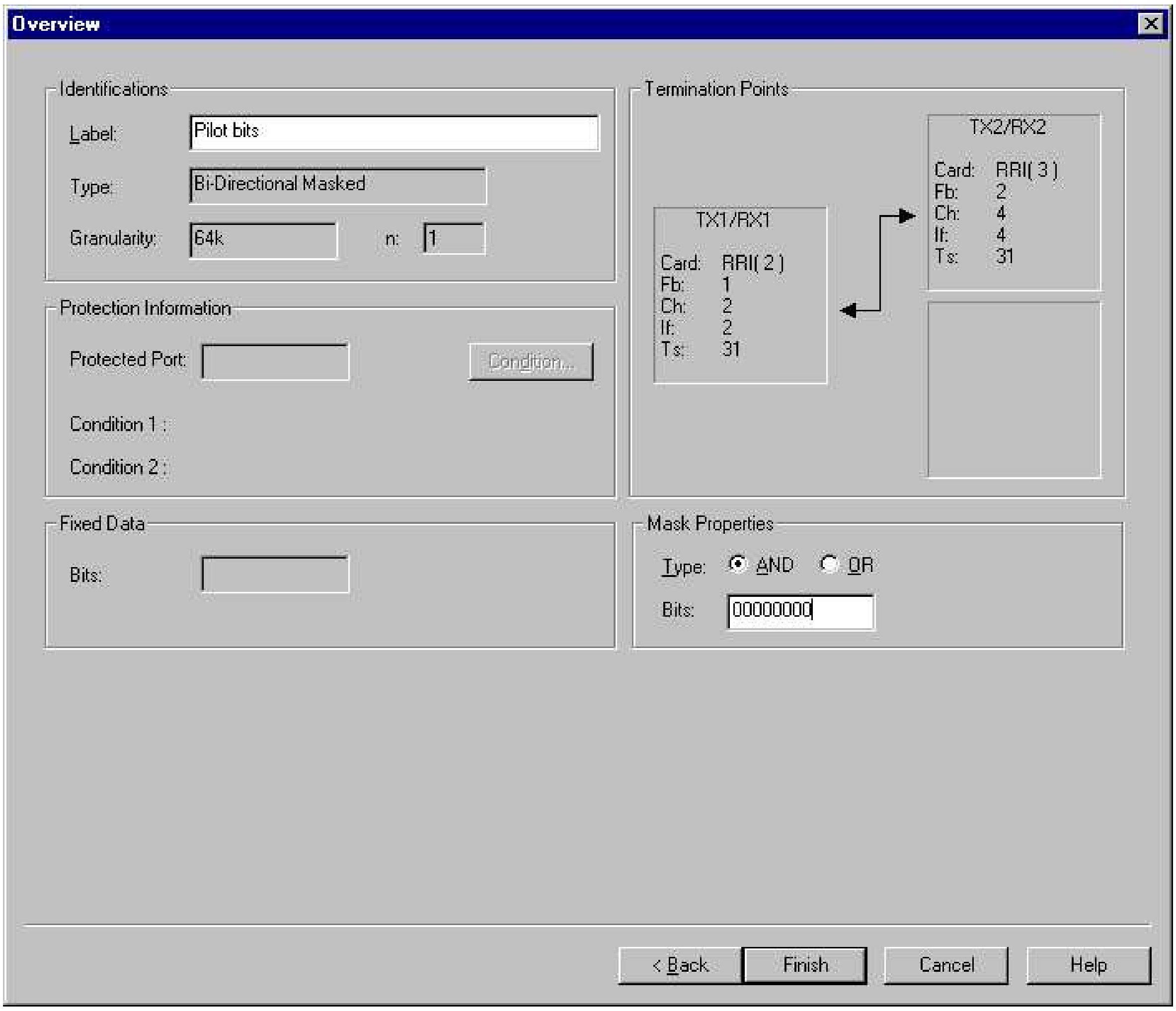


Figure 17. Pilot bit sent from a loop master

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.

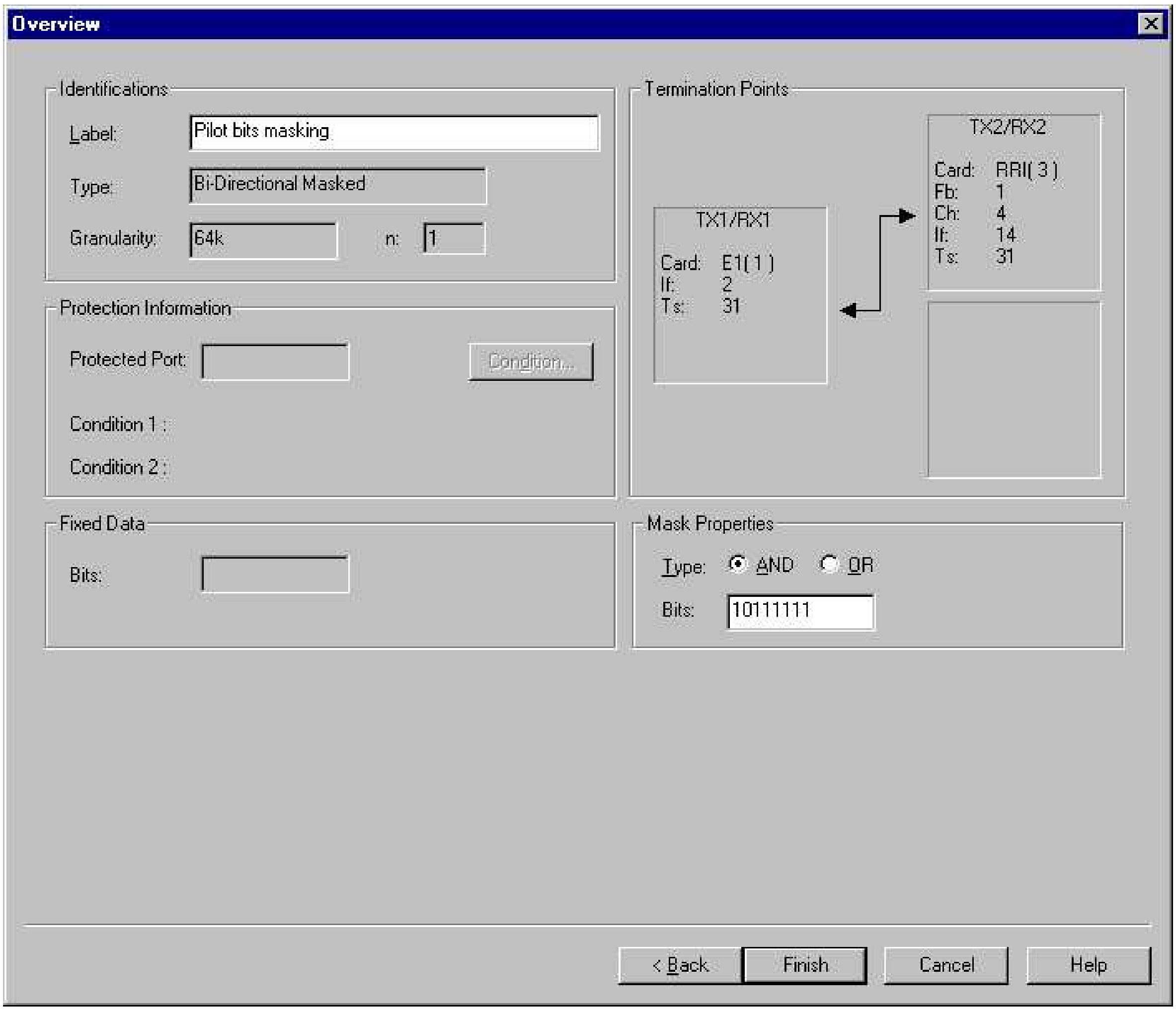


Figure 18. Pilot bit masking in the second loop slave

Nokia 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.

4.2.3 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.

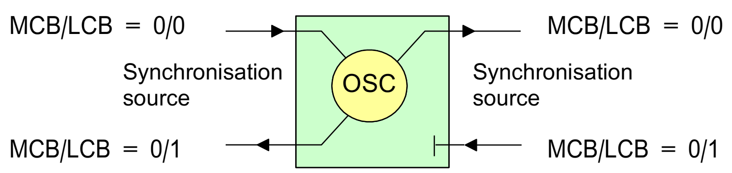


Figure 19. Manipulating synchronisation loop control bit

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.

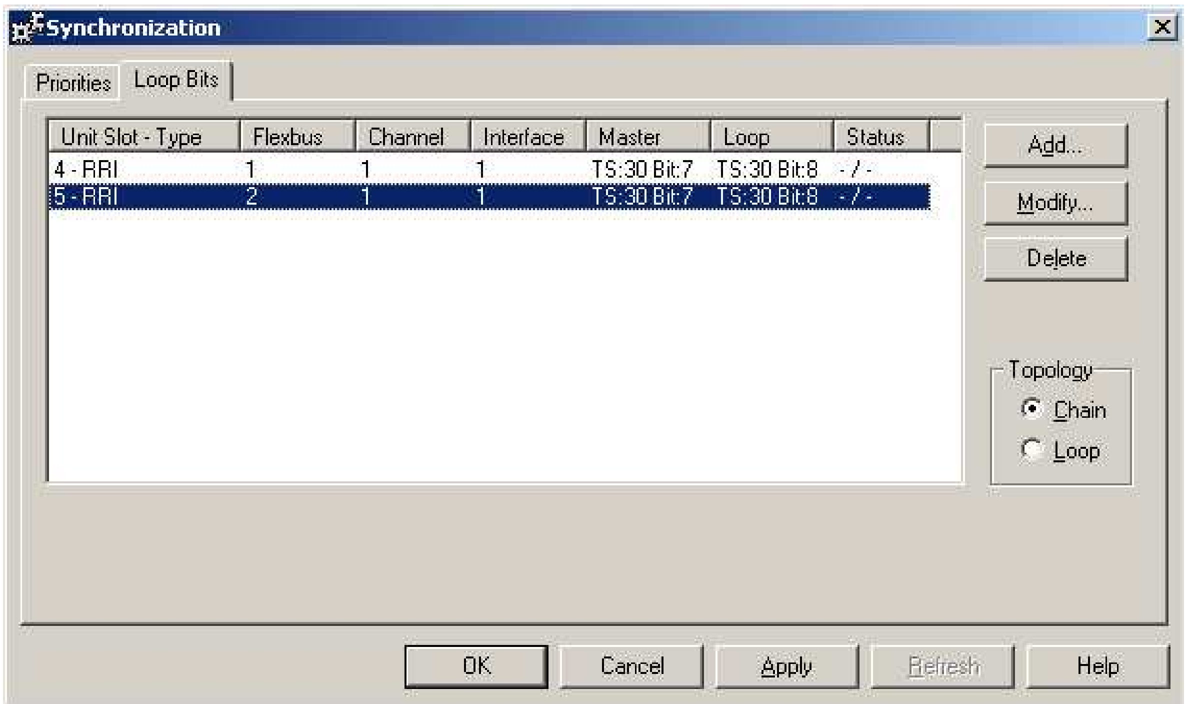


Figure 20. Setting of loop control bits

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.

4.2.4 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 Nokia 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.

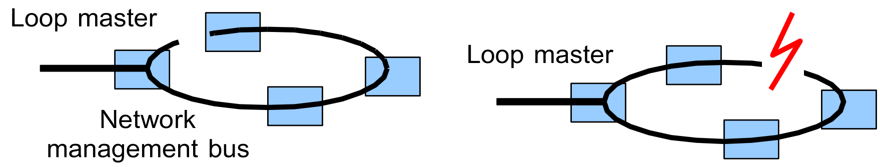


Figure 21. Network management bus circulation prevention

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 Nokia PDH loop protection. This termination is used when the loop master is a Nokia MetroHub node, UltraSite BTS node, or Nokia 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 Nokia 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. Nokia MetroHub, UltraSite EDGE BTS, and MetroSite EDGE BTS support Q1 slave protection.

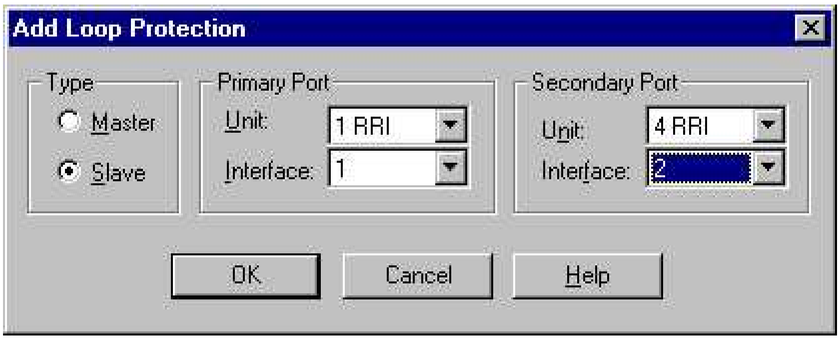


Figure 22. Setting of Q1 protection in the slave (in case of slave protection)

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.

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

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 Nokia PDH Loop Protection in GSM Networks document that can be obtained on request.

4.3 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.

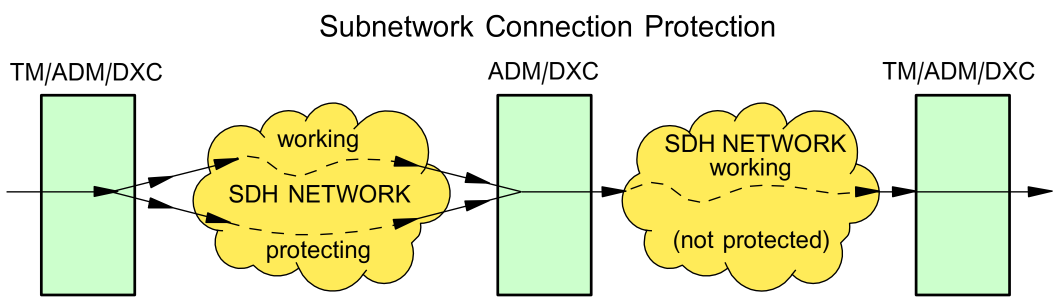


Figure 23. Subnetwork connection protection

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.

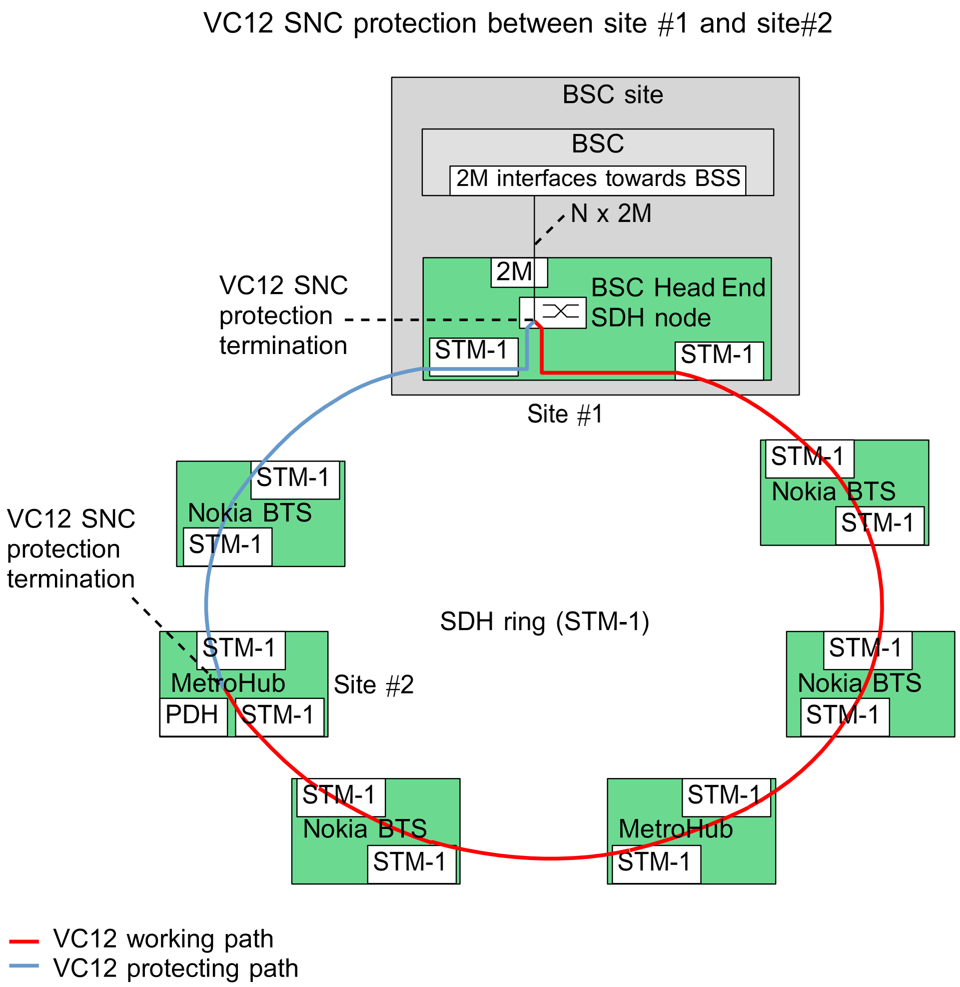


Figure 24. SNC ring protection scheme

4.4 Technical description of power protection in Nokia MetroHub

Due to the integration of the modules, the reliability of Nokia MetroHub is increased significantly compared to non-integrated solutions. However, node power protection is recommended for nodes with high amount of traffic through them, such as loop master nodes.

The centralised power supply of Nokia MetroHub can be protected with an optional redundant power supply. The redundant power supply has all the functions of the main power supply. Further, one can protect against AC failure with an optional battery unit where the power supply switches automatically from AC to DC input from the battery unit in case of AC failure. This switching does not cause traffic interruptions or disturbance of performance.

The optional battery unit is equipped with smart battery supervision, giving protection for the node and the radios for a reasonably long time. Nokia MetroHub uses high-performance batteries to ensure reliable performance in both tropical and arctic environments.

If the capacity of the internal battery unit is not sufficient, there is an optional high-capacity battery backup unit available. This Nokia MetroSite Battery Backup roughly doubles the MetroHub battery backup capacity and therefore offers longer backup times. For details, refer to *Nokia MetroSite Battery Backup Product Overview*.

4.5 Technical description of fading margin measurement in Nokia 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. Nokia 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 Nokia 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.

4.6 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.

4.6.1 Lazy changeover timing

Quality class 1 lazy changeover function is supported, which means that the best possible protection against undetectable transmitter faults is available. It makes the first Tx changeover soon after constant BER is detected in the far-end. Also if far-end BER exceeds 1E-3, the Tx changeover is done immediately.

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 3. Primary and secondary periods of Quality Class 1

Class 1	h:min:s	
BER	Primary period	Secondary period
1E-9	24 days 20:31:24	24 days 20:31:24
1E-8	10:00:00	18:00:00
1E-7	0:30:0	3:00:00
1E-6	0:03:00	0:30:00
1E-5	0:00:30	0:10:00
1E-4	0:00:10	0:05:00
1E-3	0:00:05	0:02:00

4.6.2 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.

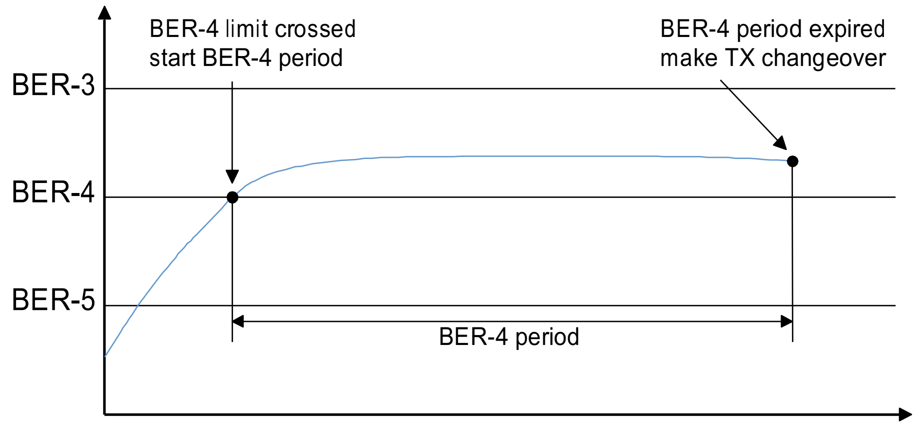


Figure 25. BER stays over the threshold for the primary period

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.

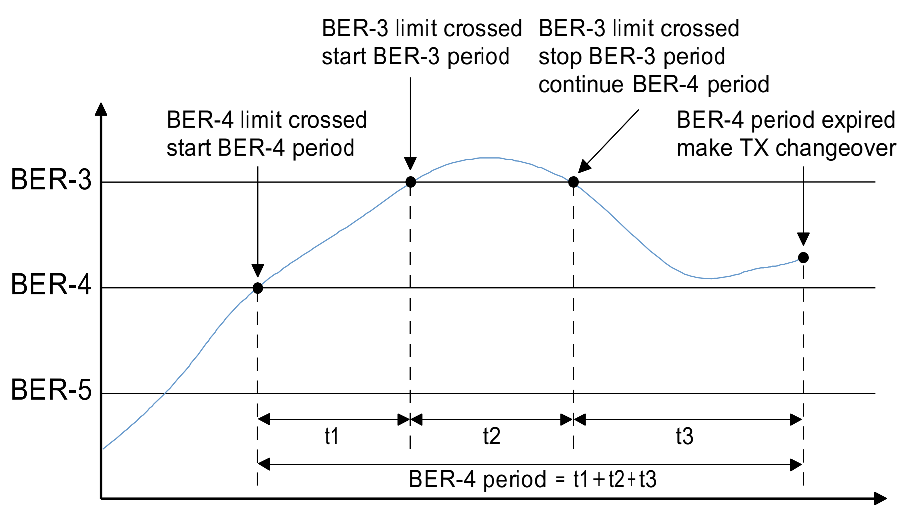


Figure 26. BER drops to the previous level and stays over threshold for the primary period

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.

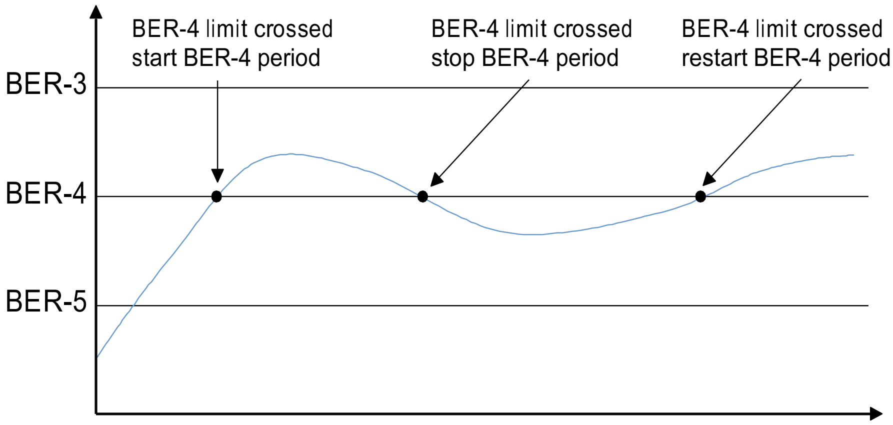


Figure 27. BER drops temporarily under the threshold and the primary period is restared

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.

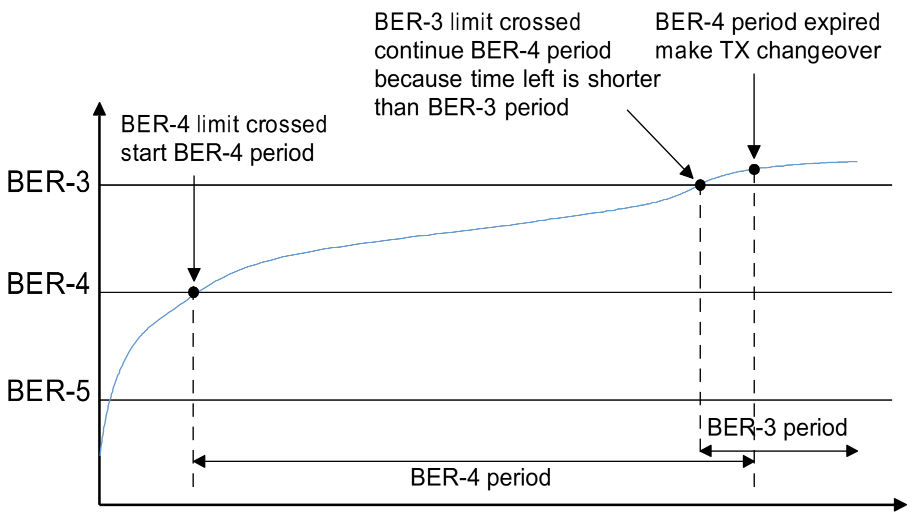


Figure 28. Lower BER primary period is continued

Example 5

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

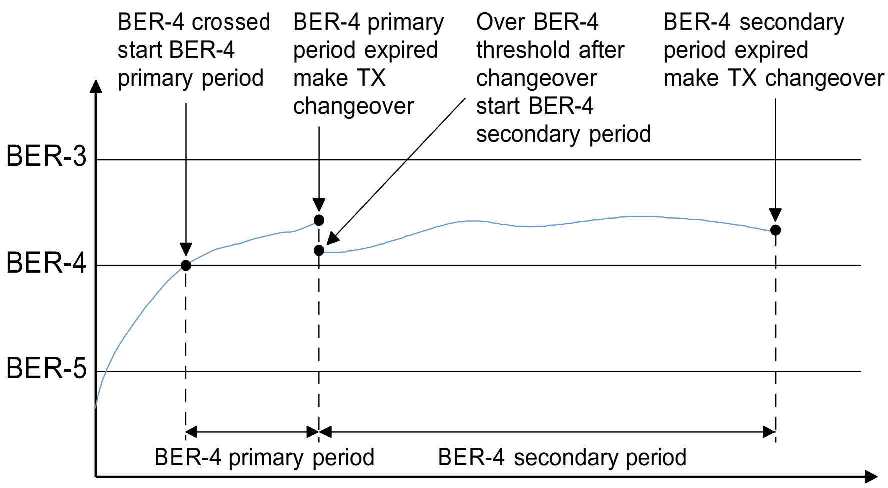


Figure 29. After the first changeover the secondary period is used

5 Technical description of functional areas

5.1 Technical description of optical Abis

Typically SDH equipment is configured with 2M granularity. This means that one or several 2M connections are dropped at the BTS site. These 2M connections are mapped to VC-12 paths, which are routed transparently to the BSC site, where they are dropped towards the BSC. As result, a full VC-12 is used from the BTS site to the BSC, although the capacity is only partially used. This results in ineffecient use of the transmission capacity and BSC interfaces.

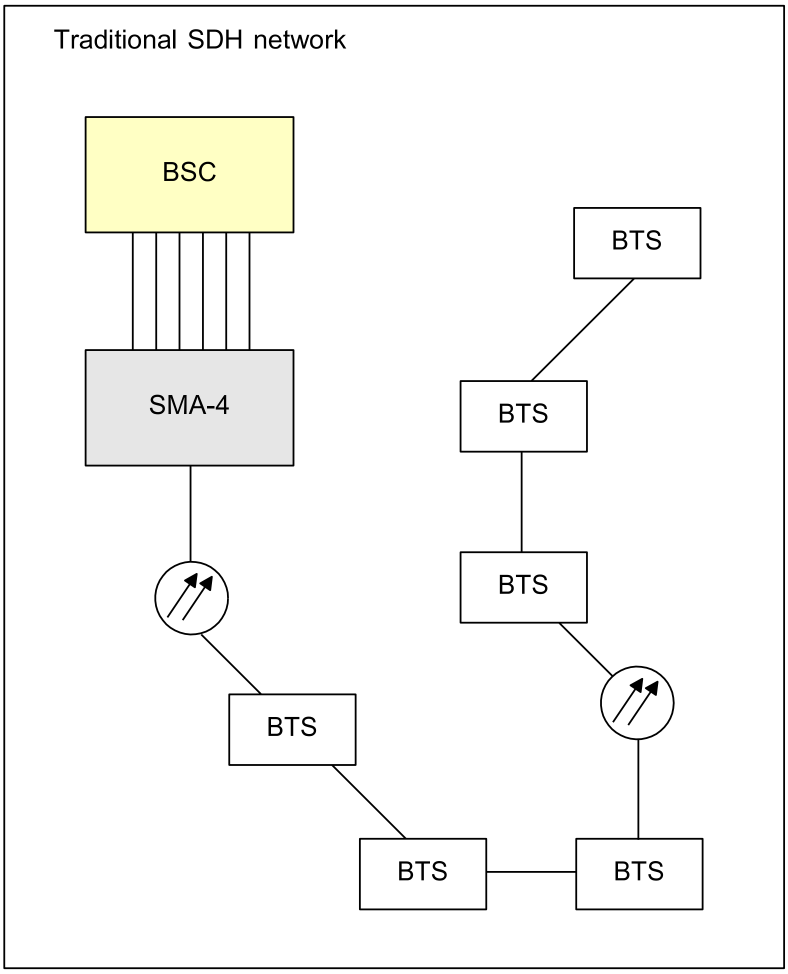


Figure 30. Traditional SDH network

The combination of a SDH add/drop multiplexer (FXC STM-1) and a PDH cross-connect (FXC Bridge/FXC E1T1/FXC RRI) in the Nokia BTS or MetroHub enables to fully utilise the capacity in the BSS SDH network and provide transmission capacity savings. The reduced number of E1 interfaces at the BSC brings further savings. The method for making these savings is called optical Abis.

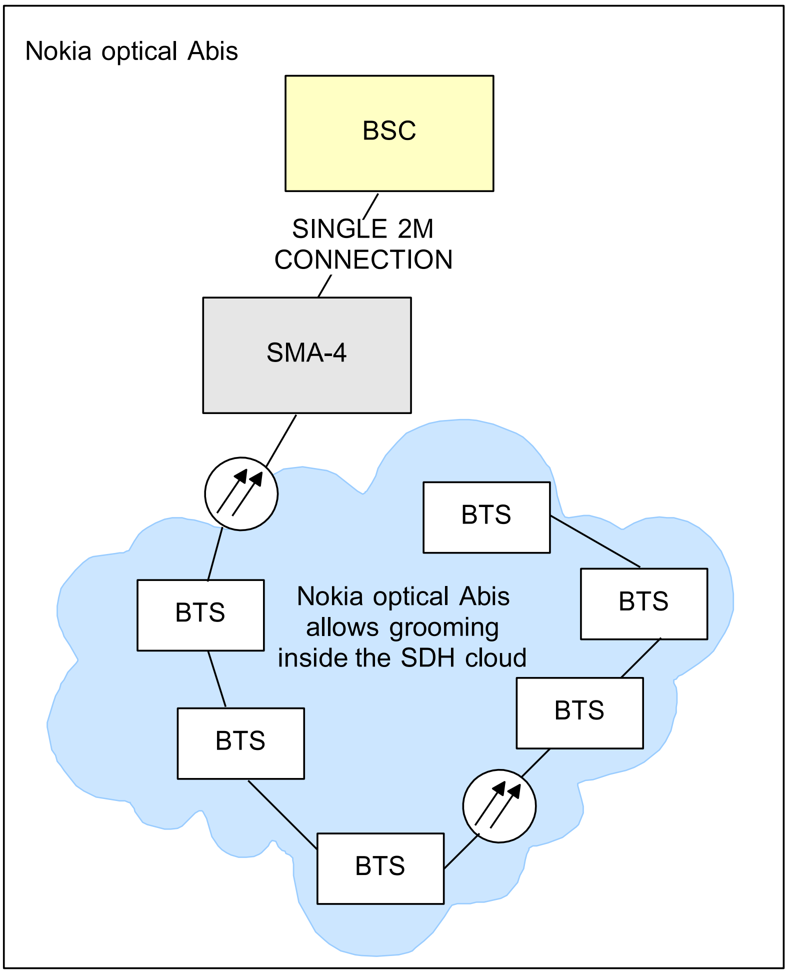


Figure 31. Nokia optical Abis

The figure below (example 1), shows two BTS sites in a chain. The figure serves only as an example, explaining the principle of optical Abis. The possibility for capacity savings can be scaled and applied directly into larger networks. In example 1, the grooming of the capacity is done at BTS site 1 with the result that only one VC-12 needs to be used towards the BSC, instead of two and only one E1 connection between the head-end MetroHub and the BSC.

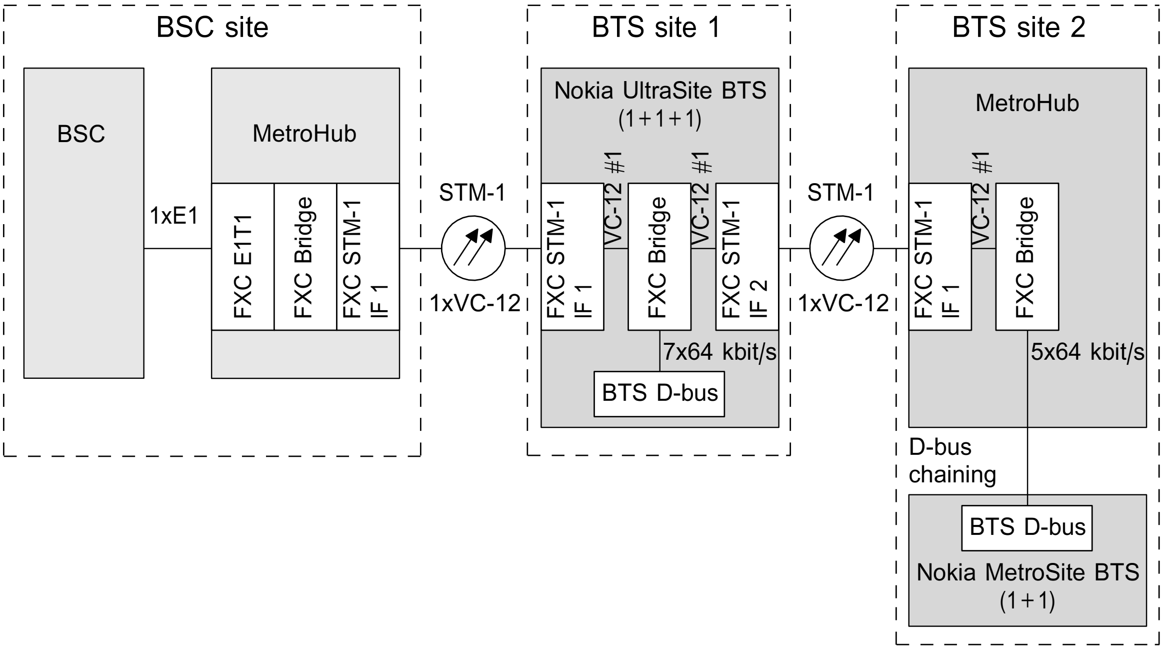


Figure 32. Optical Abis example 1

In the figure below (example 2), the grooming capacity is limited to the BSC site with the head-end MetroHub. In this case there is only one E1 connetion between the head-end MetroHub and the BSC, but two VC-12s are needed for transferring the BTS capacity up to the BSC site.

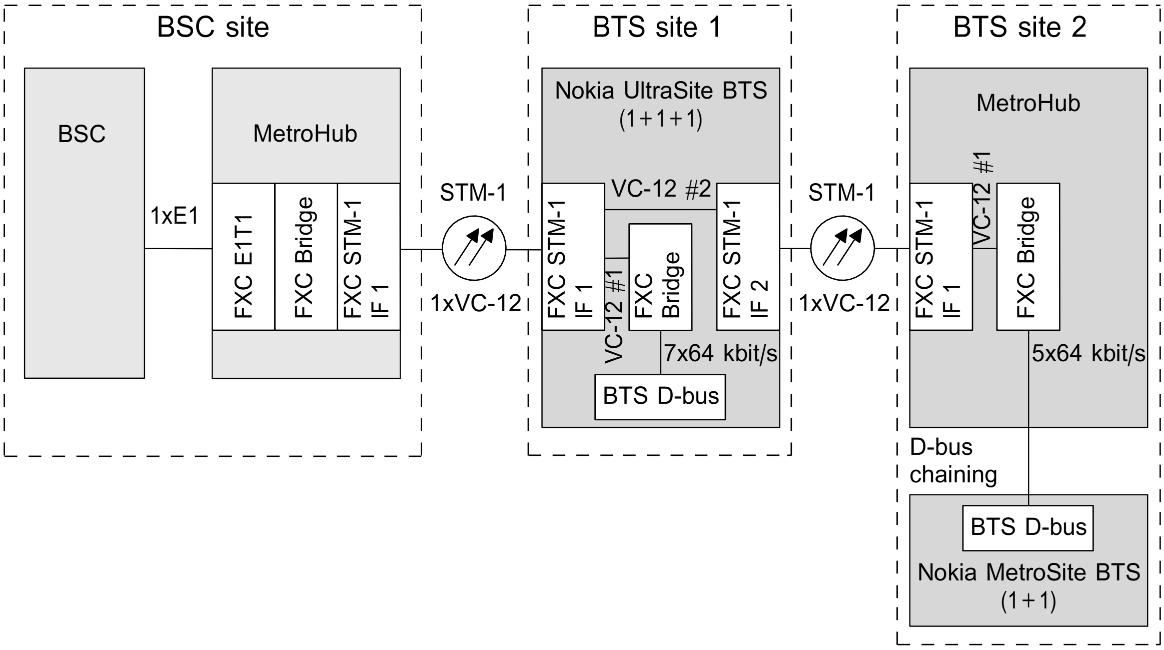


Figure 33. Optical Abis example 2

5.2 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

Note

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

Note

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 only possible 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.

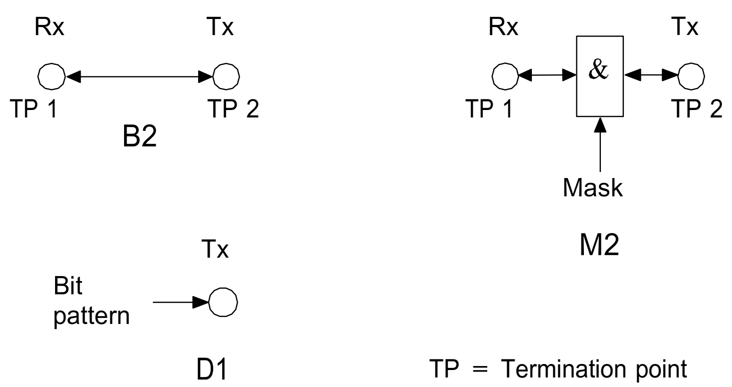


Figure 34. Basic cross-connection types supported

- 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.

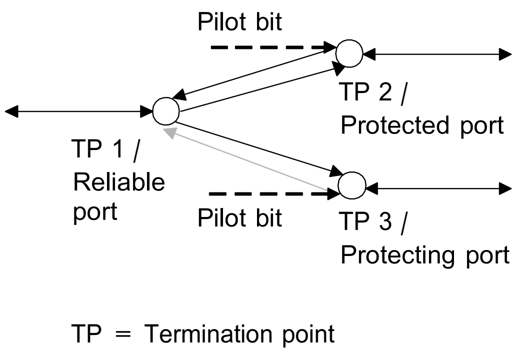


Figure 35. Protected bi-directional cross-connection

Note

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.*

5.3 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.

Note

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

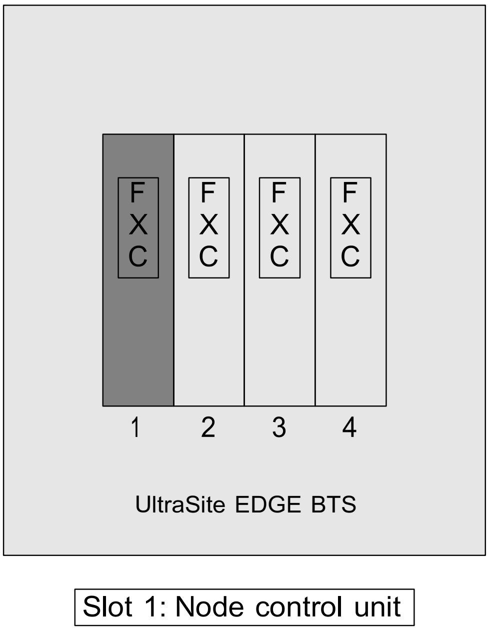


Figure 36. Transmission unit slots in Nokia Ultrasite EDGE BTS

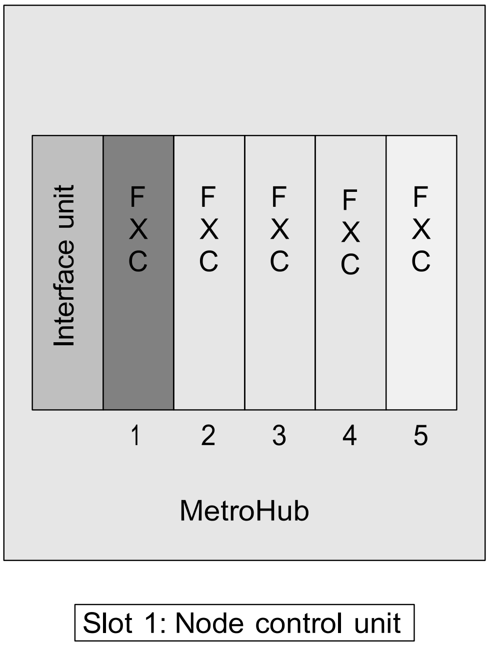


Figure 37. Transmission unit slots in Nokia MetroHub

5.4 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 Nokia 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 Nokia 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 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).

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

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 has to 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 has to 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.

5.5 Technical description of Q1 management

Nokia Q1 is a Nokia proprietary management protocol and it is backwards compatible with the currently used Q1. In this information set, Nokia 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.

Nokia MetroHub is a Nokia 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.

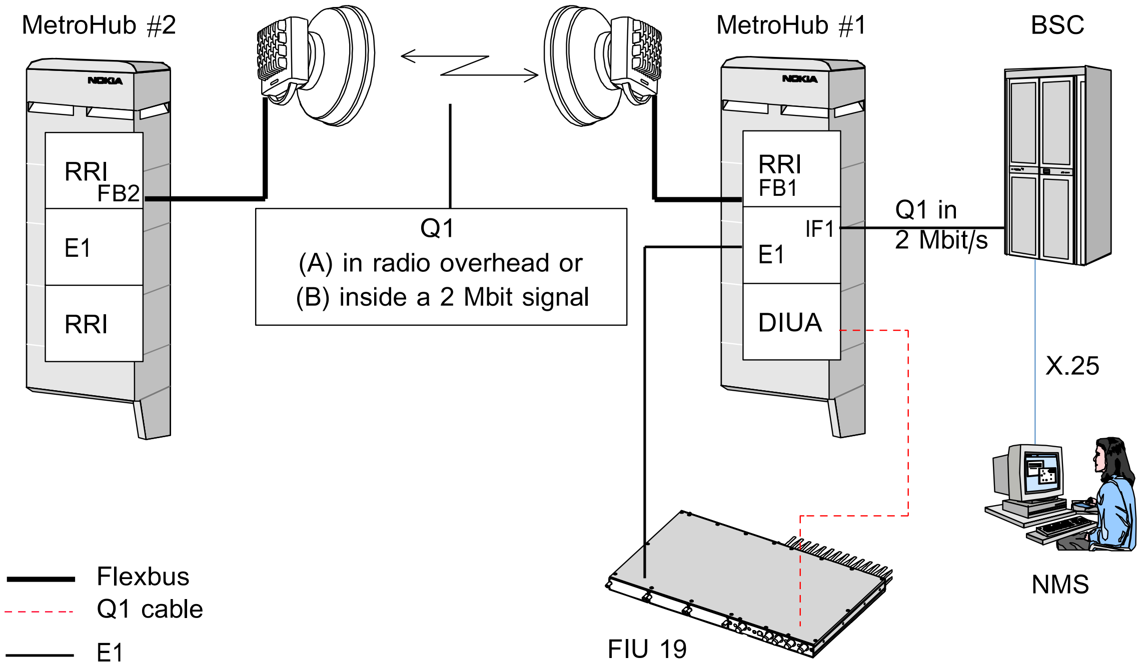


Figure 38. Examples of Q1 network connections

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.

5.6 Q1 management options for Nokia MetroHub

To enable remote management, a transmission channel for Q1 has to be created. With UltraSite BTS Hub, Q1 is embedded in the OMUSIG channel. With MetroHub, either Q1 has to be provided via one of the Q1 ports or a a dedicated Q1 DCN channel has to be created. This channel is called embedded operations channel (EOC), and the channel can be embedded into:

- any E1 or T1 timeslot in FXC E1 and FXC E1/T1 units
- the E1 timeslot in FXC Bridge
- any E1 timeslot in one of the Flexbus channels of an FXC RRI unit
- the radio overhead in an FXC RRI unit

The embedding is done by creating an EOC.

In FXC E1, FXC E1/T1, and FXC RRI transmission units, it is possible to use part of the payload signal to carry Q1 management data.

The Q1 network management channel has a bus structure and, therefore, EOC can be distributed in multiple directions.

To get MetroHub under Q1 management, you must further set up a Q1 hybrid. The use of the Q1 hybrid is optional with UltraSite BTS Hub and in the FXC transmission unit used within a MetroSite BTS. The hybrid controls the Q1 signal flow inside MetroHub, UltraSite BTS Hub, or MetroSite BTS FXC unit and in E1, T1, and Flexbus interfaces.

There are four hybrid switches:

- processor switch
- internal switch
- internal to external switch
- external switch

You can only set their use on or off.

It is recommended to leave the hybrid switches in the default values. Only if there is a need to change the Q1 flow for one of the above cases, you should change the hybrid switch settings in one of the described ways.

MetroHub defaults:
processor switch on, external switch on, internal switch off, and internal to external switch off.

UltraSite BTS Hub, MetroSite FXC unit defaults:
processor switch off, external switch off, internal switch off, and internal to external switch off.

Different cases and the resulting Q1 hybrid switch settings are listed below. The block called *uP* is the control function of MetroHub, UltraSite BTS Hub, or the MetroSite BTS FXC unit.

MetroHub managed via EOC or Flexbus overhead channel

This setting is used typically with **BSC as Q1 master** in exceptional cases with BTS as the Q1 master.

The processor and external switch are on. The internal and internal to external switch are off (default settings).

By having the external switch closed, other Q1-managed devices at the same site can be connected to the Q1 bus via the Q1-1 and Q1-2 interfaces.

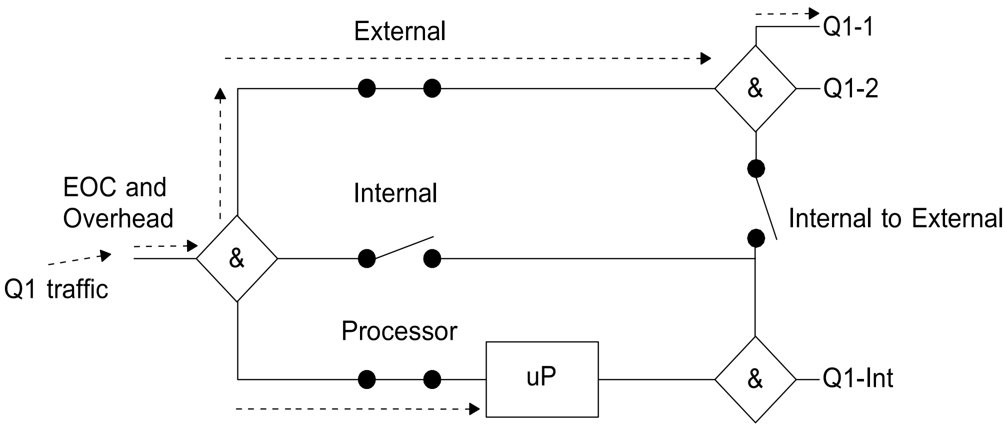


Figure 39. MetroHub managed via EOC or Flexbus overhead channel

MetroHub managed via Q1-1 or Q1-2 interface

This setting is used typically with **BSC as Q1 master** in exceptional cases with BTS as Q1 master.

The processor and external switch are on. The internal and internal to external switch are off (default settings).

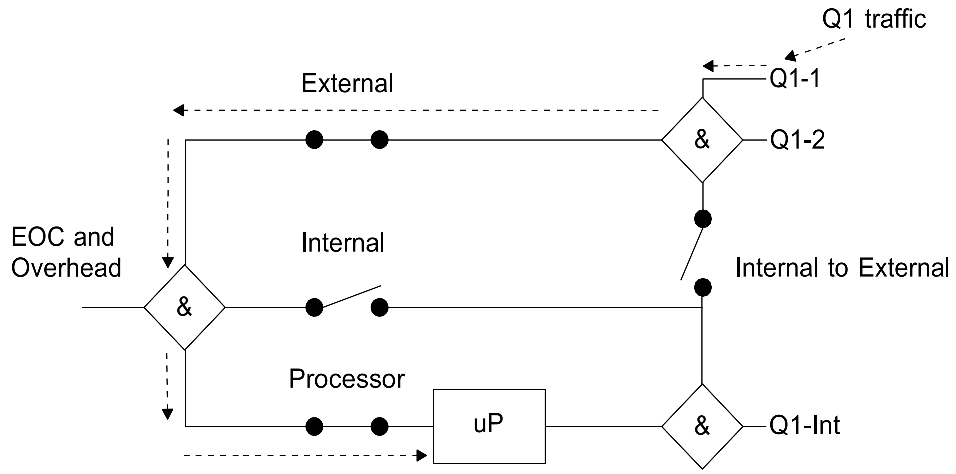


Figure 40. MetroHub managed via Q1-1 or Q1-2 interface

MetroHub managed via Q1 internal channel

This setting is used only with **BTS as Q1 master**.

The processor switch, external switch, and internal switch are off. The Internal to external switch is on.

This scenario occurs only if the MetroHub is chained to a MetroSite BTS via a D-bus cable. The Q1 internal bus is passed in this case from MetroSite BTS to MetroHub via the D-bus cable. The closing of the internal to external switch allows to pass the Q1 traffic from Q1 internal bus to the external Q1-1 and Q1-2 interfaces.

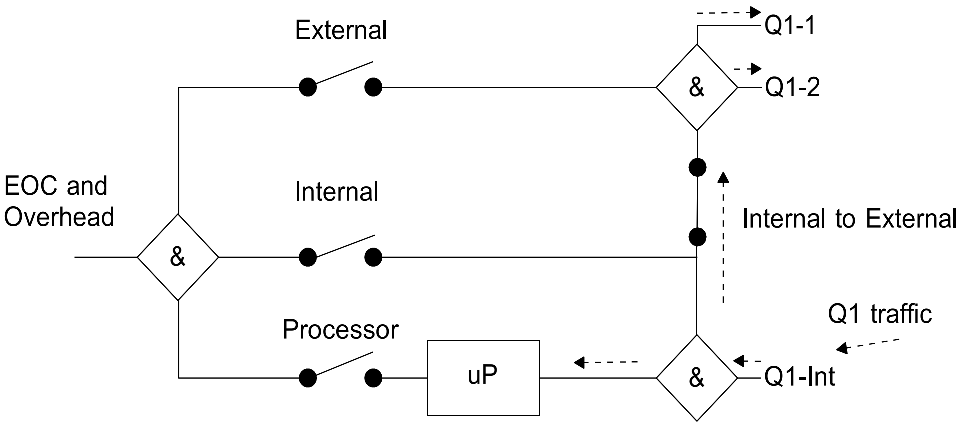


Figure 41. MetroHub managed via Q1 internal channel

UltraSite BTS Hub, MetroSite FXC unit managed via internal Q1 channel

This setting is used only with **BTS as Q1 master**.

The processor switch, external switch, and internal switch are off. The internal to external switch is on (optional).

BTS is always the master for the Q1 internal channel. Remote management traffic is passed to the BTS embedded in the OMUSIG channel.

By closing the internal to external switch, the Q1 traffic from the Q1 internal bus is passed to the Q1-1 and Q1-2 interfaces for connecting an external Q1-managed device to one of these interfaces.

See figure *MetroHub managed via Q1 internal channel* above for the Q1 flow and the switch positions.

MetroHub, UltraSite BTS Hub managed via internal Q1 channel and passing Q1 traffic to EOC and overhead

This setting is used only with **BTS as Q1 master**.

The processor switch and external switch are off. The internal to external switch and internal switch are on.

The internal switch needs to be closed if there is need to connect Q1-managed devices at a different site to the Q1 internal bus via the embedded operations channel or Flexbus overhead.

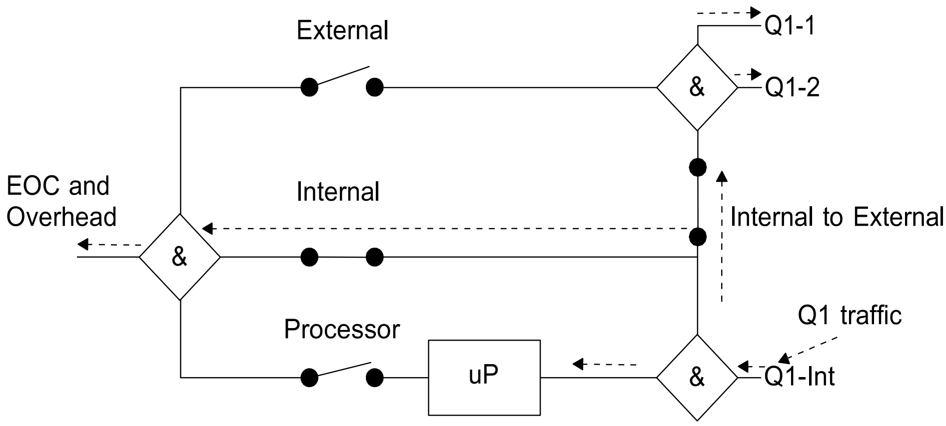


Figure 42. MetroHub, UltraSite BTS Hub managed via internal Q1 channel and passing Q1 traffic to EOC and overhead

UltraSite BTS Hub, MetroSite FXC unit managed via EOC or Flexbus overhead channel

This setting is used only with **BSC as Q1 master**.

The processor switch and internal to external switch are on. The internal and external switch are off.

With the described switch settings and configuring the UltraSite BTS Hub to supervise BSC in the BSC Q1 polling list, it is possible to have BSC as the Q1 master for the UltraSite BTS Hub. The advantage is that if a fault occurs in BTS, the supervision of UltraSite BTS Hub continues. The disadvantage is that a more complex Q1 network and additional utilisation of transmission bandwidth, in case an embedded operations channel, are used.

The recommendation is to use BTS as the Q1 master for the UltraSite BTS Hub. External Q1-managed devices at BTS site can be in control of BTS as a Q1 master. This is done by closing the internal to external switch. The internal and external switch needs to be open to avoid that the Q1 bus (from BSC via EOC) and the BTS Q1 internal bus are connected together, which would render the overall Q1 DCN unusable.

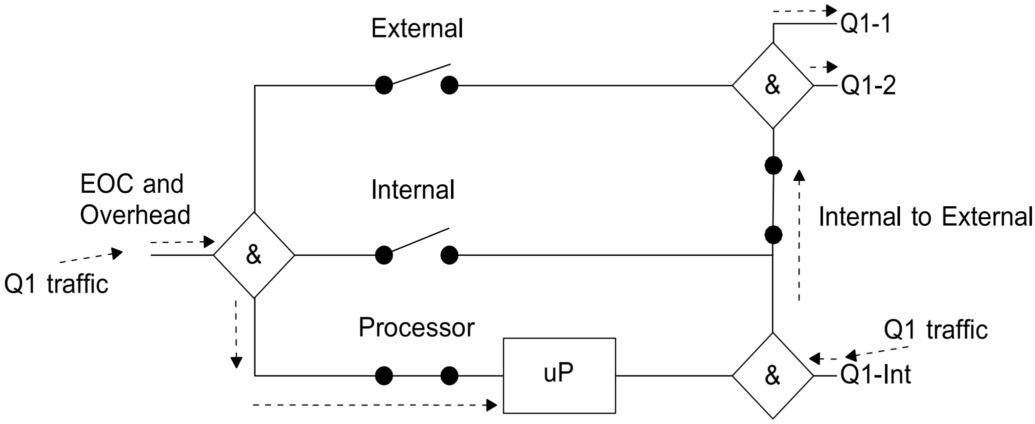


Figure 43. UltraSite BTS Hub, MetroSite FXC unit managed via EOC or Flexbus overhead channel

If the intention is to have all Q1-managed devices at direct control of BSC Q1 master, then the external switch needs to be closed and the internal to external switch opened.

Note

There are Q1 devices that can only be controlled by BTS. Check whether such a device is used at BTS site before setting up the switches in the described way.

If UltraSite BTS Hub is intended to be in control of BSC as the Q1 master, ensure that this has been configured correspondingly in the Q1polling list of BSC.

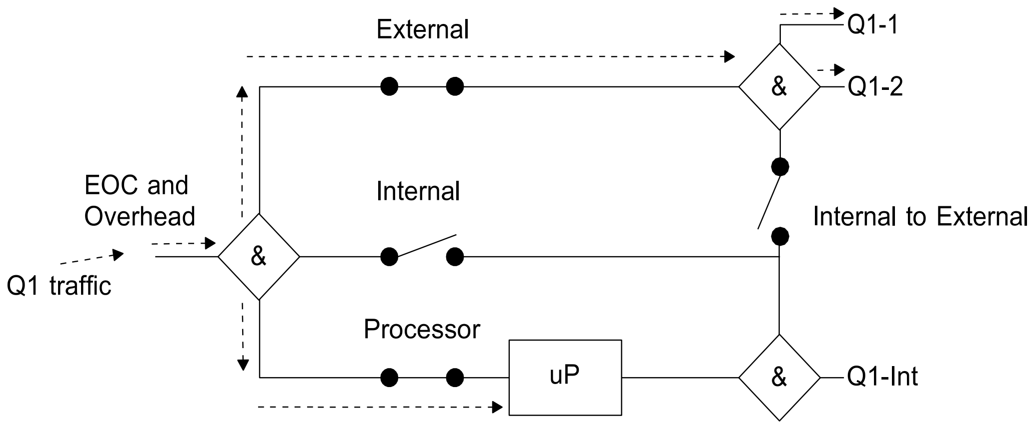


Figure 44. Whole Nokia BTS site managed via EOC or Flexbus overhead channel

5.6.1 Q1 management and FXC STM

Because of architectural reasons, the Q1 bus is handled inside the node in a special way if FXC STM is used. This means that the timing properties of the Q1 bus together with FXC STM get tighter and time-outs can occur when having an ITN node with FXC STM in control of a BSC Q1 master.

As a result, the following guidelines exist when creating a Q1 DCN with FXC STM used in MetroHub or UltraSite BTS Hub:

- If FXC STM is used within an UltraSite BTS Hub, use the BTS as the Q1 master. Do not use BSC as the Q1 master in this case.
- If FXC STM is used within MetroHub and the MetroHub is in control of BSC as Q1 master, use one dedicated BSC Q1 service channel for this MetroHub only.
- Always use a whole E1 timeslot (all 8 bits) as EOC channel and configure the speed of the Q1 bus to 9600 baud.

For instructions on Q1 management settings, see *Adjusting Q1 management settings*.

5.7 Technical description of the performance management of FXC transmission units

5.7.1 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 4. 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 4. 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 5. 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.

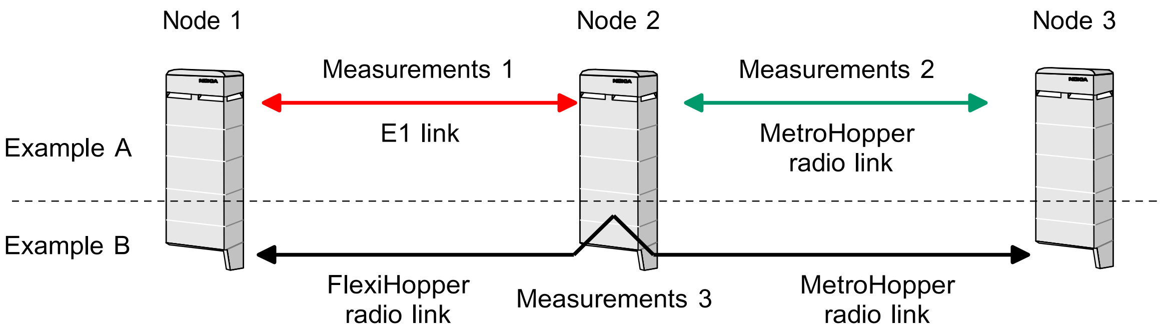
The following error performance events are collected with ITN transmission interfaces according to G.826:

- 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 = Nokia UltraSite, MetroSite or MetroHub

Figure 45. Measurements

Note

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 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 via an E1 line. Measurements 2 are made between Node 2 and Node 3 along a connection created with Nokia 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 is implemented via using the traffic bypass feature. In this case the signal is not terminated in Node 2, since cross-connections made via traffic bypass are transparent on the 2 Mbit/s level. The connection between Node 1 and Node 2 is set up using Nokia FlexiHopper (Plus) and the connection between Node 2 and Node 3 is set up using Nokia MetroHopper.

5.7.2 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 6. 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

Table 6. Statistics for STM-1 interfaces and SDH-PDH channels and statistical error counters (cont.)

AT	seconds	Available Time AT = TT - UAS (where UAS = Unavailable Seconds)
ES	seconds	Errored Seconds: seconds with one or more errored blocks
SES	seconds	Severely Errored Seconds: a subset of ES. G.826 gives two definitions for SES. In Nokia 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

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).

5.8 Technical description of Nokia MetroHub cabinet management

5.8.1 Technical description of Nokia MetroHub cabinet management

5.8.1.1 Cabinet management bus

The communication between the node control unit and all the other units (not FXC units) takes place via an internal cabinet management bus, see the figure *Block diagram of Nokia MetroHub*. The cabinet management bus is used, for example, to read the alarms of units (including EAC), for climatic control, temperature measurement and unit ID information.

5.8.1.2 Node internal tests

The internal tests of MetroHub are performed in the commissioning phase and some of them can also be used as preventive maintenance tests. If a maintenance test is not passed, an alarm is given and passed on to the NMS.

Cross-connection test

This test can only be run during the commissioning phase. The test is for ensuring that the FXC unit combination is working. The test result is either pass or fail. The self-test function internally tests the operation of the backplane cross-connection bus between the units based on 64 kbit/s data.

In the test, all the units form a chain, the transmission quality of which is monitored for approximately 30 seconds. The self-test function of the node proceeds to the available loop tests inside FXC units. The node manager automatically makes the loopback configurations in the interfaces and cross-connections from one interface to the next. The internal bit pattern generator and receiver of the node control unit are used to monitor bit errors.

If there are radios connected to the FXC RRI transmission units, the data is looped back from the radio units during the test.

Interface unit (DIUx) tests

The tests ensure that the DIUx unit is performing the External Alarms and Control (EAC) functions properly. The user has to perform the site-specific settings separately with the configured external circuitry.

- External alarms and controls test

These tests only verify the internal hardware, independent of the usage and settings of the interfaces. External alarms tests are performed by reading the actual states of the alarm inputs, inverting the last stage of the input in hardware and verifying the results. External controls are tested by reading the stages of the control outputs and comparing the results to the settings. The testing does not affect the use of the user-defined external circuitry.

If the test is not passed, the *126 Unit function degraded* alarm is activated and it stays active until the test has been passed, or the unit has been removed. The interface unit DIUx LED also indicates this alarm (steady yellow).

Fan (DMFx) test

The fan is a mechanical device, the service life of which depends on the usage (equipment temperature) and the conditions where it is used (dust, other contaminant of the incoming air). You can test the fan to confirm that the fan provides sufficient air flow for cooling the equipment.

A precondition before performing the fan test is that the fan temperature is warmer than -10°C (14°F). Otherwise the message 'Not allowed' is displayed. The fan speed is set to the maximum for 30 s. During the test there is an indication of an ongoing test, that is, the alarm *23 Test mode active* is active. The fan alarms are monitored during the test period and after the test a message is displayed indicating either pass or failed (broken indicates that the achieved speed is < 20% of the maximum, or degraded, that is, achieved speed is < 85% of the maximum). Any alarm that has arisen stays active until the test has been passed or the unit is removed.

Unit heating test (FXC units)

The FXC units have heating elements to provide the components with a better usage environment and thus increase their life span. The function of the heating element can be tested.

A precondition before performing the unit heating test is that the ambient temperature (measured from the backplane) is below +30°C. Otherwise the message 'Not allowed' is displayed. If the unit heating is on, it is switched off for approximately 1 minute before the test. The unit temperatures are measured and stored. Half of the heating power is activated for 2 minutes. During the test the *23*

Test mode active alarm is active, as an indication of the ongoing test. After the heating period, the unit temperatures are read and compared to the temperatures read before the test. An assessment of a successful test is made for each unit, based on the expected temperature rise in the FXC units. If the test is not passed, the alarm *126 Unit function degraded* is activated for the corresponding unit.

Battery connection/capacity test

The battery life span depends on the environment, and the rate and depth of discharging. To check the performance of the battery, you can run an automatic test.

Battery capacity testing is divided into two parts: testing the connection and after that, if applicable, testing the battery capacity (performance). The battery connection test is performed to find out if the DC connection, including fuses, is satisfactory in the power supplies.

- Connection test

The test is started in both power supply units and the DC output alarms are polled for a period of 30 s. After the test, a message is displayed indicating either 'pass' or 'failed'.

- Capacity test

The capacity test is based on the normal load usage of the node. There is no disturbance caused to normal operation, but the back-up time is degraded for a couple of hours after the test, and before the battery has been recharged. The duration of the capacity test depends on the node configuration. If only a couple of units are in use and no radios are connected to the node, the test takes approximately 30 minutes. If there is a higher load, the available battery capacity can be measured in a shorter time period.

The node control unit polls the battery test status from the master power supply. The master power supply performs the test and monitors that the battery voltage is sufficient. During the test the *23 Test mode active* alarm is active, as an indication of the ongoing test

After the master power supply unit has finished the test, and the result is 'Low capacity' the *126 Unit function degraded* alarm is generated. If the result is 'Average capacity' the alarm *8 Low battery voltage* is generated. If there are no alarms from the battery, a message indicating high capacity is displayed.

Note

Check that there has not been an AC failure within 24 hours before performing the test, as that may have an effect on the test results.

5.8.2 Technical description of cold-starting Nokia MetroHub

Possible cold start situations are:

1. initial power up
2. starting the equipment for the first time
3. situation that occurs after an AC mains break down, with or without an internal battery.

A cold start situation is indicated with a steady yellow LED in the power supply unit.

The cold start logic in the power supply unit switches on the heating elements (100% heating) when the temperature is too low in MetroHub (< -10°C (14°F) in units). In a cold start case, the temperature is measured with separate sensors because there is no electricity in the node control unit and the internal buses are not working.

In a cold start situation, the batteries are charged and heated with AC (if available).

Typically the cold start time is less than 10 minutes. There is a back-up limit in the power system, which starts up after 50 minutes.

5.8.3 Technical description of the temperature management of Nokia MetroHub

The main purpose of the cooling and heating functions of MetroHub is to implement optimal temperature circumstances for unit electronics and the battery unit. Cooling is provided by a speed-controlled fan. The node control unit controls the fan speed and the heating power. It collects temperature information from the following units:

- FXC transmission units
- DIUx interface unit

- Backplane (ambient)
- DSUx power supply units
- DMFx fan unit

The hottest unit determines the speed of the fan and the backplane sensor determines the heating level. Heating and cooling are never on at the same time.

When MetroHub is operational and heating is needed, the node control unit controls the heating with reduced heating power (0...50% of maximum). The control information is transferred from the node control unit to the heating control logic in the power supply unit via the cabinet management bus.

The following units have heating elements:

- FXC transmission units
- DIUx interface unit
- DBBx battery unit

The battery AC voltage heater is switched on by the power supply unit logic. The batteries are charged under normal conditions and heated when the battery temperature is below 5°C (41°F). The heating level and time are determined by the power system.

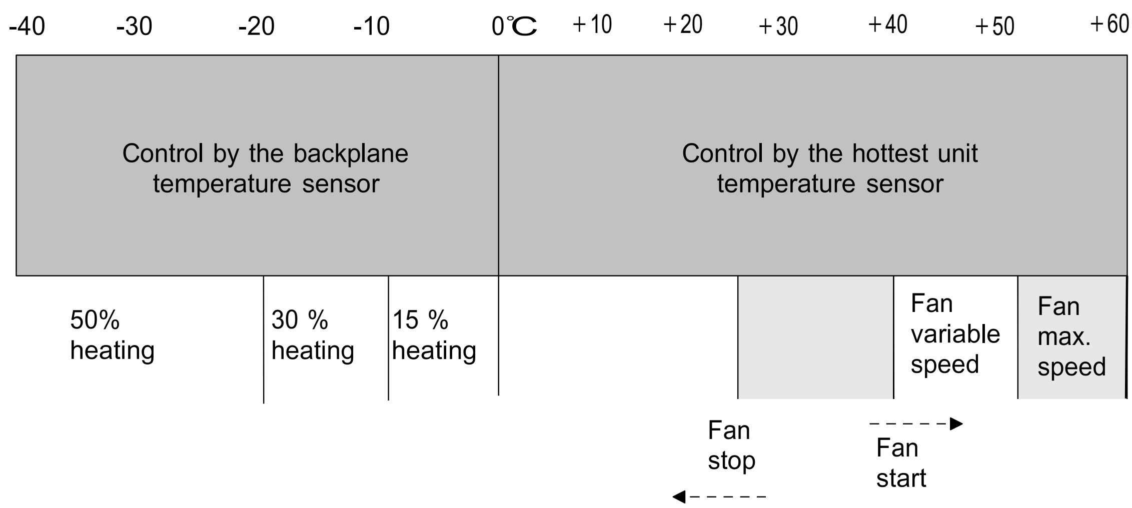


Figure 46. MetroHub cabinet temperature management for units (except for the battery unit)

Overheat protection

The power supply units are the hottest units in the node during normal operation. They have their internal overheat protection, including alarms, before all the output voltages are shut down, except the fan voltage. The power supply voltages are reconnected when the internal temperature has decreased to 15°C (59°F). During operation within the specified load and temperature ranges, overheating is an abnormal situation.

6 Technical description of products

6.1 Technical overview of Nokia MetroHub

The capacity and quality requirements for telecommunications networks are increasing dramatically. Internet and commercial data applications require flawless communication connections as well as an ever-increasing amount of capacity. At the same time, the mobile phone is gradually becoming the preferred phone both at the office and at home.

To meet the expectations of their customers, network operators need modular solutions that allow them to expand the capacity of their networks flexibly and to maintain the quality of the connections at all times. Interruptions in traffic and network downtime translate into huge revenue losses and also damage the network operators' reputation. Increased capacity and quality, on the other hand, allow operators to create more revenue-generating services and attract more subscribers.

Nokia MetroHub Transmission Node offers an efficient transmission solution with flexible network configuration capabilities and integrated PDH/SDH conversion. The new SDH solution provides support for the mixed use of FXC STM-1 and the other FXC units in the same node, which was not possible in earlier releases.

Nokia MetroHub is an integral part of the Nokia MetroSite Capacity Solution for mobile networks, a transmission solution for microcellular and macrocellular mobile networks, which allows network operators to increase the capacity to match the demand. It provides a cost-effective means of fulfilling the quality and capacity expectations of network operators.

In general, MetroHub can be used as an all-in-one transmission node in any BSS (Base Station System) network. Nokia MetroHub together with Nokia radios can form a stand-alone hub site or it can be located at a Nokia base station site. Smaller sites can use the traffic collection capability of an UltraSite transmission Hub, whereas larger transmission sites, which require protection and long transmission back-up times, use Nokia MetroHub. Nokia MetroHub can act as traffic collection point for tens of Nokia base stations.

6.1.1 Cost-optimised and fast transmission capacity expansion

Network capacity can be expanded efficiently and smoothly with Nokia MetroHub. It provides cross-connection and media change functionality in an all-in-one package, including outdoor housing, redundant power supply and battery back-up. MetroHub offers transmission protection with PDH loop configuration and subnetwork connection protection, a ring protection scheme with the FXC STM unit.

Importantly, Nokia MetroHub, Nokia MetroSite EDGE BTS and Nokia UltraSite EDGE BTS all use FXC transmission units. Using the same transmission unit in a number of transmission solutions has a number of advantages:

- the same transmission functionality is available throughout the Abis part of the mobile network,
- the exceptionally compact size gives operators the ultimate freedom in terms of site selection (indoors and outdoors),
- significant savings in operations and maintenance costs,
- faster implementation (network roll-out).

The operator configures and manages the transmission network with a graphical user interface, Nokia MetroHub element manager. The manager makes remote operations possible, thus allowing the operator to control the network from the Nokia Network Management System (NMS) environment. With this solution, the operator can manage the network topology freely and make later configuration changes at minimum costs.

With Nokia MetroHub, network capacity can be expanded fast and smoothly and the quality improved, all with minimised implementation and operation costs. Transmission network planning thus becomes transmission capacity planning.

Typically Nokia MetroHub connects microcellular and macrocellular elements in the Abis part of mobile network.

Nokia MetroHub can be installed quickly at new locations, both indoors and outdoors. Thanks to its small size and unobtrusive appearance, Nokia MetroHub blends into the city environment.

Figure 47. Nokia MetroHub on a site

6.1.2 Unique transmission platform

Nokia MetroHub provides a unique transmission platform for various transmission equipment, such as Nokia FlexiHopper, Nokia FlexiHopper Plus, and Nokia MetroHopper radios and form a stand-alone hub site. With Nokia MetroHub, a network can be rolled out in a fraction of the time previously needed. Thus, it is possible to start creating revenue faster. Nokia MetroHub is unique because it allows the operator 'to install' the cross-connection and media change functionality where it is needed. This maximises the trunking efficiency with less equipment. Because Nokia MetroHub is so flexible, and can be part of any number of network configurations, site maintenance is easy. As a direct consequence of this network reliability and availability are increased.

6.1.3 Quality through traffic protection

Nokia MetroHub provides the network with fast and automatic traffic protection with loop topology. It also offers cost-effective protection for radios and wireline connections via hot standby operation and lazy transmitter changeover. Hot standby 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. Hot standby provides protection against equipment faults. Lazy transmitter changeover is a protection method against transmitter faults that cannot be detected by the equipment itself, for example, a faulty antenna

Nokia MetroHub is designed for Abis applications, and traffic protection switching takes place within a fraction of a second, which allows phone conversations to stay alive during switching. Loop topology allows you to maximise transmission network availability and also to secure the transmission capability. This can, for instance, be helpful when using radios in rainy weather. Nokia MetroHub also provides power section redundancy and back-up functionality as options for added security.

6.2 Technical description of Nokia Network Management System

Remote control, alarm and performance data collection of Nokia MetroHub is done using Nokia Network Management System (NMS).

Nokia NMS incorporates a full range of functions from fault, performance, and configuration management to transmission, trouble, and security management. With the same applications and tools that are used to manage a GSM or an UMTS network, the user is also able to manage the elements that provide the transport layer. Nokia NetAct's capability to manage both PDH and SDH transmission equipment in the BTS access network makes it a highly integrated management solution for digital cellular networks. The availability of the BTS access network from the network management system is increased when you operate both the BTSs and the transmission equipment with the same NMS. Additionally, a centralised management system allows faster network changes and reduced monitoring effort and response time to locate and repair the faults.

Nokia MetroHub manager is delivered on the SiteWizard CD package, which is NMS compatible. MetroHub can be remotely controlled from a NMS site or via an x-terminal session. When operating Nokia MetroHub via Nokia NetAct, be aware that an established Q1 remote connection will timeout after five minutes. If this occurs, disconnect the connection and establish a new connection.

For more detailed information, please refer to NMS documentation, for example, Nokia NetAct documentation.

6.3 Technical description of the remote management with Nokia Circuit Manager

Nokia Circuit Manager is used for remote integration of PDH transmission equipment in a base station system (BSS). It supports the following elements:

- FXC RRI
- FXC E1
- FXC E1/T1

The Circuit Manager requires the enabling of TruNet in base stations and the assignment of an IP address to the base station as part of the node manager settings. TruNet is a private TCP/IP network that occupies a fixed 16 kbit/s capacity in a PDH frame.

The Circuit Manager main features are:

- remote setup of end-to-end cross-connections in a PDH network
- setup of PDH synchronisation
- near real-time view of the BSS network
- creation of temporary Q1 connections, setup of Q1 network
- offline definition of BSS areas for eased roll-out network planning

Nokia Circuit Manager main focus is eased and it has efficient roll-out procedures: the basic settings of a base transceiver station (BTS) and its transmission equipment can be applied locally during commissioning, whereas the BTS integration can be done remotely from the node manager server. Due to this, Circuit Manager allows to adapt to changed traffic and to routing requirements during roll-out.

Targets of the Nokia Circuit Manager usage can be summarised as follows:

- reduced number of site visits
- reduced number of errors in detailed network planning

- full access to the network from network management system (NMS) level for configuration / maintenance and network documentation
- fast BTS setup and configuration using predefined template files

For more detailed information, see Circuit Manager documentation in Nokia Online Services (NOLS).

7 Technical description of units and mechanics

7.1 Technical overview of Nokia MetroHub hardware

Nokia MetroHub has a modular structure, as shown in the figures. Nokia MetroHub comprises a cover and a mechanical cabinet providing a base for various plug-in units and an optional battery unit. Free unit slots have to be filled with shielding units to keep the air flow constant in any configuration and to provide sealing for the connectors.

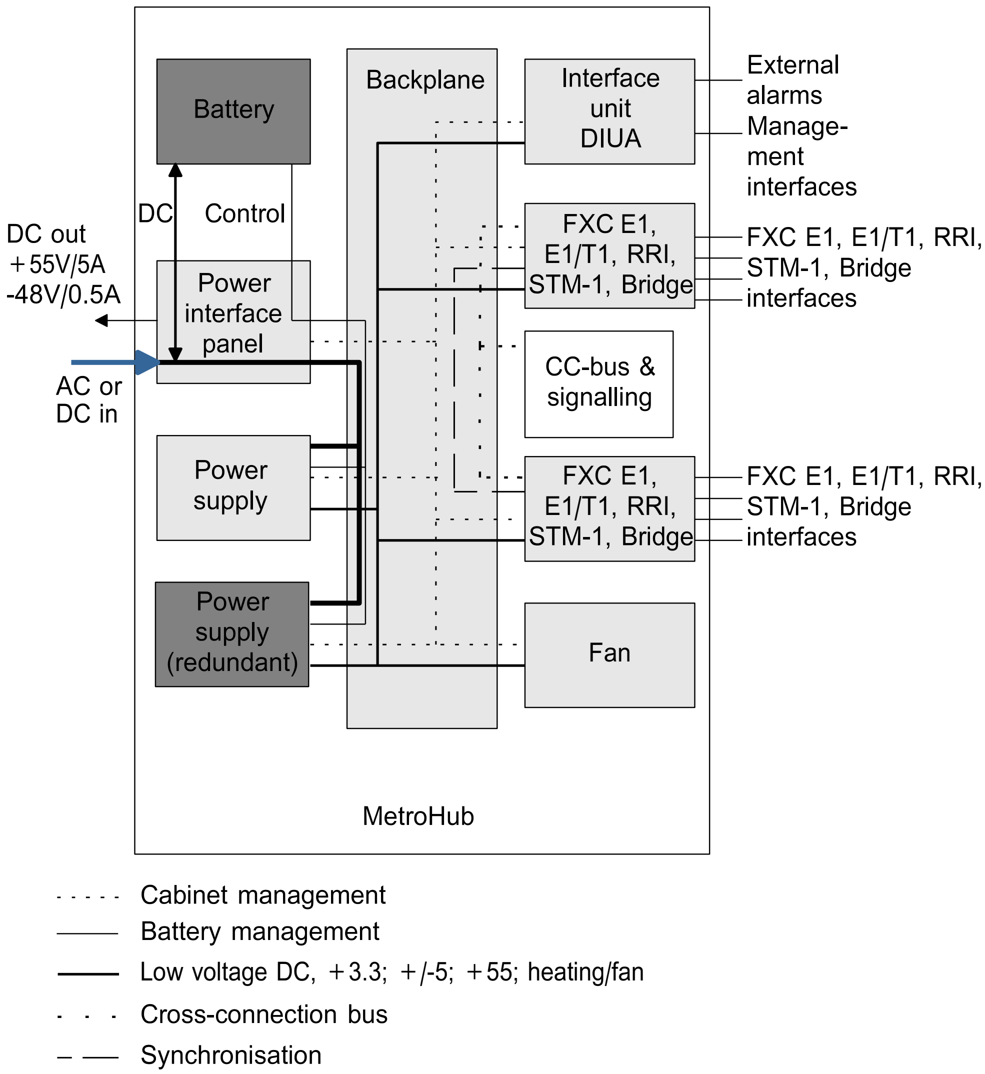


Figure 48. Block diagram of Nokia MetroHub

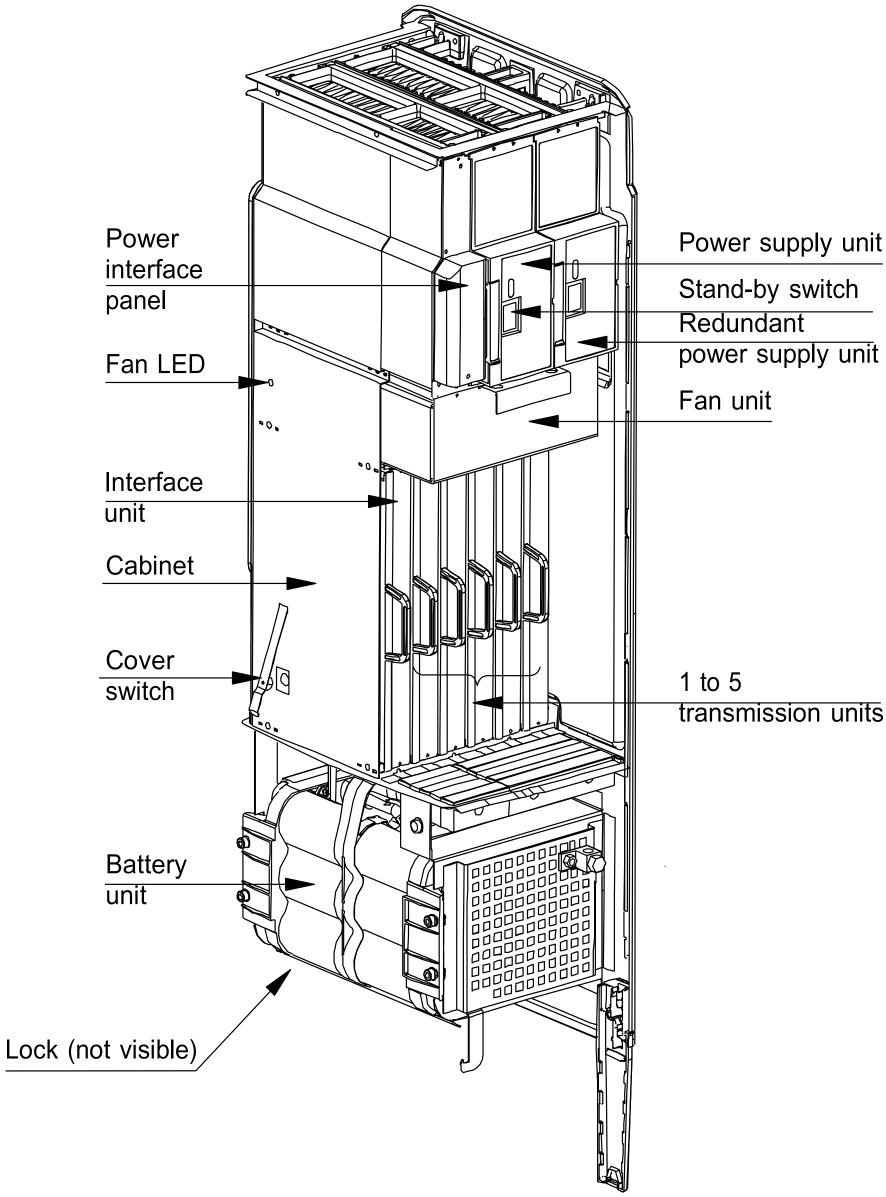


Figure 49. Nokia MetroHub

Plug-in units

The plug-in units inside the cabinet are:

- Power interface panel
- One or two identical power supply units
- Fan unit
- Interface unit (DIUx)
- Optional battery unit

Transmission units

In addition to the above-mentioned plug-in units, Nokia MetroHub always houses one to five transmission units:

- FXC RRI transmission unit
- FXC E1 75 Ω transmission unit
- FXC E1/T1 120/100 Ω transmission unit
- FXC STM transmission unit
- FXC Bridge transmission unit

Connectors

There are connectors on the back of the units for connection to the backplane. The front panels contain the connectors for the user. All connectors are standardised and sealed against water. The connectors are provided with caps (not shown in pictures).

Cables

Cables are installed while the cover is off. All units can then be easily accessed, even in pole installations. Standard cables can be used.

7.2 Technical description of transmission interfaces

The transmission interfaces of the transmission node are implemented using FXC transmission units. Nokia MetroHub can host up to five FXC transmission units and Nokia 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 via 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 via the local management port (LMP) of the Nokia BTS or Nokia MetroHub, or remotely via the Nokia 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. Nokia FlexiHopper (Plus) radios have bit error ratio measurement for the air interface before the error correcting algorithm.

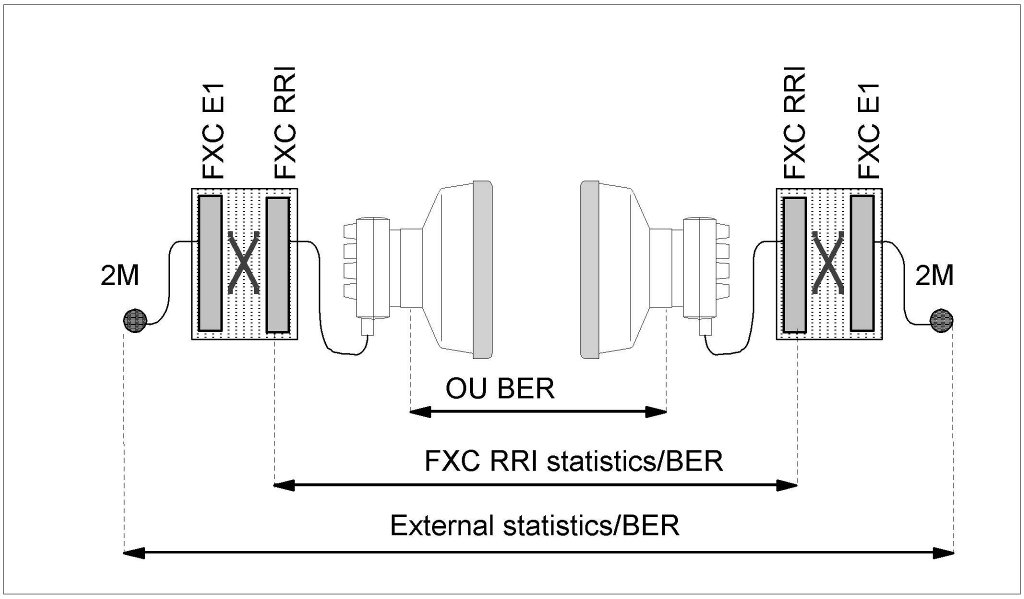


Figure 50. BER and statistics measurement points at unit level

8 Technical description of units

8.1 Technical description of Nokia MetroHub power supply units

Warning

Read Warnings and cautions carefully before working with any unit of the power system.

The power system comprises the power interface panel (DIPx) and one power supply unit (DSUx). As an option, it is possible to use an additional DSUx as a redundant power supply.

To gain maximum reliability for the power system, use a redundant power supply unit with an optional internal battery unit (DBBx).

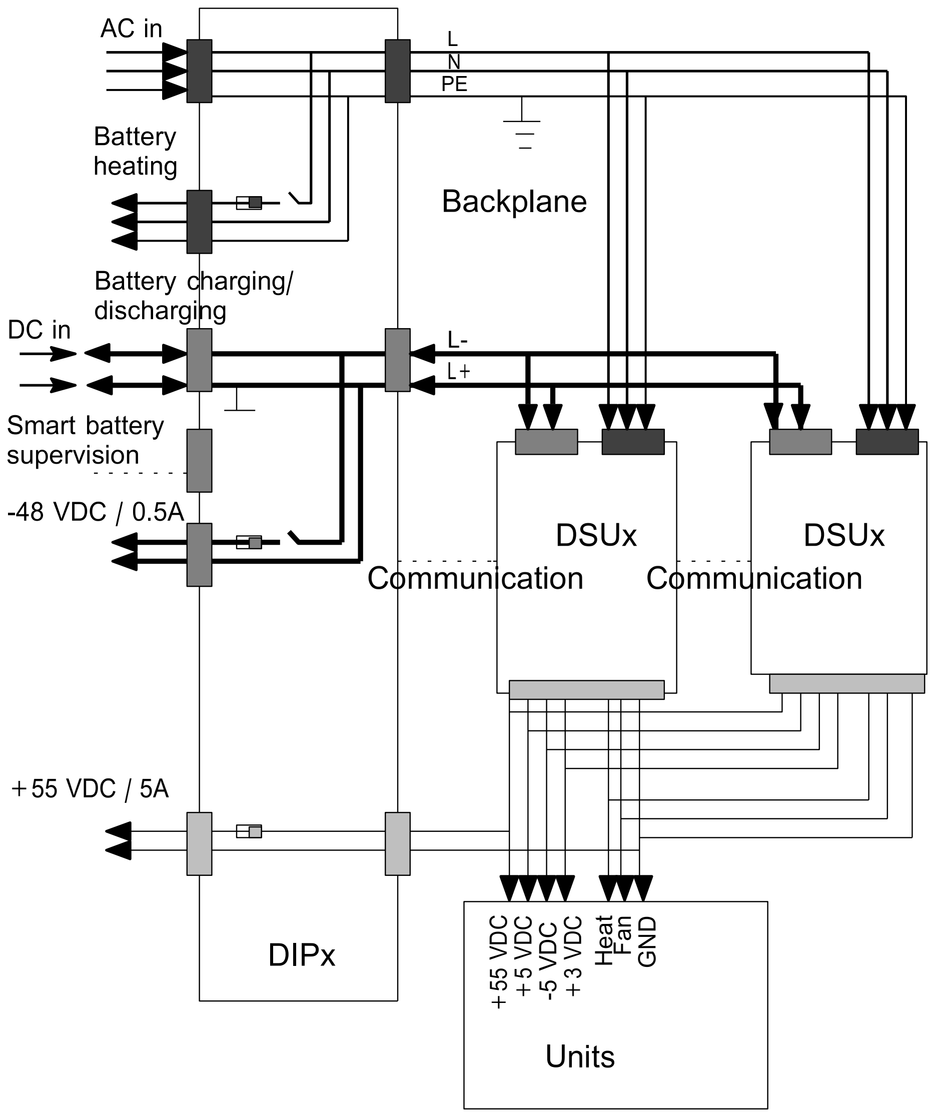


Figure 51. Block diagram of power system

Power interface panel (DIPx)

Power interface panel provides all external power connections, and distributes the incoming AC and DC voltages to the power supply units. If AC is the regular input, the DC input can be connected to the optional battery unit. As an alternative to AC, Nokia MetroHub can also be powered from an external DC source.

The DIPx contains the following interfaces:

- AC supply input
- DC supply input
- Battery back-up connection
- DC supply outputs

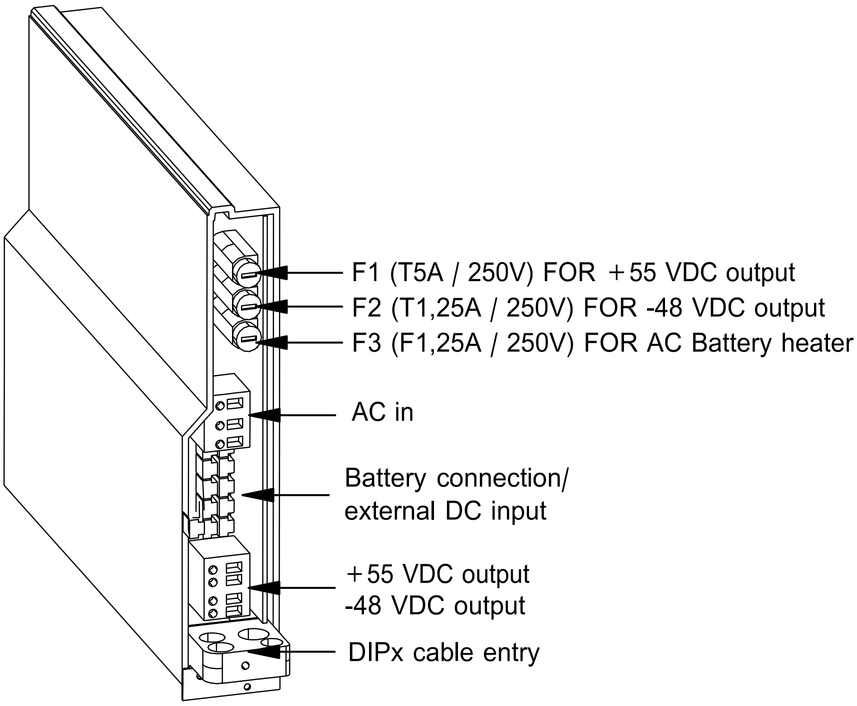


Figure 52. DIPx (without front cover)

Power supply unit (DSUx)

The power supply unit has a dual input: AC and DC. The inputs are supplied via the backplane. Both inputs can be used for normal operation. The power supply switches automatically from AC to DC input in case of an AC failure, without any traffic interruption or performance disturbance.

Battery unit (DBBx)

The optional battery unit supplies Nokia MetroHub with back-up power in case of mains failure. During normal operation, the power supply unit provides a charging voltage to keep the battery unit fully charged. Temperature compensated charging, deep discharging protection, battery testing, and battery heating are controlled by the power system. The battery unit consists of one 48 V block with a handle for lifting. The unit comes with a ready-made cable with plugs.

For increasing the Battery Back-up capacity, the Nokia MetroSite Battery Back-up can be used in addition to the battery unit of Nokia MetroHub. If Nokia MetroSite Battery Back-up is used to support MetroHub, the internal battery unit of MetroHub is also needed.

See *Power requirements for Nokia MetroHub* for the measured battery back-up times of different configurations at different temperatures.

8.2 Technical description of the Nokia MetroHub interface unit (DIUx)

The interface unit (DIUx) includes the digital interfaces needed for local supervision, maintenance and operation: Q1 and LMP. The unit also contains an interface for connecting up to ten external alarms and four controls (EAC). There is also a cover switch sensor inside the unit and a LED on the unit.

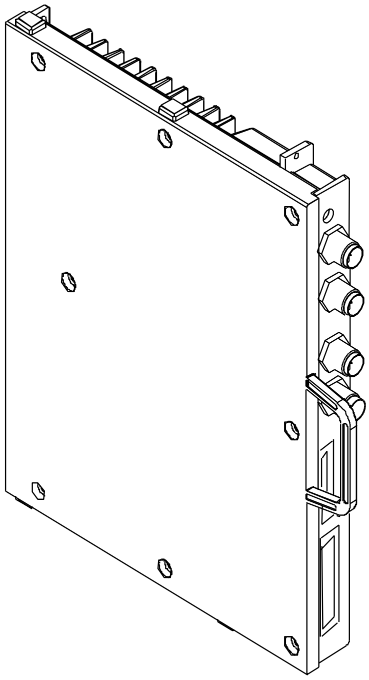


Figure 53. Interface unit (DIU)

The interface unit provides the following interfaces:

- local management ports (LMP), 2 pcs
- Q1 external ports, 2 pcs
- EAC (10 external alarm inputs, and 4 external control outputs)
- extension interface.

8.2.1 Local management port (BQ connector)

The local management port (LMP) is used to access the MetroHub node locally with MetroHub Manager.

There are two LMPs on the DIUx front panel to make it possible to chain several Nokia products on the site.

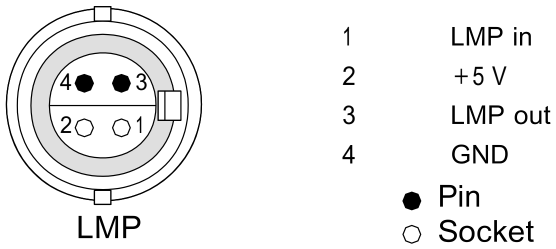


Figure 54. Local management port

8.2.2 Q1 port (TQ connector)

The interface unit can forward or receive management messages from MetroHub via the Q1 interfaces (Q1-1 and Q1-2). Management messages are sent on port Q1. The unit can also transfer Q1 channel data to external devices. The maximum bit rate is 115 kbit/s.

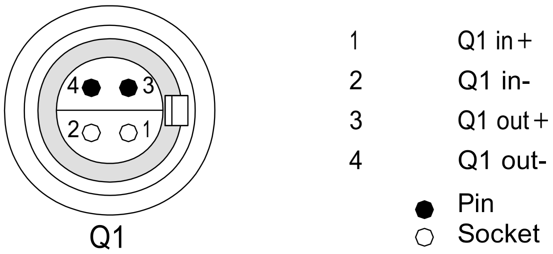


Figure 55. Q1 interface

8.2.3 EAC (mini D26 connector)

The external alarms and controls (EAC) connector provides the interface for ten user-definable external alarm inputs (EA) and four control outputs (ECO). Alarms and controls are managed with the node manager.

External alarm inputs

The inputs are activated by external alarm input connecting the input signal to GND. You can define the alarm polarity as well as whether an alarm is in use or not with the node manager.

The polarity states for the input alarms are:

- Open = The alarmless state for the active input is the open circuit.
- Closed = The alarmless state for the active input is the closed circuit.

The inputs are protected against fast transients. Supplies of +3.3V and +5V are protected with 500 mA PTC resettable fuses.

For voltage levels of external alarm inputs and a wiring scheme, see *External alarm input voltage levels and control output logic voltage levels*.

Control outputs

The interface unit provides four open collector control outputs. The user defines the signal polarity and switch state of each control with the node manager. The outputs are protected against fast transients. Supplies of +3.3V and +5V are protected with 500 mA PTC resettable fuses.

For voltage levels of control outputs and a wiring scheme, see *External alarm input voltage levels and control output logic voltage levels*.

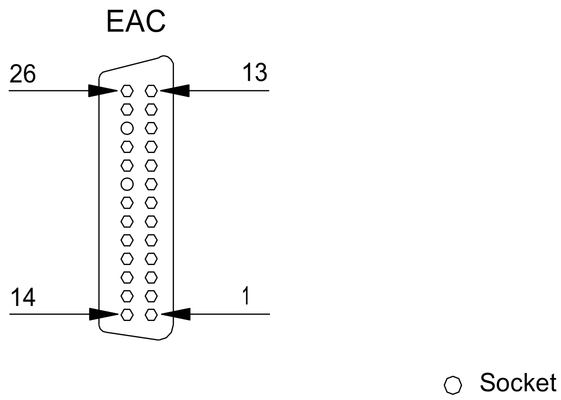


Figure 56. Pin order of EAC connector

Table 7. Pin configurations of EAC connector

Pin	Signal	Pin	Signal
1	EA1	14	GND
2	EA2	15	GND
3	EA3	16	GND
4	EA4	17	GND
5	EA5	18	GND
6	EA6	19	GND
7	EA7	20	GND
8	EA8	21	GND
9	EA9	22	GND
10	EA10	23	GND
11	ECO1	24	ECO3
12	+3 V	25	ECO4
13	ECO2	26	+5 V

8.2.4 Extension interface (mini D50 connector)

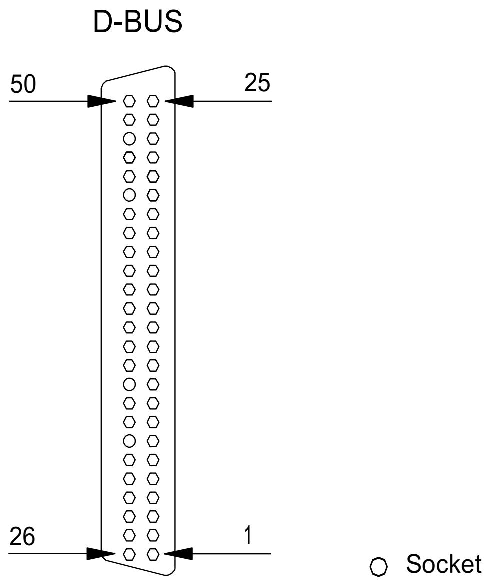


Figure 57. Pin order of the extension interface

Table 8. Pin configuration of the extension interface

Pin	Signal	Signal level	Pin	Signal	Signal level
1	CK2M_P	RS-485	26	CK2M_N	RS-485
2	D11DD_P	RS-485	27	D11DD_N	RS-485
3	D2DL_P*	RS-485	28	D2DL_N*	RS-485
4	FSYN_P	RS-485	29	FSYN_N	RS-485
5	D11DU_P	RS-485	30	D11DU_N	RS-485
6	D2DU_P*	RS-485	31	D2_DU_N*	RS-485
7	EXTFCK_P*	RS-485	32	EXTFCK_N*	RS-485
8	EXTFN_P*	RS-485	33	EXTFN_N*	RS-485
9	Q1DD_P	RS-485	34	Q1DD_N	RS-485

Table 8. Pin configuration of the extension interface (cont.)

Pin	Signal	Signal level	Pin	Signal	Signal level
10	Q1DU_P	RS-485	35	Q1DU_N	RS-485
11	LMPEXT1_P	RS-485	36	LMPEXT1_N	RS-485
12	LMPEXT2_P	RS-485	37	LMPEXT2_N	RS-485
13	D12DD_P	RS-485	38	D12DD_N	RS-485
14	D12DU_P	RS-485	39	D12DU_N	RS-485
15	D13DD_P	RS-485	40	D13DD_N	RS-485
16	D13DU_P	RS-485	41	D13DU_N	RS-485
17	CAB_SHUT1*	TTL +5V	42	CUA0*	TTL +5V
18	CAB_SHUT2*	TTL+5V	43	CUA1*	TTL +5V
19	CAB_SHUT3*	TTL+5V	44	CUA2*	TTL +5V
20	CAB_SHUT4*	TTL+5V	45	CUA3*	TTL +5V
21	TERM1*	TTL+5V	46	DOGS	TTL +5V
22	TERM2*	TTL+5V	47	DGND	TTL
23	+5V	+5V (for pullups)	48	DGND	
24	+5V	+5V (for pullups)	49	DGND	
25	+5V	+5V (for pullups	50	DGND	

8.3 Technical description of the Nokia MetroHub fan unit (DMFx)

The fan is a mechanical device, the service life of which depends on the usage (equipment temperature) and the conditions where it is used (dust, other contaminant of incoming air). The fan maintains the air flow needed for cooling MetroHub. The speed of the fan varies according to the temperature inside the equipment. The speed is controlled with cabinet management commands.

To make sure that the fan provides sufficient air flow for the equipment cooling it can be tested. See the following for more details on testing:

- *Technical description of Nokia MetroHub cabinet management*
- *Running a Nokia MetroHub system test*

8.4 Technical description of the FXC E1 and FXC E1/T1 transmission units

In mobile networks, it has to be possible to route the traffic in many different ways. FXC E1 and FXC E1/T1 offer great flexibility in this regard. FXC E1 and FXC E1/T1 transmission units provide the transmission functionality, including cross-connections, for various Nokia transmission solutions. The units can be applied as a single-unit transmission equipment or a multi-unit cross-connect node. Using these interfaces the operator defines the traffic routes using the cross-connection functions available in the network elements.

8.4.1 FXC E1

The FXC E1 transmission unit has four pairs of unbalanced 75 ohm connectors (type BT-43). Each pair forms a transmission interface. The Tx and Rx line interface connectors are separate; the upper connector is always the Tx connector and the lower the Rx connector. Each FXC E1 interface provides a 2 Mbit/s connection. With this interface, the signals can travel up to 1 km over a coaxial cable.

The 75 ohm Tx and Rx connectors are connected to each other with a grounding bridge. If the grounding bridge is removed, the grounding of the Rx connectors' outer conductor changes from direct grounding to capacitive grounding.

The unit has a tri-colour status LED, which can emit green, yellow and red.

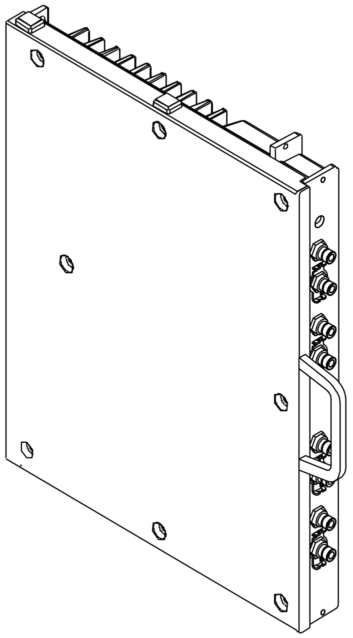


Figure 58. Unbalanced FXC E1

Additional synchronisation interface in FXC E1

The Rx-connector of line interface 4 can be used as a synchronisation interface for an externally provided 2048 kHz clock signal. Software settings determine whether this interface is used or not.

8.4.2 FXC E1/T1

The FXC E1/T1 transmission unit has four balanced TQ connectors (Tx and Rx in the same connector). Each line interface can be independently configured as a 120 ohm E1 interface or a 100 ohm T1 interface. This makes it possible to use it as an E1/T1 converter. The E1 interface offers a maximum capacity of 2 Mbits/s whereas the T1 interface offers 1.5 Mbit/s. With either one of these interfaces, the signals can travel up to 1 km over a shielded telecommunications cable.

The unit has a tri-colour status LED which can emit green, yellow and red.

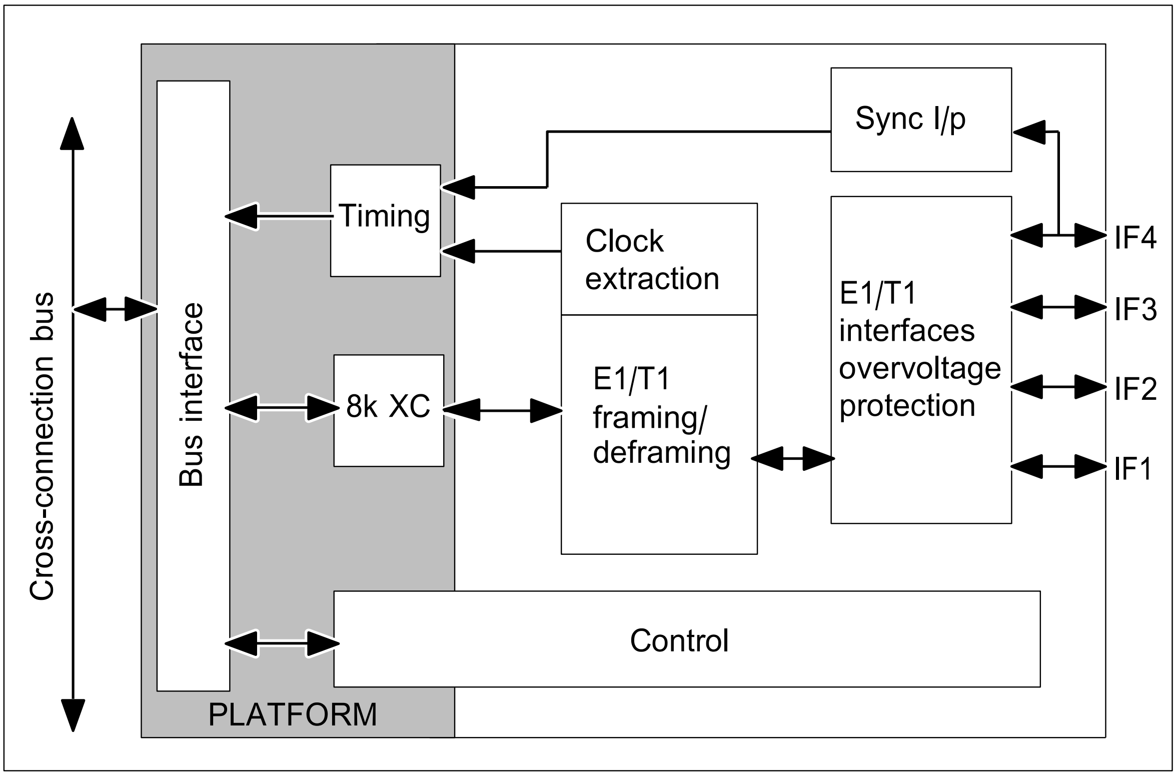


Figure 59. FXC E1 and FXC E1/T1 block diagram

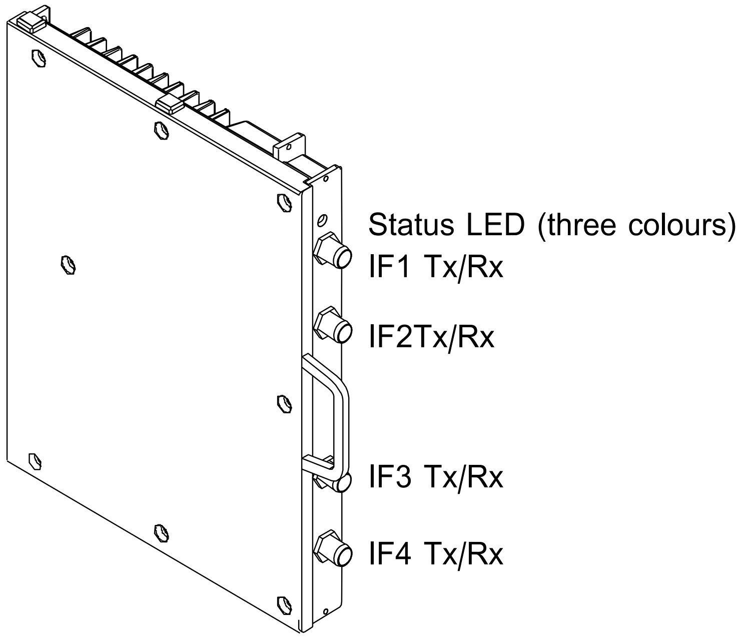


Figure 60. Balanced FXC E1/T1

There are four common TQ connectors for T1 (100 ohm) and E1 (120 ohm). The line interface connectors offer both the Tx and Rx direction.

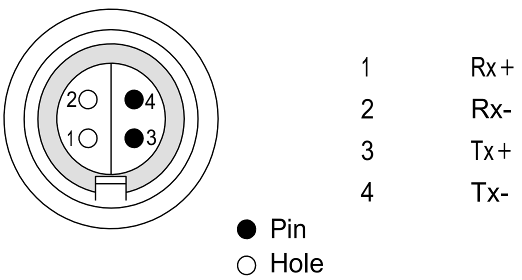


Figure 61. TQ connector

Additional synchronisation interface in FXC E1/T1

The Rx-connector of line interface 4 can be used as a synchronisation interface for an externally provided 2048 kHz clock signal. Software settings determine whether this interface is used or not.

8.5 Technical description of the FXC RRI transmission unit

The FXC RRI transmission unit has two Flexbus interfaces, which allow the operator to connect the unit to any radio unit with a Flexbus interface. This requires a Flexbus cable. For example, it is possible to connect FXC RRI to:

- Nokia MetroHopper radio with 4 x 2 Mbit/s capacity
- Nokia FlexiHopper (Plus) radio with 2 x 2, 4 x 2, 8 x 2 or 16 x 2 Mbit/s capacity

FXC RRI contains two Flexbus interfaces, FB1 and FB2, located on the front panel and a cross-connection bus interface on the backplane. FXC RRI does not have a separate management connector, as it is managed via the local management port (LMP) of the base station or the transmission node, or via Nokia Q1 bus.

FXC RRI has separate short circuit protection for each of the Flexbus interfaces. This ensures that a short circuit in one Flexbus interface does not affect the other in MetroHub.

If a Flexbus interface is connected to an outdoor unit, the power feed (55 V_{DC}) to the outdoor unit is done through the interface.

Currently FXC RRI supports three operating modes:

- single use
- hot standby
- hot standby + space diversity

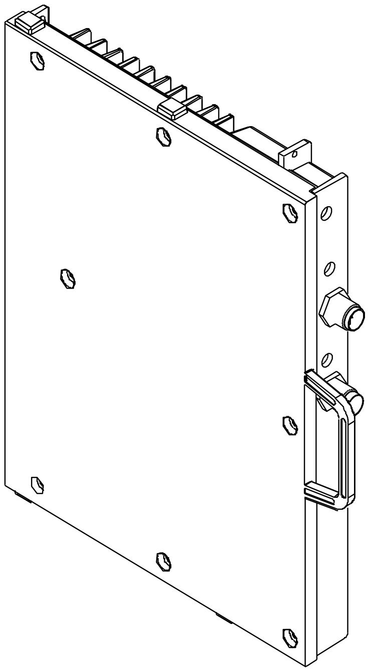


Figure 62. FXC RRI transmission unit

The FXC RRI offers a bypass cross-connection feature, which can be used to bypass traffic through the unit transparently without terminating the signal. From the performance management point of view, a link can be extended to include several nodes, while the performance data is gathered for the whole extended link. It is possible to make bypass cross-connections even if all the platform interfaces of the FXC RRI unit are in use. In other words, the bypass cross-connection does not reserve any capacity from the cross-connection bus.

The platform interfaces of each indoor unit have a maximum capacity of 16 x 2 Mbit/s. This traffic can either be dropped to the cross-connection bus or bypassed from one interface to another in the same FXC RRI in a separate 2 Mbit/s cross-connection field. If the total Flexbus interface traffic in one FXC RRI exceeds 16 x 2 Mbit/s, the surplus traffic has to be bypassed. In such a scenario, time slot 0 is not regenerated.

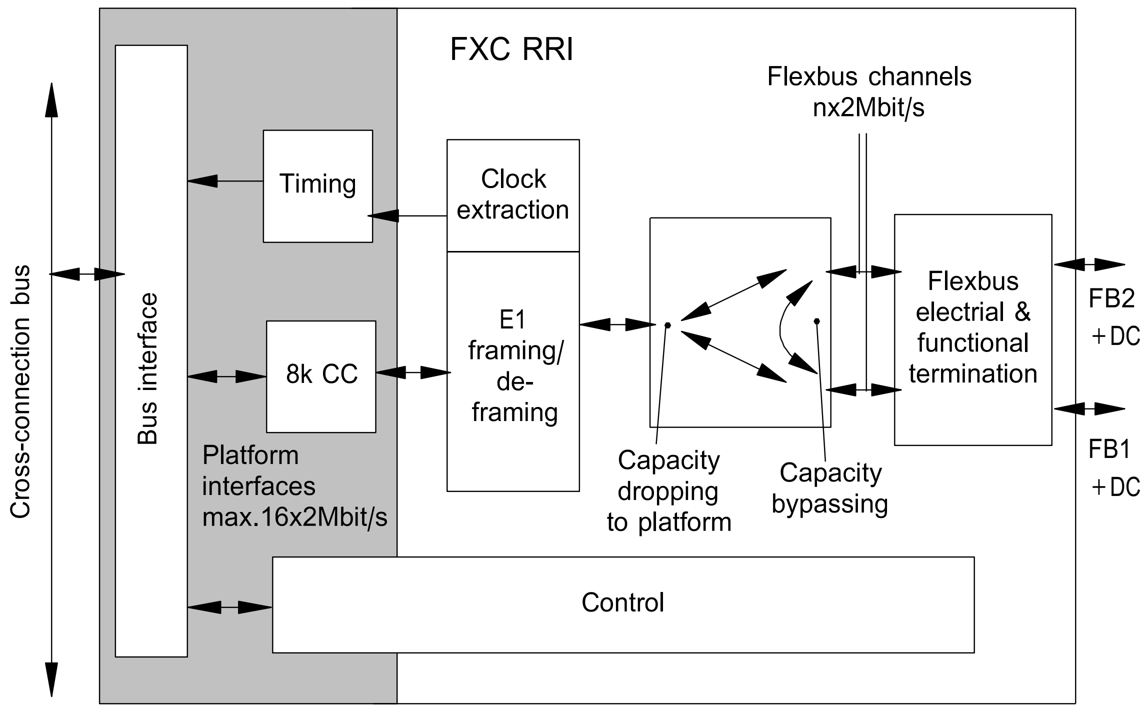


Figure 63. FXC RRI block diagram

A connection made between a Flexbus channel and a platform interface is a blocking connection. This means that the whole 2 Mbit/s frame is reserved for the connection even if only part of it, for example, one time slot, is used.

The operator defines the traffic routes in the network elements by using the cross-connection functions available in the network elements. Thus, routing traffic means managing the cross-connections in the network elements.

The cross-connection function of the FXC RRI transmission unit allows the traffic to be groomed. This ensures that the transmission paths are fully utilised, thereby reducing transmission costs.

The amount of 2M capacity add/drop towards the D-bus of a Nokia BTS is configurable, allowing you to utilise the available capacity to its maximum.

Note

FXC RRI platform interface 15 is always connected to the D-bus, because at least 1*2M capacity is always needed for the Nokia BTS. Only FXC RRI platforms 13 and 16 are configurable.

D11, D12, and D13 are only configurable via the RRI manager in a configuration with an RRI connected to a FlexiHopper (Plus).

8.6 Technical description of the FXC STM-1 and FXC Bridge transmission units

The FXC STM-1 and FXC Bridge transmission units enable 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 Nokia MetroHub transmission nodes. FXC STM-1 performs the main SDH functions, whereas 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.

The units both have a tri-colour status LED, which can emit green, yellow and red. In addition, the FXC Bridge unit has a test interface.

The FXC STM units do not have separate Q1 management interfaces. Instead, they are managed locally via the local management port (LMP) of Nokia BTS or Nokia MetroHub, or remotely via the Nokia Q1 bus.

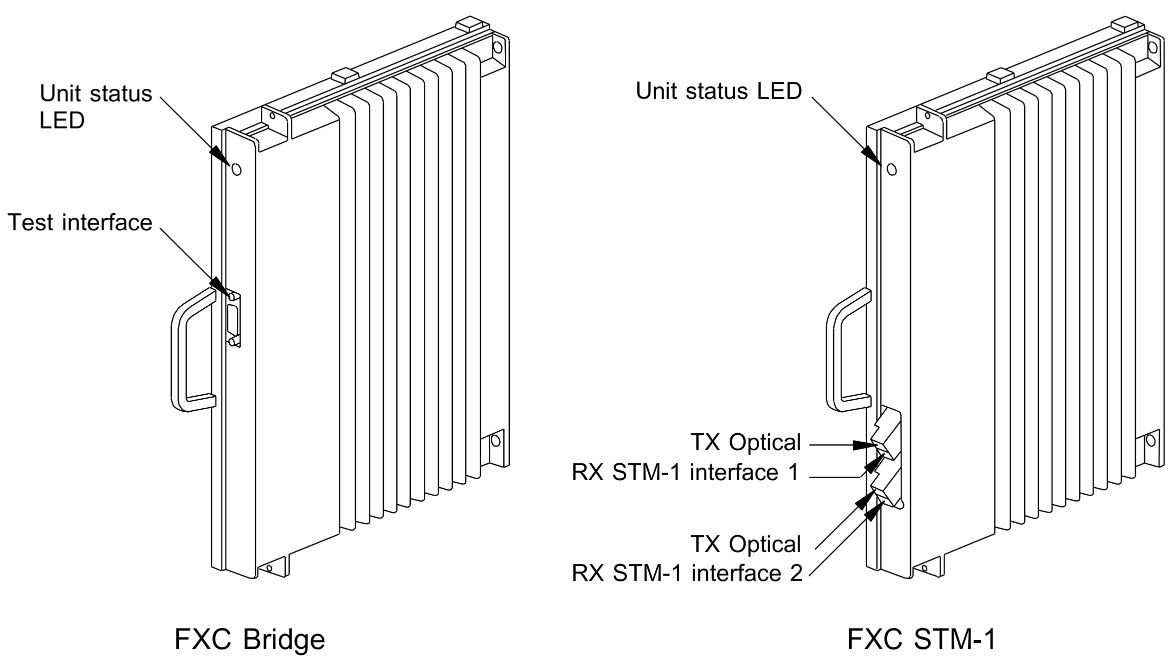


Figure 64. FXC Bridge and FXC STM units

8.6.1 Main features of FXC STM-1 and FXC Bridge

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 subnetwork connection protection), that is, protection on the VC-12 level.
- 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.

8.6.2 Main blocks of the FXC STM-1 and FXC Bridge units

The FXC STM-1 and FXC Bridge units are encased plug-in units constructed on a printed circuit board. The units connect to other units in their environment via their backplane connectors. Thus, they do not require any cabling besides the STM-1 interface cabling.

The two figures below show the backplane structures of a Nokia BTS and MetroHub.

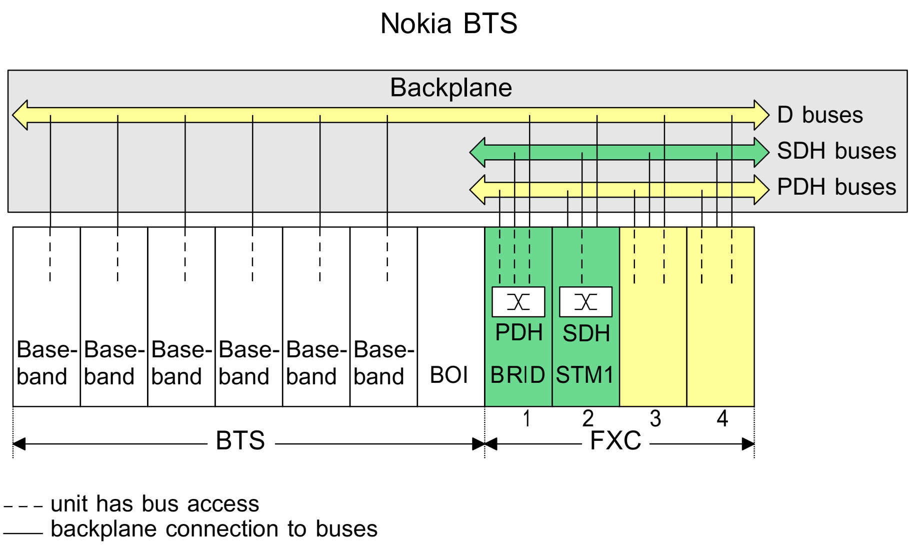


Figure 65. Nokia BTS backplane structure

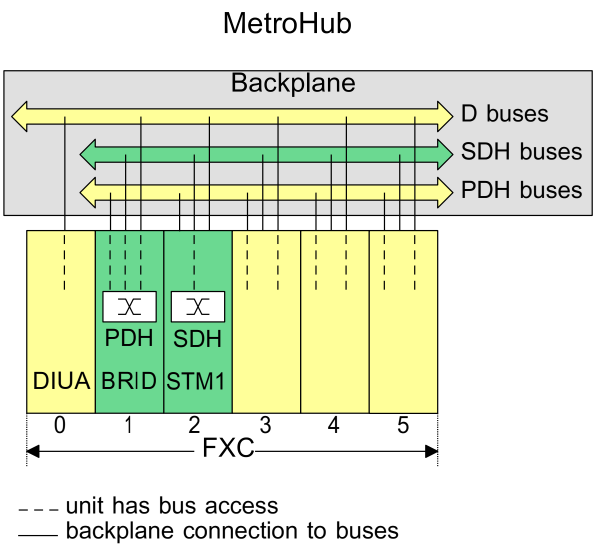


Figure 66. Nokia MetroHub backplane structure

SDH buses

The SDH buses are used for communication between the FXC STM-1 and FXC Bridge units. Main information/signals transferred via the SDH buses are:

- add/drop payload (via tributary bus)
- SDH byte information (time-division multiplexing (TDM) bus)
- SDH timing and synchronisation signals
- communication between units.

Note

Note The FXC (PDH) units do not access the SDH buses.

PDH buses

The PDH buses are used for communication between the FXC (PDH) units, including the FXC Bridge unit. Main information/signals transferred via the PDH buses are:

- Q1 communication buses
- PDH timing and synchronisation signals
- communication between units
- node control buses (for example temperature and fan control, and external alarm inputs/outputs).

D-buses

D-buses are three PDH buses, each supporting 2M. They are used for transferring the PDH add/drop and Q1 management traffic between the local BTS baseband units, and the FXC (PDH)/FXC Bridge transmission units. No external cabling is needed for this purpose.

8.6.3 FXC STM-1

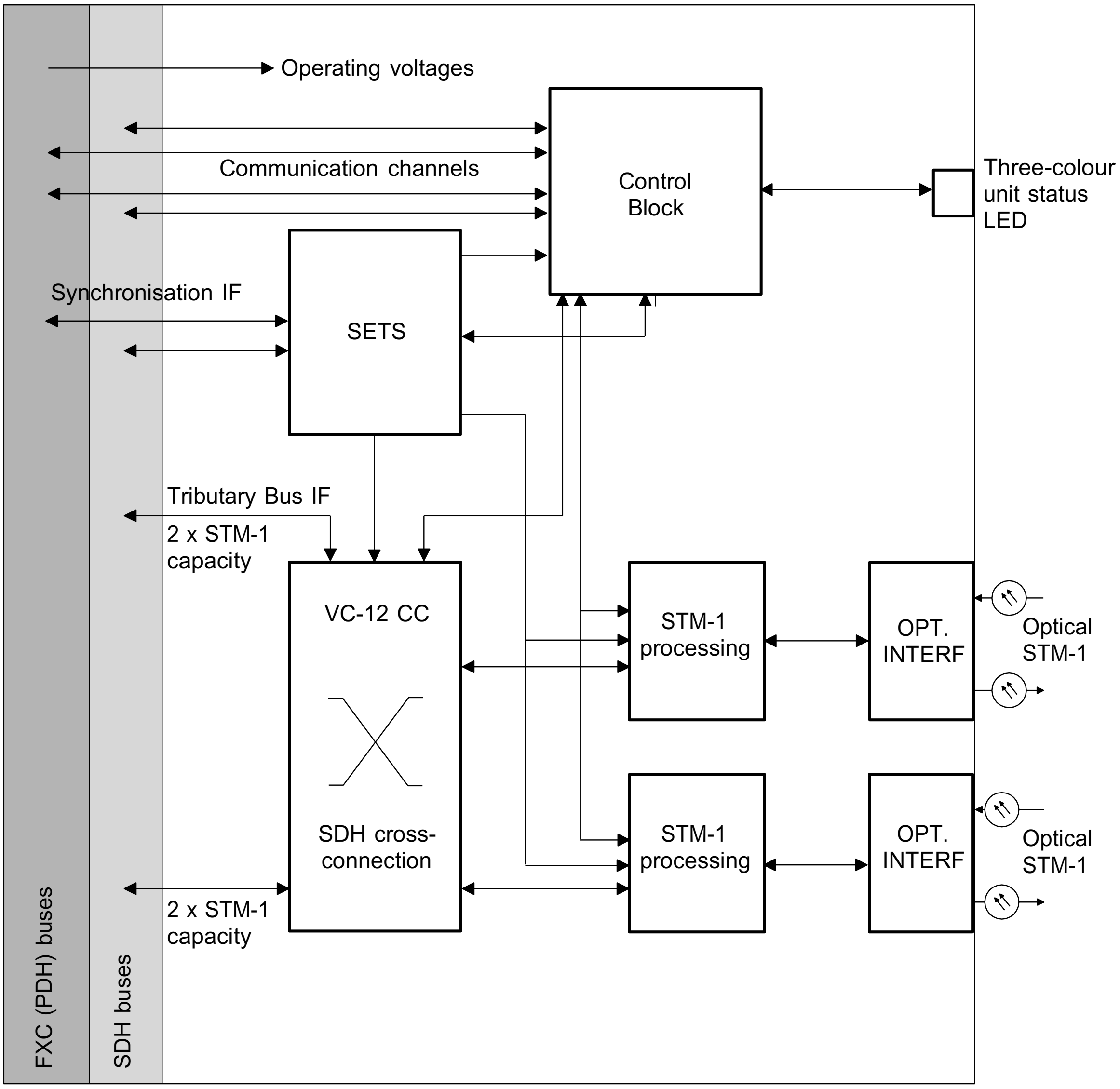


Figure 67. FXC STM block diagram

Optical interfaces

FXC STM-1 has two L-1.1 long-haul optical interfaces, which perform the following functions:

- optical to electrical signal conversion
- electrical to optical signal conversion
- clock and data recovery and serial to parallel conversion for the Rx signal
- data and transmit clock generation and parallel to serial conversion for the Tx signal
- optical output power measurement.

STM-1 processing block

The two STM-1 processing blocks perform the following functions:

- termination of the STM-1 signal between the optical section and the VC-12 path layer.
- adaptation from incoming clock rate (from optical interface) to SDH node clock rate through a TU pointer buffer.
- two aggregate bus input and output interfaces towards the VC-12 cross-connection block for transferring an AU-4 signal including 63 x TU-12 with STM-1 data rate.
- two serial data communication channel interfaces for transferring management traffic.

SDH cross-connection block

The SDH cross-connection block performs the following functions:

- cross-connections on the TU-12 level.
- generation of clock and frame synchronising signals for the buses.

SETS block

The SETS (synchronous equipment timing source) block:

- includes the SDH node clock.
- provides a 19.44 MHz synchronisation signal to synchronise the SDH functionality of the FXC STM transmission units.
- provides 2.048 MHz and 4.096 MHz synchronisation signals as reference for the PDH node clock.
- provides a 32.768 kHz clock signal for the real-time clock of the unit.

Control block

The control block in FXC STM-1 contains:

- a three-colour unit status LED.
- unit control and supervision functionality
- the real time clock (RTC)
- unit temperature measurement functionality
- data interfaces for local unit control
- serial communication channel interfaces for the transfer of management and software download information between different FXC transmission units and/or local STM-1 interfaces.

8.6.4 FXC Bridge

PDH control block

The PDH control block in FXC Bridge contains:

- a three-colour unit status LED
- control functions for the PDH part of the unit system internal communication channels via the backplane
- user management channels (Q1 and LMP) via the backplane
- unit temperature supervision functionality
- cabinet management functionality (in Nokia MetroHub)

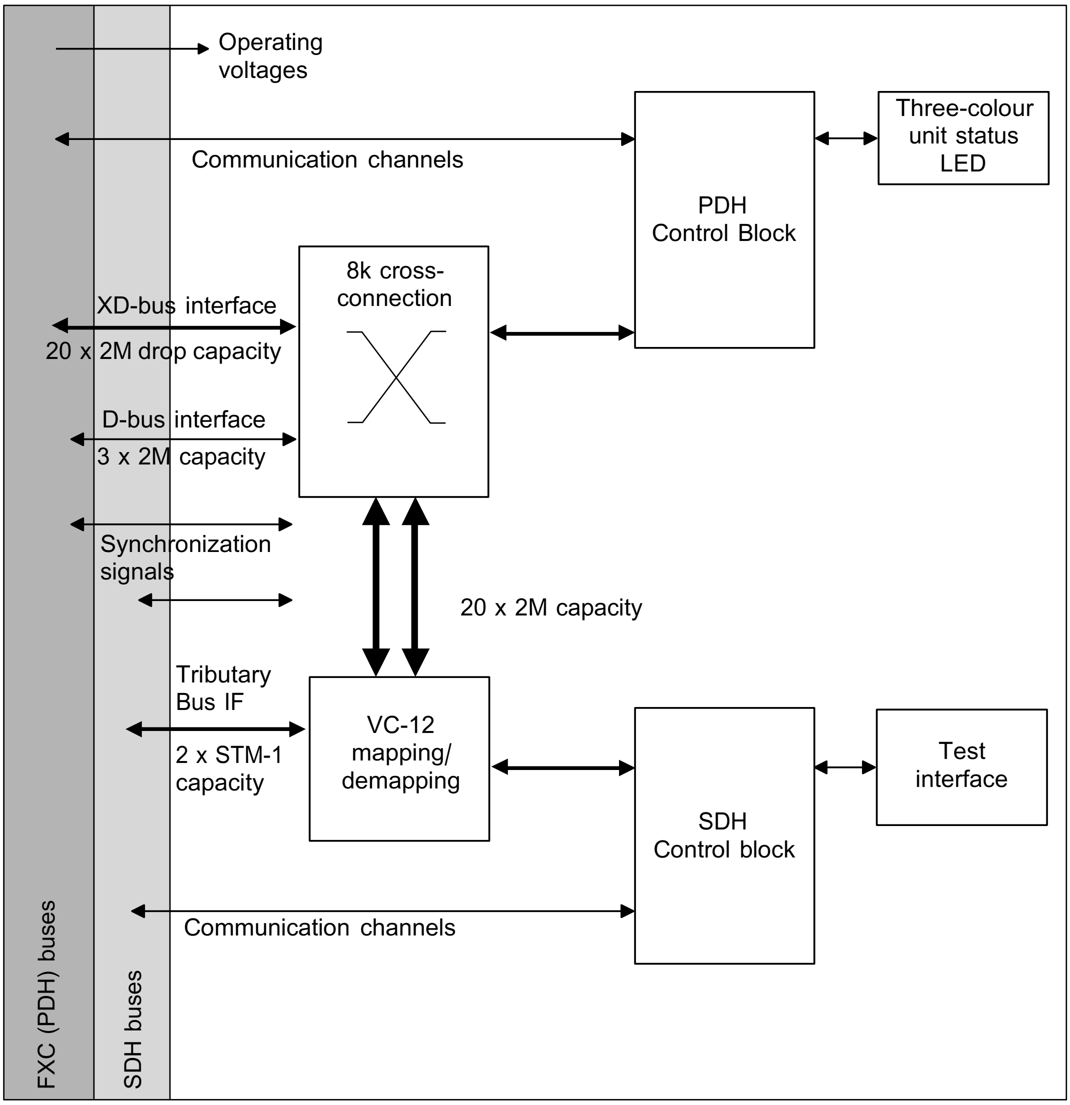


Figure 68. FXC Bridge block diagram

8k cross-connection block

The 8k cross-connection block has:

- 24 x 2 Mbit/s cross-connection capability at 8 kbit/s granularity.
- a connection to the cross-connection bus (XD-bus) on the backplane (56 x 2M capacity).

- 3 x 2 Mbit/s fixed D-bus connections towards the base station or hub.
- elastic buffers for incoming signal to align the 2M frames so that the PDH data can be cross-connected on the sub-2M level.

SDH control block

The SDH control block in FXC Bridge contains:

- the control functions for the SDH part of the unit.
- system internal communication channels via the backplane.
- user management channels (Q1 and LMP) via the backplane.

VC-12 mapping/demapping block

The VC-12 mapping/demapping block performs the following functions:

- in SDH to PDH direction: terminates up to 20 TU-12 level signals, extracts the 2 Mbit/s signals, and forwards them to the 8k cross-connection block.
- in PDH to SDH direction: maps the transmitted 2 Mbit/s signals to VC-12 containers and generates the TU-12 signals towards the FXC STM-1 unit. Asynchronous and byte synchronous 2048 Kbit/s mapping modes are supported.
- connects to the SDH tributary add/drop bus on the backplane.

Synchronisation block

The synchronisation block:

- connects to the backplane synchronisation signals.
- in node control functionality:
    - synchronises the PDH cross-connection system to the SDH node clock.
    - provides the PDH node clock master functionality.

8.6.5 FXC Bridge D-bus implementation

FXC Bridge supports up to three D-buses for connecting PDH add/drop and Q1 management traffic between the BTS and the FXC (PDH)/FXC Bridge transmission units.

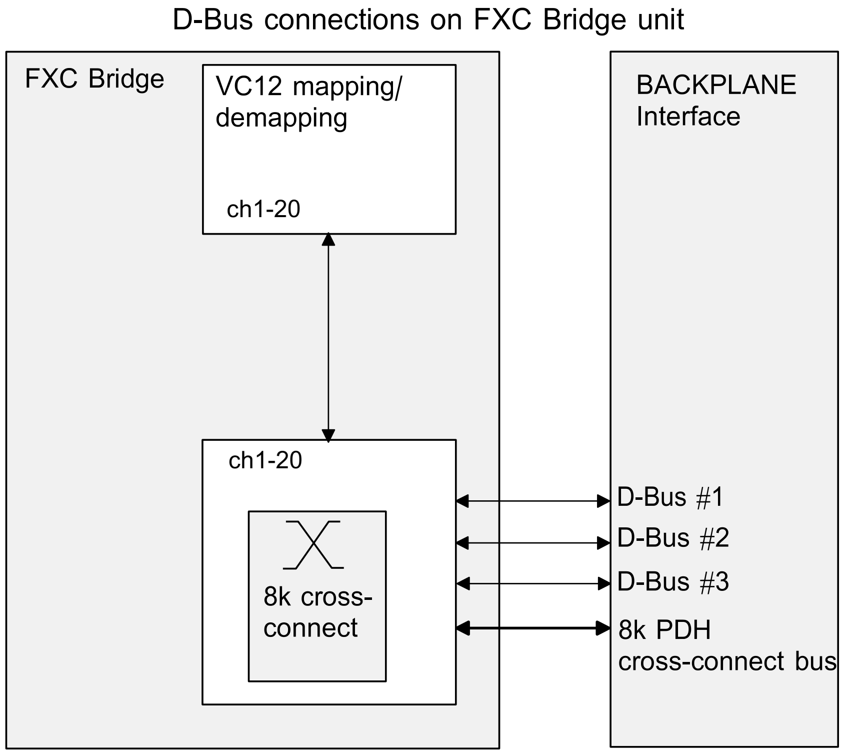


Figure 69. FXC Bridge D-bus implementation

9 Ordering parts and accessories

9.1 Ordering parts and accessories for Nokia MetroHub

To order spare parts and accessories, contact your Nokia representative.

Before placing you order you can browse the Nokia Spare Part Catalog in NOLS (Nokia Online Services). The Nokia Spare Part Catalog contains information on the spare parts available for Nokia's products and lists the product codes and a short description of the items. For some of the spare parts a picture and/or additional information is available to help identify the different items.

9.2 Nokia MetroHub products, accessories and spare parts

Nokia MetroHub products

Table 9. Nokia MetroHub products

Nokia MetroHub unit	Type name	Product code
Cabinet unit	DMCA	468021A
Standard cover	HVCU	468582A
Fan unit	DMFA	468022A
Power supply unit	DSUB	468025A
Power supply shield	DSSB	468028A

Table 9. Nokia MetroHub products (cont.)

Nokia MetroHub unit	Type name	Product code
Power interface panel	DIPB	468029A
Battery unit	MetroHub battery	CS70402.00
Digital interface unit	DIUA	468023A
Transmission unit, FXC RRI	VXRB	467610A
Transmission unit, FXC E1 75 ohm	VXTA	467612A
Transmission unit, FXC E1/T1 120/ 100 ohm	VXTB	467611A
Transmission unit, FXC STM-1	VXOA	T36140.01
Transmission unit, FXC Bridge	VXOB	T36145.01
Transmission unit, FXC shield	VXSA	467619A
Mounting kit, pole	VMPA	466803A
Lock and key		Customer-specific
Nokia SiteWizard CD-ROM		468783A

Table 10. Product codes for different radio types

Product	Software code
MetroHopper SW	P55820.01
FlexiHopper SW	P55040.01 (for old HW versions)
FlexiHopper SW	P55046.01
FlexiHopper Plus SW	P58040.01

Table 11. Nokia MetroHub customer documentation

Customer documentation product	Release	Product code
Nokia MetroHub Transmission Node Rel C3 Product Documentation (NOLS)	C3	C33525.90
Nokia MetroHub Rel. C3 (CD-ROM)	C3	C33525.90

Nokia MetroHub customer documentation is available as a NED (Nokia Electronic Documentation) in Nokia Online Services (NOLS) and on CD-ROM. The information set is also be available as PDFs, which are embedded in the NED. For more information about NED, refer to the NED User Guide and NOLS.

Nokia MetroHub accessories

The following accessories are available for Nokia MetroHub.

Parallel (old and new) cable codes are presented when applicable.

Table 12. List of accessories

Accessory	Product codes	
Connector Set 4xBT43-F/0, 75 ohm	CS70100.01	T36601.01
Cable Reel E1, 75 ohm, 500 m	CS74801	T36602.01
Cable TQ-M/0–TQ-M/0, 120 ohm, 3 m	CS72452.01	T36612.01
Cable TQ-M/0–TQ-M/0, 120 ohm, 7 m		T36612.02
Cable TQ-M/0–TQ-M/0, 120 ohm, 30 m		T36612.03
Cable TQ-M/0–TQ-M/0, 120 ohm, 50 m	CS72452.03	T36612.04
Cable TQ-M/0–TQ-M/0, 120 ohm, 15 m	CS72452.02	T36612.05
Cable Reel E1/T1, 120/100 ohm, 305 m	CS72452	T36614.01-A1
Connector Set 2xTQ-M/0, 120 ohm	CS72452.21	T36615.01
E1/T1 Adapter Cable TQ-M/0-RJ45, 120/100 ohm, 0.5 m		T36623.01
Cable TNC-M/0–TNC-M/0, 50 ohm, 4 m	CS72450.11	T36625.02
Cable TNC-M/0–TNC-M/0, 50 ohm, 8 m	CS72450.12	T36625.03
Cable TNC-M/0–TNC-M/0, 50 ohm, 15 m	CS72450.13	T36625.04
Cable Reel Flexbus RG223, 50 ohm, 500 m	CS72260.00	T36626.01
Connector set 2xTNC-M/0, 50 ohm	CS72450.23	T36627.01
Connector set 2xTNC-M/90, 50 ohm	CS72450.24	T36627.02

Table 12. List of accessories (cont.)

Accessory	Product codes	
Cable TNC-F/0-TNC-M/0, 50 ohm, 2.5 m	CS72450.10	T36628.01
Cable Reel Flexbus RG214, 50 ohm, 500 m	CS72260.01	T36629.01
Connector set 2xTNC-M/0 RG214, 50 ohm	CS72450.21	T36630.01
Connector set 2xTNC-M/90 RG214, 50 ohm	CS72450.22	T36631.01
MetroSite alarm cable (EAC) mini D26-D26, 15 m	CS72451.20	
Power cable for AC230V, 3x1.5 mm^2, 10 m	CS72452.50	
Power cable AC 110V, 3x2.5 mm^2, 10 m	CS72452.51	
Power cable for MetroHub DC, 3x6mm^2, 10 m	CS72452.53	
Earthing cable reel 16 mm^2, 100 m/1000 m/3000 m	CS73174	
Power cable for AC110V 3x2.5 mm^2	Country-specific	

The following table lists the cables used when MetroHub is chained to a Nokia BTS.

Table 13. List of D-bus chaining cables

Product	Product code
Chaining cable kit, 15 m	469826A
Medium chaining cable kit, 35 m	469827A

Note

UL recognised power cables are required for installations complying with UL 1950.

Note

For a complete list of accessories available for the Nokia MetroSite system, refer to the Nokia MetroSite Accessories document.

Nokia MetroHub spare parts

All MetroHub units are naturally available as spares. In addition to them, the following spare parts can be ordered:

Table 14. Spare parts

Spare part	Product code
Cable cover	813263
Cable cover support	813264
Unit fixing screw	814037
Unit fixing nut	813589A
Fixing cage for nut	814342
Upper sealing	813958

Table 14. Spare parts (cont.)

Spare part	Product code
Cable entry set	813957
Mounting rack	814735D
Safety strap	814609
Gasket for transmission units	M100004871
Ground connector for cabinet	815065
Fuses: 1 pc 5x20mm T 5A 250V (55V output) 1 pc 5x20mm T 1.25A 250V (-48V output) 1 pc 5x20mm F 1.25A 250V (battery heater) 1 pc 1 1/4x1/4in F 15A 250V (battery)	468915
DC input connectors: Anderson Powerpole Modular Connector 1 pc 15/45 amp Housing 1327 (red) 1 pc 15/45 amp Housing 1327G6 (black) 1 pc 15/45 amp Housing 1327G5 (green) 3 pcs 45 amp Contacts 261G2-LPBK	468916
Transmission connector seal (BQ, TQ, TNC)	M10003853
Transmission connector seal (mini D26)	M10004804
Transmission connector seal (mini D50)	M10004805
Transmission connector seal (BT43)	M10003855
FXC E1 75 ohm, ground jumper	M100003856
Power interface cable sealing	813957
Power interface cover	813264

Note

All product codes may not have been available at the time of printing. Please contact your Nokia representative to find out the final product codes.

Related Topics

Technical description of hot standby with the FXC RRI transmission unit

Instructions

Setting Nokia FlexiHopper and Nokia FlexiHopper Plus settings

Reference

128 Fault in equipment

143 Fault in changeover function

Descriptions

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

Technical description of lazy transmitter changeover

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

Instructions

Setting Nokia FlexiHopper and Nokia 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 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 Nokia 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 Nokia MetroHub cabinet management

Instructions

Running a Nokia MetroHub system test

Descriptions

Technical overview of Nokia MetroHub hardware

Reference

8 Low battery voltage

23 Test mode active

126 Unit function degraded

Technical description of the temperature management of Nokia MetroHub

Instructions

Monitoring transmission node temperature

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 Nokia MetroHub power supply units

Reference

Power supply unit LEDs for Nokia MetroHub

Power requirements for Nokia MetroHub

Warnings and cautions

Warnings and cautions

Technical description of the Nokia MetroHub interface unit (DIUx)

Instructions

Connecting interface cables to the interface unit (DIUx)

Adjusting service interface settings

Reference

Interface unit (DIUx) LEDs for Nokia MetroHub

External alarm input voltage levels and control output logic voltage levels

Technical description of the Nokia MetroHub fan unit (DMFx)

Instructions

Maintaining the Nokia MetroHub fan unit

Running a Nokia MetroHub system test

Fan test fails in the manager

Descriptions

Technical description of Nokia MetroHub cabinet management

Reference

Fan unit LEDs for Nokia MetroHub

Technical description of the FXC E1 and FXC E1/T1 transmission units

Instructions

Connecting cables to the FXC E1 transmission unit

Connecting cables to the FXC E1/T1 transmission unit

Reference

Transmission unit LEDs

Dimensions and weight of the FXC E1 and E1/T1 transmission units

Interfaces of the FXC E1 transmission unit

Interfaces of the FXC E1/T1 transmission unit

Power requirements for the FXC E1 and FXC E1/T1 transmission units

Technical description of the FXC RRI transmission unit

Instructions

Connecting the Flexbux cable to the FXC RRI transmission unit

Reference

Transmission unit LEDs

Flexbus DC LEDs on the FXC RRI transmission unit

Dimensions and weight of the FXC RRI transmission unit

Interfaces of the FXC RRI transmission unit

Flexbus cable requirements for the FXC RRI transmission unit

Power requirements for the FXC RRI transmission unit

International standards; FXC RRI transmission units

Technical description of the FXC STM-1 and FXC Bridge transmission units

Instructions

Connecting cables to the FXC STM-1 transmission unit

Reference

Dimensions and weight of FXC STM-1 and FXC Bridge transmission units

Power requirements for FXC STM-1 and FXC Bridge transmission units

International standards; FXC STM and FXC Bridge transmission units