NOKIA

Single RAN, Rel. SRAN 18A, Operating Documentation, Issue 02

Single RAN System Description

DN09185655
Issue 02B
Approval Date 2018-03-20

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Table of Contents

This document has 36 pages

List of Figures

List of Tables

Summary of changes

List of changes between document issues.

Changes between document issues are cumulative. Therefore, the latest document issue contains all changes made to previous issues.

Changes between issues 02A (2018-01-24, SRAN 17A) and 02B (2018-03-20, SRAN 17A)

Updated chapter SBTS system modules with information related to dual FSMF configuration and *SR001621: SRAN cell sets allocation on full AirScale module.*

Updated the chapter SBTS supported configurations with information related to *SR001621: SRAN cell sets allocation on full AirScale module.*

Changes between issues 02 (2017-12-15, SRAN 17A) and 02A (2018-01-24, SRAN 17A)

Updated the chapter SBTS transport.

Changes between issues 01B (2015-12-10, SRAN 16.10) and 02 (2017-12-15, SRAN 17A)

Updated the following chapters:

- Concept of Single RAN
- Single RAN network architecture
- SBTS RF sharing
- Single RAN management functions
- SBTS transport

Added the following chapters:

- SBTS system modules
- SBTS supported configurations

Updated Single RAN operability

- Added information related to BTS Mediator.
- Removed the section on BTS profiles.
- Updated the topic Web-based Element Manager (WebEM).

Added the topic Support for network sharing.

Changes between issues 01A (2015-09-22, SRAN 16.2) and 01B (2015-12-10, SRAN 16.10)

Added the chapter Single RAN license management.

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1 Concept of Single RAN

Description of Single RAN principles and benefits.

The concept of Single RAN (SRAN) is the evolution from the classical RF sharing, where only radio modules were shared, to having one network entity with common operability and transport platform, sharing both system module (baseband) and radio modules between multiple radio access technologies (RATs). The Single RAN hardware and software solution is a multi-RAT network element with common operability and maintenance functions that simplify network management. The Single RAN BTS (SBTS) is based on the Flexi Multiradio 10 BTS. SRAN 17A introduces the Nokia AirScale BTS.

SRAN offers high performance by enabling simultaneous coordination and cooperation of different radio access technologies. The SRAN product presents Common Operability and Common Transport solutions for all RATs (FDD-LTE, WCDMA and GSM) in a logical single SBTS node. In the Nokia AirScale system module, TDD-LTE can be supported with SBTS (FDD-LTE, WCDMA, GSM) as two logical BTS's (LBTS and SBTS).

SRAN comprises the SBTS (based on Flexi Multiradio 10 BTS or Nokia AirScale BTS) entity, the existing Nokia GSM and WCDMA controllers and the WCDMA OMS. The SBTS, along with the traditional GSM and WCDMA BTSs share the same controllers (BSC and RNC).

Single RAN and the SBTS offer the following benefits to the operator:

- SRAN allows the operator to evolve and refarm their network flexibly and efficiently to meet the user demand for a shift from 2G and 3G to LTE.
- Simplified network architecture.
- Flexible and efficient RF spectrum usage and refarming of network based on user demand from 2G and 3G to LTE.
- Efficient shared hardware usage.
- Reduced energy consumption and site size through BTS hardware resource sharing.
- Common Transport and Operability for all RATs.
- SRAN site visualization managed as one network element in NetAct.
- One SBTS Web-based Element Manager (WebEM) with site management covering all RATs.
- Converged planning, operations and management.
- system module sharing.
- RF sharing.

2 Single RAN network architecture

Description of Single RAN network architecture and its key functionality

Nokia solution is a fully flexible evolution to Single RAN (SRAN). Refarming, RF sharing, network sharing, modernization, and evolution of Single RAN enables operators to simplify their networks, reduce costs, grow their business, and balance investments more efficiently.

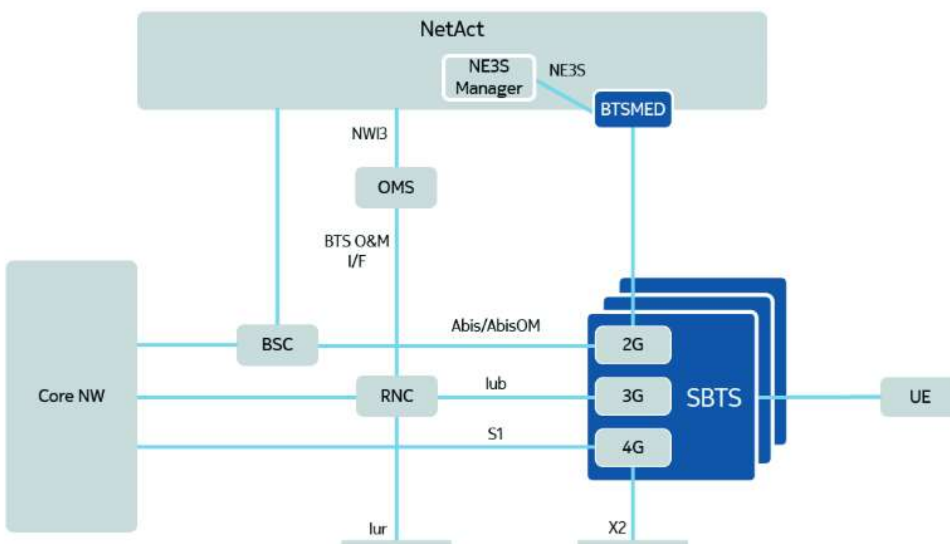
Single RAN brings evolution to the network, management, and operations structure. The Single RAN BTS (SBTS), offers three key functionalities: Common Transport, Common Operability, System and Radio Module sharing with shared RF fibers. The SBTS can coexist with the dedicated RAT BTSs within the same network.

Single RAN supports a multitude of sharing options – baseband, RF, backhaul and fronthaul transport, network, spectrum - with the bonus of end-to-end security and one common Operations and Maintenance (O&M) functionality embedded into the solution.

In Single RAN, all radio technologies are configured at the same BTS site, ensuring cost efficiency. Single RAN introduces common O&M functionality with one management system. All network elements related to the Single RAN site are integrated into NetAct, the Element Management System.

Figure 1: SRAN system architecture shows an overview of the Single RAN network architecture.

Figure 1 SRAN system architecture



2.1 Nokia Single RAN product solution

Description of products in the Single RAN portfolio

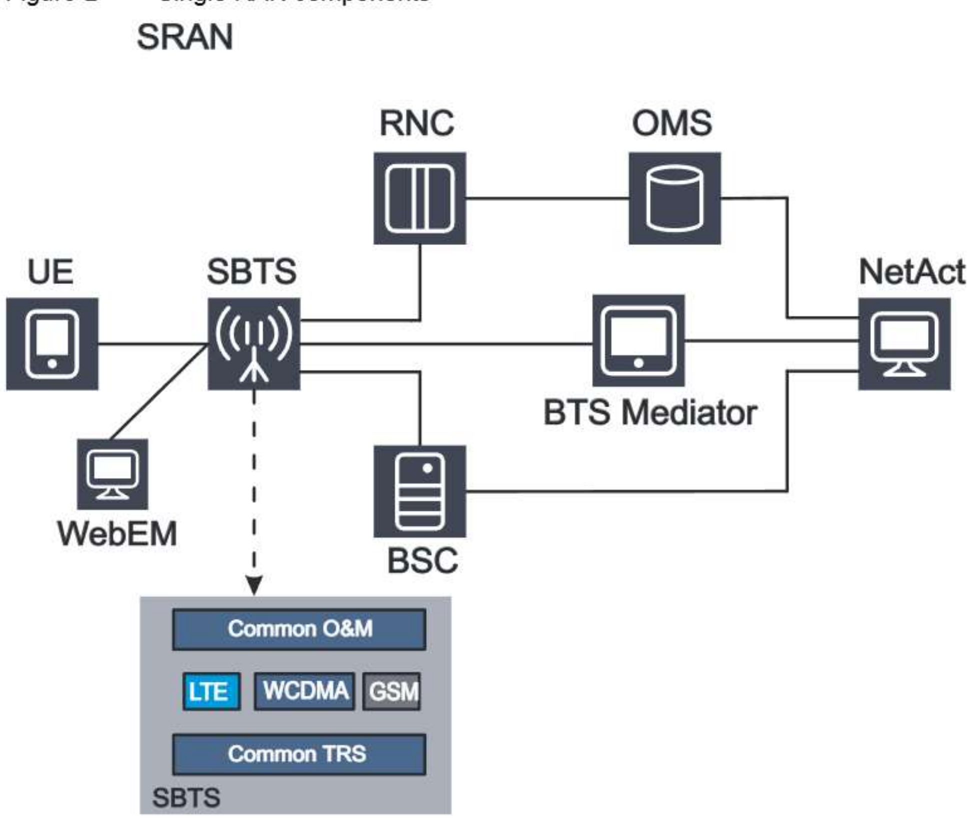
The Nokia Single RAN product with its new operability and base station software architecture, enables the creation of a Single RAN Base Transceiver Station (SBTS) entity covering GSM, WCDMA, LTE radio access technologies, as well as NarrowBand-Internet of Things (NB-IoT). The key functionalities of Single RAN are Common Transport, Operability, Parity to latest RAT releases, Web Element Manager, RAT components and a shared BTS Mediator.

SRAN comprises the SBTS entity (based on Flexi Multiradio 10 BTS or Nokia AirScale BTS), the existing Nokia GSM and WCDMA controllers, and the WCDMA OMS. The SBTS, along with the traditional GSM and WCDMA BTS's share the same controllers (BSC and RNC). The SBTS brings the capability of running the baseband of all three RATs into a single Flexi Multiradio 10 BTS or Nokia AirsScale BTS.

The SRAN solution consists of:

- SBTS (Flexi Multiradio 10 System Module or AirScale System Module), radios, racks, cables and antennas.
- BTS Mediator for M-plane mediation.
- 2G/3G Controllers and OMS are common for Single RAT and Single RAN solution. OMS mediates the RNC M-plane communication with NetAct.
- NetAct is the Element Management System for SRAN.

Figure 2 Single RAN components



Single RAN Base Transceiver Station (SBTS)

Flexi Multiradio 10 BTS

The Flexi Multiradio 10 BTS powerfully supports the Nokia Single RAN solution. It is the smallest high-capacity, software-defined, multi-technology base station. The SBTS software architecture requires only one system module for GSM, WCDMA/HSPA and LTE radio access technologies.

For more information on the base station, see *Flexi Multiradio 10 Base Station Product Description*.

Nokia AirScale BTS

The Nokia AirScale Base Station comprises RF elements, including single-band radios, multiband radios and baseband module. The Nokia AirScale BTS also allows the use of existing site investments to seamlessly expand the Flexi Multiradio 10 base station sites.

For more information on the Nokia AirScale BTS, see *Nokia AirScale System Module Product Description*.

Flexi Multiradio 10 BTS radios

The Flexi Multiradio BTS radios comprise the Radio Frequency module (RF module or RFM) and the Remote Radio Head (RRH). The RF modules in the Flexi Multiradio 10 BTS support the RF sharing application software.

The RFM is a three-sector, multi-standard radio transceiver module that consists of independent branches, capable of transmitting and receiving signals of multiple radio technologies. The RRH is a single-sector, multi-standard radio transceiver module. Each branch of the RRH consists of a transmitter and receiver chain. The RRH is intended for outdoor mounting and is optimized for feederless applications.

For more information on radios, see *Flexi Multiradio BTS Radio Module and Remote Radio Head Description*.

BTS Mediator

The BTS Mediator is a new network element (NE) in the SRAN product. It performs the mediation function between the BTS M-Plane and the destination Element Management System (EMS). The mediation functionality comprises data collection, data harmonization, data conversion and data distribution.

The main task of BTS Mediator is to provide info model conversion from the BTS external info model to the BTS internal model, and to mediate the network management operations between NetAct and the BTSs. The connectivity requirement for the BTS Mediator southbound interface follows the NetAct capacity requirements and BTS Mediator serves the same number of BTSs as NetAct. Additionally, the backwards compatibility requirements of the BTS Mediator southbound interface and data must follow the NetAct requirements. BTS Mediator provides NetAct the same pre-validation services for the planned BTSs as the SBTS Adaptor.

For information on BTS Mediator, see the *SR001536: BTS Mediator* feature description. Additional information on BTS Mediator is available in the **Single RAN, SRAN 17A Operating Documentation ► BTS Mediator**.

Web Element Manager

SRAN 17A introduces a common and uniform element manager tool for SRAN BTS element management.

The main functional areas of the Web Element Manager are commissioning, troubleshooting (also possible from NetAct), software and configuration updates. The WebEM functionality can also be used when the O&M link to NetAct is not available.

For information on Web Element Manager, see the *SR001503: Web-Based Element Manager (WebEM)* feature description.

NetAct

NetAct is the element management system for SRAN.

For more information related to NetAct, see the *NetAct™ Operating Documentation*.

2.2 Single RAN rollout

Description of BTS site evolution to Single RAN

SRAN rollout can be carried out in phases according to the needs and schedules of the operator. Existing GSM, WCDMA or LTE radio networks can carry traffic while new SBTSs are utilized within the same network area. It is also possible to migrate existing technologies (WCDMA or FDD-LTE) to SRAN and add additional RATs later.

SBTS installation and commissioning follow the same principles as dedicated RAT BTSs:

- Installation of new SBTS software, common site configuration and radio network plan update for a new SBTS can be done remotely if there is no change of hardware.
- Reuse of existing Flexi Multiradio 10 system module and Nokia AirScale hardware in SRAN configuration can be done locally at the BTS site. FDD-LTE sites can be deployed on Nokia AirScale and moved to SRAN.
- Commissioning the SBTS can be done locally using Web Element Manager (WebEM) or remotely from NetAct. An SCF is required to commission the SBTS locally. The SCF can be validated by NetAct, BTS Mediator or WebEM. The commissioning data is transferred to the SBTS through BTSMED or WebEM.

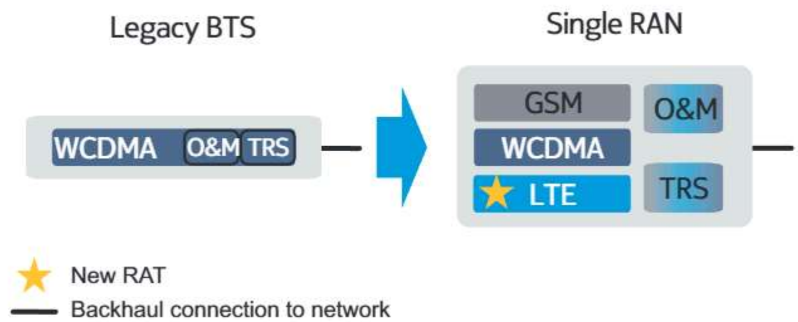
For more information on migration and commissioning, see *Migration to SBTS and Commissioning SBTS*.

Modernizing and reusing an existing Single RAN site

A new Single RAN site is deployed when a BTS is taken into use in Single RAN mode.

An existing dedicated-mode BTS can be modernized to SBTS. The existing BTS changes to Single RAN mode and new RATs can be added to the SBTS using the Commissioning Wizard. Separate O&M in RAT-specific BTSs is replaced by common O&M in the SBTS. The same rule applies for the transport entity. The Dedicated Mode BTS enhanced with new RAT shows an example of this process.

Figure 3 Dedicated-mode BTS enhanced with new RAT



Operator benefits

Single RAN rollout practices offer operators the following benefits:

- Up to four radio technologies (WCDMA, FDD-LTE, GSM and NB-IoT) in one BTS at one site
- One common site configuration for the SBTS site, instead of different RF sharing configurations (fewer configurable parameters and reduced complexity)
- One common transport and transport configuration for the SBTS site
- One software package per SBTS including necessary software components for all included technologies
- One software download and activation process for the entire SBTS, instead of separate RAT-specific software download processes with possible software compatibility issues

3 Single RAN operability

A list of topics related to Single RAN operability

3.1 Single RAN O&M Architecture

Description of the common Operation and Maintenance (O&M) functionality

Single RAN introduces a new harmonised information model and a common Operation and Maintenance (O&M) architecture, with BTS Mediator as the O&M interface between the SBTS and NetAct. The SBTS provides the same functionalities and capabilities across different radio technologies for operations and maintenance. BTS-level aspects, such as software management and site configuration, cover the BTS as one entity.

The main functionalities include:

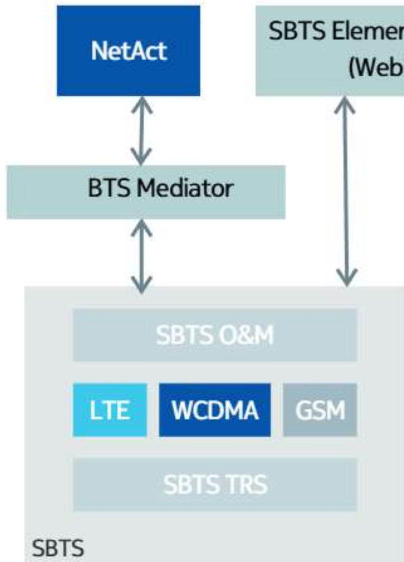
- Network management operations between NetAct and the BTSs via BTS Mediator
- Common software and site configuration management
- Support for flexible RAT-level maintenance and recovery
- SBTS Web-based Element Manager (WebEM)

For more information on the harmonized object model in the Single RAN O&M architecture, see the *SR001541: Harmonization Object Model for SRAN* feature description.

The high-level O&M architecture comprises NetAct and BTSMED with BTSMED, as O&M interface between the SBTS and NetAct, and the new WebEM. At the BTS level, the SBTS O&M is completely decoupled from RAT applications. This truly harmonized O&M is one of the key enablers to support system module sharing functionality. The Nokia proprietary NE3S interface is used between NetAct and SBTS. Part of the SBTS O&M software is run through BTS Mediator in NetAct. It enables better support of pre-integration approaches. With the new O&M architecture it is easier to decouple the different rollout procedure phases, and the configuration management validation is more efficient.

Figure 4: O&M Architecture for SBTS shows an overview of the Single RAN O&M architecture.

Figure 4 O&M Architecture for SBTS



The new SBTS functionality and the common O&M interface require certain system level considerations. The common O&M in the BTS is integrated into one NetAct system. BTS Mediator is used to mediate between the BTS M-Plane and NetAct. Multiple BTSMEDs (integrated to one NetAct) can serve multiple SBTS systems. A complete SRAN network, which includes all radio technologies with the BTSs, controllers, and one OSS, is operated with one NetAct system, per region.

The same controllers (BSC and RNC) can serve SRAN and single-RAT base stations in the SRAN 17A architecture.

3.2 Single RAN O&M impact on transport

SBTS transport is fully integrated with the operability framework

The main functionalities include:

- One SBTS O&M, covering transport
- Full support of the new O&M features, including fault management, performance management, configurations management
- New transport information model seamlessly integrated with the SBTS information model
- Transport configuration fully integrated into WebEM

3.3 Web-based Element Manager (WebEM)

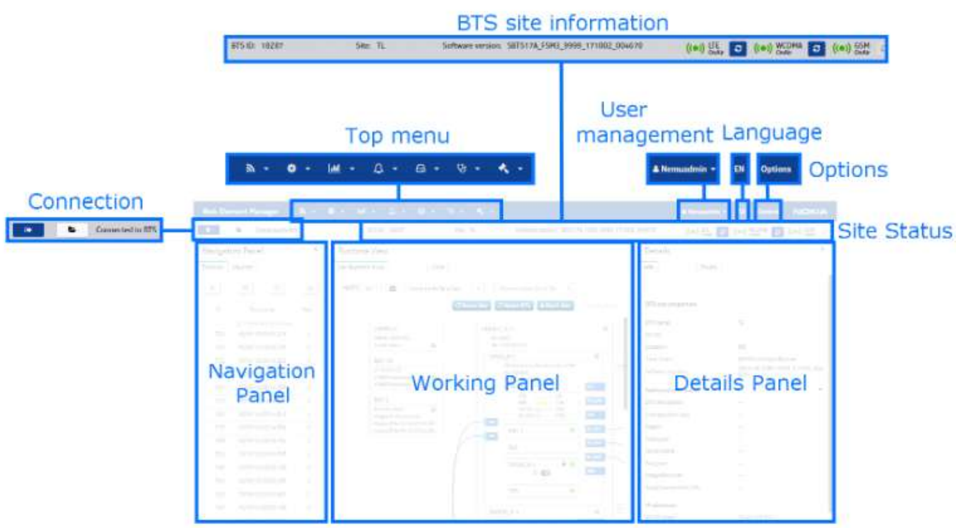
Description of the SBTS Element Manager

Separate BTS site management tools for different RATs are replaced with a single user interface. SBTS Element Manager is a Web application that loads directly from the BTS. It can be used locally as well as remotely, without the need to install any additional software on the operator's side. Furthermore, it does not require updates because of a release upgrade.

WebEM works with Google Chrome browser (version 51.0.2704.84 onwards) and Mozilla Firefox browser (version 51 onwards). Users are authenticated using a centralized user database from NetAct or from local user credentials. The SBTS Element Manager is a new tool with a dedicated set of features and functionalities:

- SBTS configuration
- SBTS software management
- Hardware/software status view:
  - Software status and version information
  - Equipment view
  - Site properties
  - Synchronization status
  - Local test procedures to verify hardware functionality
- Fault and alarm state view
- Snapshot creation, view, and file transfer
- Initiation of offline tests and creation of test reports
- Multiple concurrent WebEM sessions to BTS up to a maximum of 10 sessions
- User authentication using centralized users database (CNUM) from NetAct or from local user credentials. NetAct Single Sign-On support is used to connect WebEM to the NetAct environment.

Figure 5 Web Element Manager user interface layout



3.4 Single RAN management functions

A list of topics related to Single RAN management

3.4.1 SBTS fault management and troubleshooting

Principles of fault management and troubleshooting in Single RAN BTS

SRAN fault management

In Single RAN, NetAct utilizes existing fault management functions and Web-based Element Manager (WebEM) is used to view alarms. Fault management has the following functionalities:

- All SBTS alarms are reported to NetAct through the NE3S O&M interface.
  - SBTS WCDMA alarms are not visible at RNC or OMS level.
  - SBTS GSM alarms are also routed to BSC (for state management).
- SBTS alarms and faults can be viewed remotely on both NetAct Monitor and Web-based Element Manager, and locally through the WebEM. The WebEM alarm view is site-specific (per site).
- SBTS alarm history browsing is available in NetAct Monitor.
- SBTS recent alarm history is available in WebEM.
- Additional information for SBTS alarms in WebEM and in NetAct (fault descriptions and proposed actions).
- Toggling alarm management at SBTS.
- SBTS alarm history is stored in System Module Black Box for Hardware Repair Center.

Recovery procedures

General recovery actions lead to site reset. Radio hot removals and inserts are supported in Single RAN.

SRAN troubleshooting

SBTS troubleshooting can be done for a specific RAT or at the SRAN-wide level. Troubleshooting functions supported in SRAN are listed below.

BTS self-test and diagnostics	BTS self-test and diagnostics include: • POST (Power On Self Test) • IP ping-test • Black Box (not user initiated) • EAC (External alarms) test • Test Clock Output diagnostic test • Input Voltage Monitoring diagnostic test
Collection of troubleshooting data	BTS troubleshooting data content selection is the same as in existing BTSs but covers all RATs. SBTS troubleshooting data collection is triggered by WebEM. The troubleshooting data is saved either in the PC running WebEM or in the NetAct file system.
Subscriber and equipment trace for tracing LTE users	The subscriber and equipment trace supports tracing for certain IMSI or IMEI while providing detailed subscriber-oriented information at call level for one or more specific

	mobiles. Subscriber trace is activated with NetAct Trace Viewer application.
Cell trace for tracing LTE users	LTE Cell trace enables all connected UEs in a target cell to be traced simultaneously. The target cell is defined by the operator. Cell trace is activated with the NetAct Trace Viewer application. The data is stored directly to NetAct Trace Viewer for evaluation.
L3Data Collector for LTE data tracing	This requires an additional, optional product, L3DC, which has dedicated HW (HP Server) to collect data and send it towards monitoring applications.

3.4.2 SBTS configuration management

Description of common site configuration management in Single RAN BTS

The introduction of the single BTS O&M architecture provides the new harmonized object model for SRAN with a new configuration approach that separates configured hardware from detected hardware and classifies parameters according to their usage.

SBTS configuration management has one configuration file for the whole SBTS. The scope of the BTS configuration includes hardware, transport and LTE radio network configuration. Radio configuration for GSM and WCDMA is managed by BSC and RNC controllers. Delta configurations (only changes sent to the SBTS) are supported in Single RAN.

NetAct makes single network level configuration for the whole radio layer possible. Network level configuration in SRAN is separated from the BTS site solution aspects.

The SBTS is configured by deploying a Site Configuration File (SCF) for the whole BTS. This configuration also covers Common Transport, which must be configured only once. For more information on O&M impact on transport, see Single RAN O&M impact on transport.

SBTS O&M controls and coordinates all configuration changes. This ensures that the different RAT applications and transport share the same overview of the configuration. It is also possible to apply the configuration changes to a specific part exclusively, for example, LTE Radio Network (RNW) or Transmission System (TRS). SBTS coordinates the activation operations in order to minimize possible disruptions on the radio service or BTS internal communication, simplifying operations and reducing possible human errors.

3.4.3 SBTS software management

Description of common software management in Single RAN BTS

SBTS software management actions are supported through NetAct Software Manager and from the Web-based Element Manager.

It is possible to simultaneously upgrade software for multiple SBTSs and set scheduled software actions using NetAct Software Manager. The SBTS supports automatic software fallback when a problem during an ongoing upgrade is detected.

NetAct provides one software packet for the entire SBTS. This software packet includes all the necessary components: O&M software, RAT software, TRS software, RF software, and Platform software.

Detailed SBTS software configuration (build) information is available through SBTS WebEM, NetAct Software Manager and NetAct Configurator.

The operator can monitor the progress of any software management operation and stop or pause mass operation.

3.4.4 SBTS performance management

Description of performance management and optimization in Single RAN BTS

Counters are collected within the SBTS. Existing RAT (GSM, WCDMA and LTE) counters are supported and new common transport measurements are introduced. Existing technology-specific measurements and KPIs remain separate for each radio technology. Counters are transferred to NetAct, where they are stored, and are available for reporting. The SBTS stores a short history of performance management (PM) data for local troubleshooting actions.

It is possible to configure the collection interval of each SBTS measurement. The configuration is supported through SBTS WebEM (for WCDMA, LTE, and common measurements) and through NetAct (for all SBTS measurements).

New SRAN specific performance management and optimization functions are introduced, for example, for Common Transport, RF and antenna sharing, and common optimization cases.

Single RAN supports PM thresholding with NetAct Thresholder. SBTS measurements are also supported through NetAct North Bound Interface (NBI).

3.4.5 SBTS security

Description of security in Single RAN BTS

The network is divided into security domains and security gateways (SGW) to protect the border of such domains. One SGW is in the SBTS and the other typically at the operator's IP backbone or core network. IP security provides data integrity, data origin authentication, anti-replay protection, confidentiality (optional) and limited protection against traffic flow analysis when confidentiality is applied.

Other security features include:

- Common IPsec engine with a unified parameter set per SBTS
- Full flexibility when assigning traffic to tunnels (single or multiple tunnels per SBTS, tunnels per RAT, per plane and so on)
- IPsec extension features (backup IPsec tunnel and emergency bypass) available for all RAT applications

For more information on security, see the *Configuring Security in SRAN* document.

4 SBTS system modules

Description of SRAN 17A system modules and system module sharing

The system modules supported by the SBTS are the Flexi 10 BTS System Module and the Nokia AirScale System Module.

The Flexi 10 BTS System Module is part of Flexi Multiradio 10 BTS and the Nokia AirScale System Module is part of Nokia AirScale BTS.

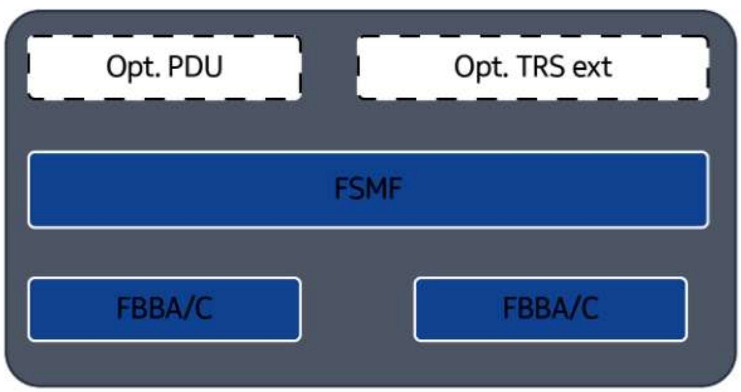
Flexi Multiradio 10 System Module

The Flexi 10 BTS System Module is a lean SRAN site solution with system module sharing, fiber sharing, and RF sharing possibilities. It is a multiradio platform for GSM, WCDMA, and LTE.

Single System Module

Flexi 10 BTS System Module baseband capacity can be shared between GSM and LTE, or GSM and WCDMA. FSMF or FBBC card baseband capacity cannot be shared between LTE and WCDMA.

Figure 6 Flexi 10 BTS System Module

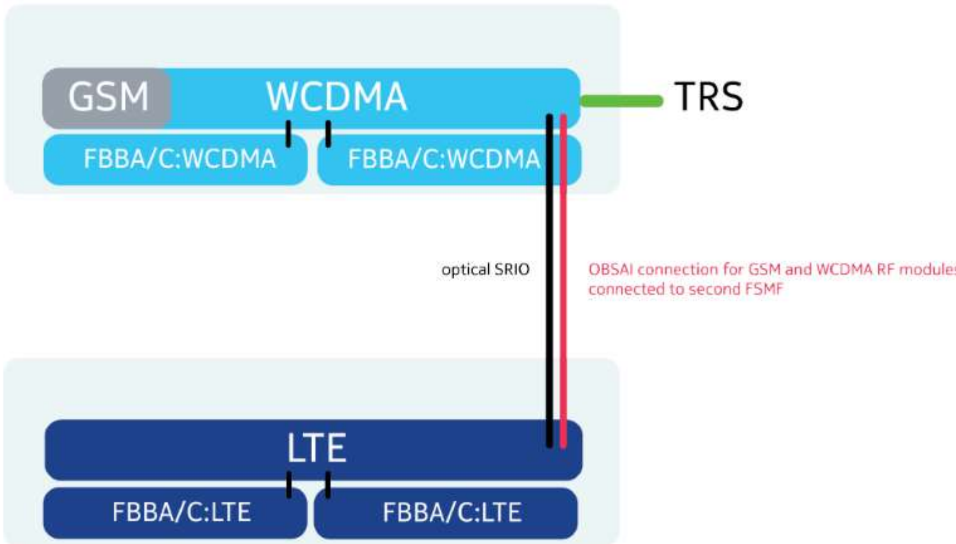


Dual-FSMF configuration

The support for two Flexi Multiradio 10 system modules (FSMF+FSMF) enables the use of a logical high-capacity BTS with radio access technologies. Up to three RATs (GSM, WCDMA, LTE) can be deployed within two inter-connected FSMFs to achieve one logical SRAN BTS.

SBTS capacity can be extended by using two system modules. The 2xFSMF obtained configuration is a powerful and scalable SBTS solution.

Figure 7 Two-FSMF configuration



Note:

- WCDMA and GSM applications are always deployed on the first FSMF.
- LTE application is always deployed on the second FSMF (without backhaul connection).
  - Up to 3 x BCS or 1 x ECS + 1 x BCS available.
- Only two-meter SRIO and OBSAI fibers (FUFAS or FSFL fibers) are supported for the connection between the FSMFs.
  - Only one OBSAI and SRIO fiber can be used between the FSMFs.
  - OBSAI ports used for interconnection are defined by cell set configuration.
- RF modules with LTE cells deployed are always connected to the second FSMF.

Note: Different LTE software allocations are possible in single BTS (for example, 2 x BCS or RCS + BCS) assuming suitable hardware capacity.

Reduced cell set (RCS)

- Up to 4 x 10 MHz LTE 2 x 2 MIMO without CoMP
- Up to 3 x 10 MHz LTE 2 x 2 MIMO with CoMP

Basic cell set (BCS)

- Up to 6 x 10 MHz LTE 2 x 2 MIMO
- Up to 3 x 10 MHz LTE 4 TX / 4 RX[1)]
- Up to 3 x 20MHz LTE 2 x 2 MIMO

Extended cell set (ECS):

Up to 3 x 20 MHz LTE 4 TX / 4 RX or 4 x 4 MIMO.

Note: 4 x 4 MIMO with any cell bandwidth requires ECS.

1) 4 TX / 4 RX = 4 x 2 MIMO in TM4 or 4 RX or both diversity mode

Note:

- RCS can be deployed only on FSMF shared with GSM.
- For BCS, LTE must be deployed on FSMF or FBBC.
- For ECS, LTE must be deployed on FSMF and FBBC or on two FBBC cards.

For more information, see the *SBTS Dimensioning* document.

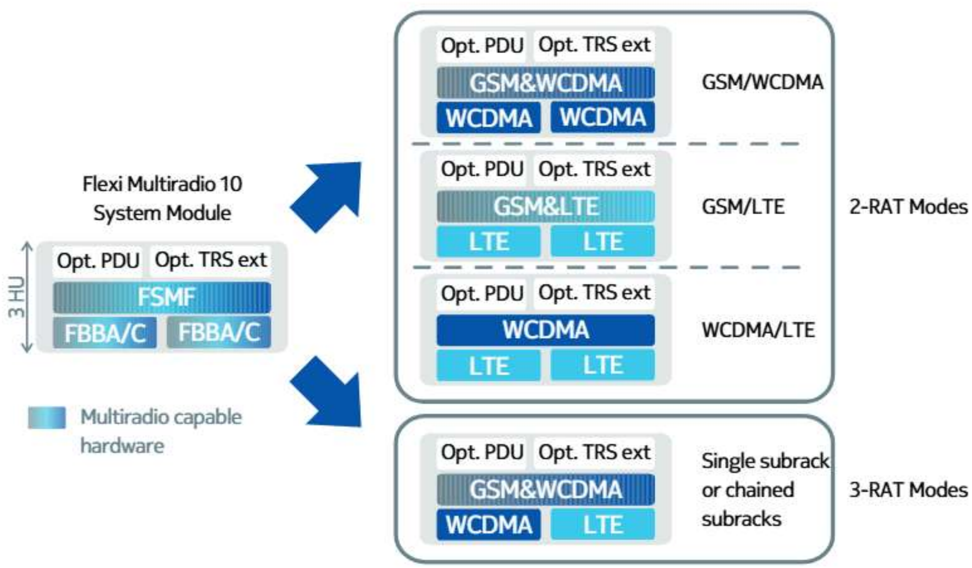
SBTS system module sharing

Single RAN brings the capability of running the baseband of all three individual RATs in a single Flexi Multiradio 10 system module or Nokia AirScale system module. System module sharing allows GSM, WCDMA and FDD-LTE deployment in one FSMF core module with optional FBBA/C baseband extension sub-modules. SBTS supports single-RAT, two-RAT, and three-RAT configurations.

The minimal configuration in a two-RAT case is Flexi Multiradio 10 (FSMF) core module without any extension modules or Nokia AirScale system module with one baseband card. Such a configuration is limited in capacity and adding extension cards increases the capacity and enables the third RAT to be added.

In the system module sharing mode, GSM is allocated at FSMF core (not FBBA/C card). Additional baseband resources for WCDMA can be allocated with FBBA/C cards.

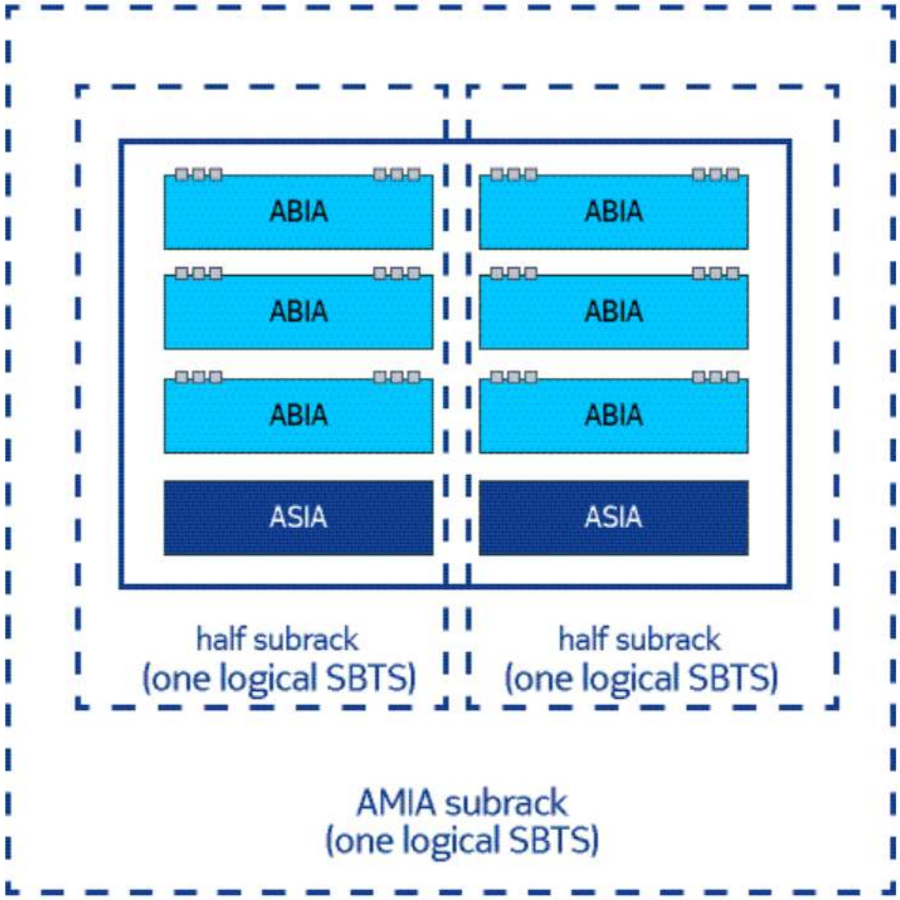
Figure 8 System module sharing two-RAT and three-RAT modes



Nokia AirScale System Module

The Nokia AirScale System Module is deployed indoor as well as outdoor, but a special cover is required for outdoor capability. ASMI supports system module sharing functionality. A single BB card can be shared between two RATs. Nokia AirScale System Module baseband dimensioning rules are interconnected between technologies (GSM, WCDMA and LTE per logical SBTS) because all technologies use ABIA cards.

Figure 9 AirScale System Module components



The Nokia AirScale System Module has the following components:

- Nokia AirScale System Module subrack (AMIA)
  - Fans
  - Backplane for high-speed signals and power distribution
- Nokia AirScale System Module Common Plug-In-Unit (ASIA)
  - Processor board for centralized control
  - Up to two units in one subrack for independent base stations or high-capacity configurations
  - Integrated Ethernet transport termination on subrack side
  - Connectivity to transport
- Nokia AirScale System Module Capacity Plug-In-Unit (ABIA)
  - Multi-RAT cell-specific baseband processing unit
  - Up to six Plug-In-Unit (PIU) per subrack for flexible expansion of BTS baseband capacity
  - RF module connectivity: 6 x OBSAI/CPRI up to 9.8 Gbps
  - A single card can handle up to two RATs

AirScale full subrack configuration

Previously only half-subrack configuration was supported on AirScale in SRAN, with one Common Plug-In-Unit (ASIA) and up to three Capacity Plug-In-Units (ABIA). SRAN 17A MP1 introduces support for full AirScale subrack configuration with the possibility to allocate SRAN cell sets on two ASIA cards and up to six ABIA cards. The full AirScale subrack can be used as one logical SBTS or as two independent SBTSs.

For more information, see the *SBTS Dimensioning* document.

Refarming

Refarming is a spectrum improvement method that allows the existing spectrum to be reused for the deployment of new RATs. As GSM traffic decreases, the spectrum can be relocated to HSPA and LTE. In a similar way, LTE capacity can be increased by refarming relocated to HSPA and LTE. In a similar way, LTE capacity can be increased by refarming from HSPA to LTE. Refarming offers the operator a cost-efficient method to improve capacity, coverage, and indoor data rates.

5 SBTS supported configurations

Introduction on cell sets for SBTS supported configurations

Cell sets

SRAN 17A introduces the concept of cell sets to describe supported configurations. SBTS17A supported configurations are defined by baseband (BB) and radio frequency (RF) cell sets. One cell set is made of one BB set and one or multiple RF sets. During the SBTS installation, the operator must assure that the RF sets are connected to the proper system module ports. The SBTS autonomously decides which baseband unit resources are used to handle given types of carriers.

BB cell sets define the supported baseband configurations available for the customers. BB cell sets are independent configurations for the SBTS. They show the capacity of the HW used per technology and which RF ports can be used to connect the required RF units (defined in the RF cell sets) for each RAT. SRAN and LTE cell sets can be combined to provide the full required SBTS configuration and also to assure half subrack support. The *SR001621: SRAN cell sets allocation on full AirScale module* feature allows full utilization of up to six ABIA cards for SBTS cell sets. It introduces flexible cell set allocation on full AirScale module (two ASIA with up to six ABIA cards).

RF cell sets define the maximum available radio capacity for one specific RAT (GSM, WCDMA or LTE) or a combination of RATs (LTE+GSM, LTE+WCDMA, WCDMA+GSM or LTE+WCDMA+GSM).

An RF cell set is defined by the supported RATs, the supported RF units, their hardware family number of optical cables, and their minimum speed.

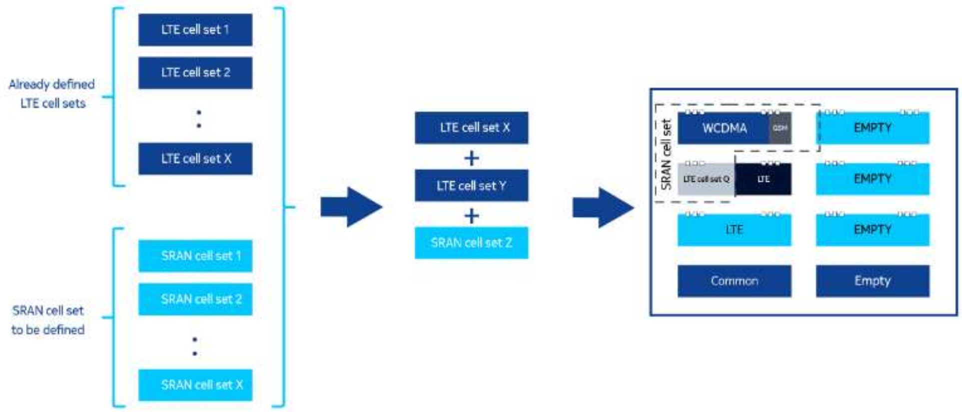
The user connects the RF unit with the system module unit, according to the selected BB, RF sets, and defined rules when constructing the SBTS configuration. These cell sets can be combined in various ways, resulting in a more flexible configuration than in the previous SRAN releases. The selected RF set impacts the number of carriers that are handled for each RAT.

SRAN cell sets for shared operation (LTE-WCDMA, LTE-GSM, GSM-WCDMA, LTE-WCDMA-GSM) and dedicated RAT operation (GSM and WCDMA) are defined on sub-baseband module level and are combined as independent building blocks.

The advantages of using the cell set concept instead of static profiles, like in the previous releases, are as follows:

- Cell sets describe configurations that are independent from each other
- Tests and releases are performed on cell set level
- The configuration flexibility allows a higher number of configurations per SRAN release
- Wider site configuration capabilities are available
- The user can create carriers and assign them to the detected RF HW once the SBTS detects the RF on specific ports during the first startup
- The user can combine LTE and SRAN cell sets to build the targeted configuration

Figure 10 Cell set concept



For information on SBTS configurations in SRAN 17A for FSMF based on the SRAN cell set concept, see the *SR001732: SRAN 17A SBTS cell sets on FSMF* feature description.

For information on SBTS configurations for Nokia AirScale BTS platform based on cell sets, see the *SR001626: SRAN 17A SBTS cell sets on AirScale* feature description.

For more information on flexible cell set allocation on a full AirScale configuration, see the *SR001621: SRAN cell sets allocation on full AirScale module* feature description.

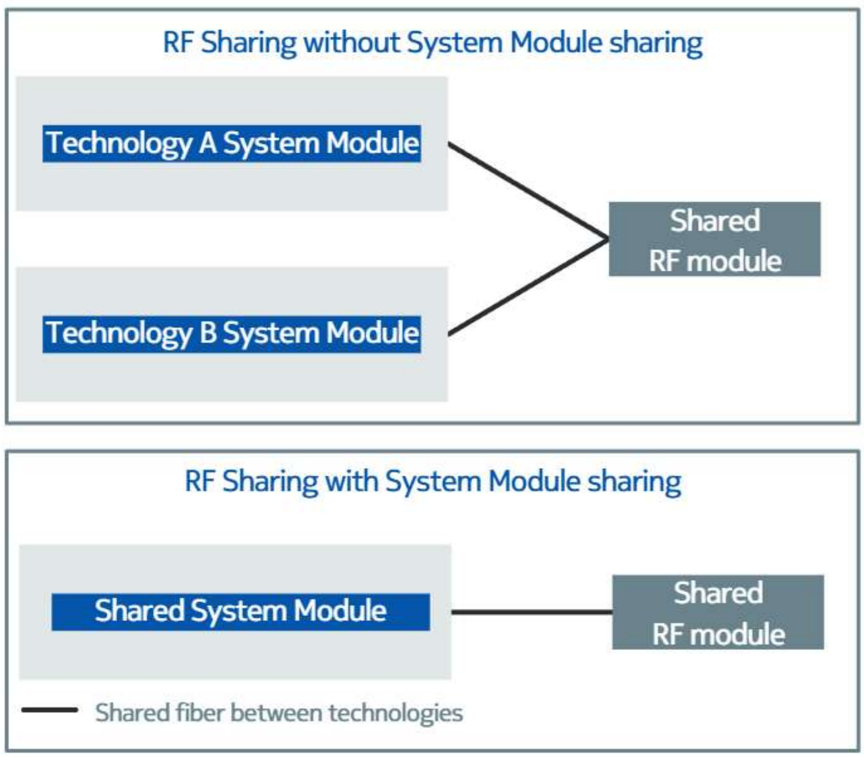
6 SBTS RF sharing

Enhancements to the SBTS RF sharing solution

System module sharing brings changes to SBTS RF sharing. The SBTS requires only one fiber to be routed to the baseband system module as compared to two fibers being routed from system modules to the radios. More than one fiber is required when one fiber exceeds transmission capacity. For a configuration with one fiber, all radio technologies are multiplexed on the same fiber. The shared fiber solution improves the connectivity and simplifies the site structure, as less fibers are used.

Single RAN has a dedicated set of supported configurations. The supported radios are defined separately.

Figure 11 Comparison of SBTS RF sharing with and without system module sharing

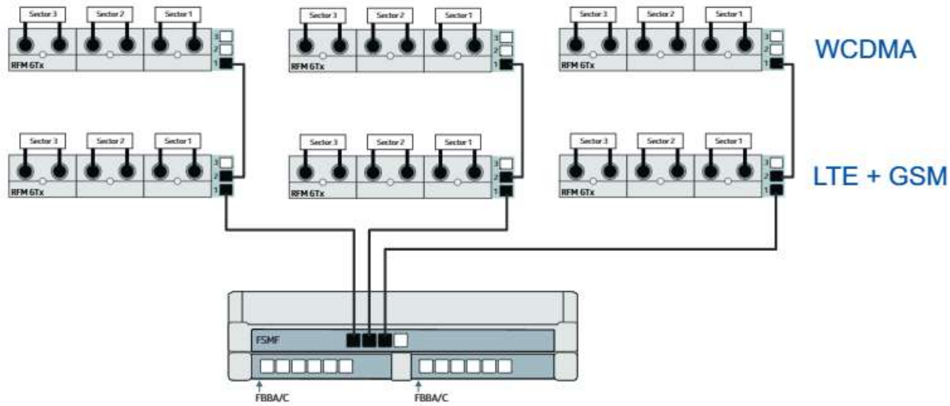


OBSAI RF unit chaining

The OBSAI RF unit chaining connects only two radios in a single chain. The amount of chains is limited by the number of optical ports on the system module. On chained radios, the operator can configure LTE, WCDMA and GSM separately or in combination. Chained radios can be used with SBTS RF sharing.

RF chaining allows the operator to build sites that require less optical links, especially on distributed sites where the system module and radios are separated by long distances. It can also connect more radios when there are fewer optical ports available on the system module.

Figure 12 OBSAI RF unit chaining

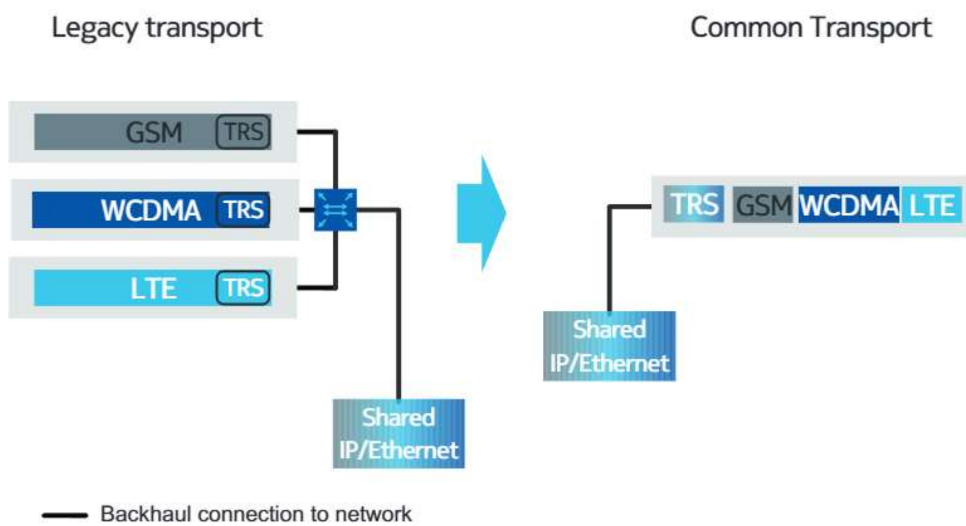


7 SBTS transport

Description of the Common Transport functionality

Common Transport is one of the key functionalities introduced in Single RAN. Instead of having one transport for each RAT, there is only one shared transport entity in SBTS. Common Transport can be connected to all three RAT application basebands or just one. The site appears on the transport layer as a single IP host. Figure 13: Legacy BTS transport and Common Transport in SBTS shows a comparison of the legacy BTS transport solution and Common Transport in Single RAN.

Figure 13 Legacy BTS transport and Common Transport in SBTS



Common Transport provides the following benefits:

- Only one IP address for SBTS
- Focus on IP/Ethernet-based transport modes
- Single SBTS transport feature set covering all RATs
- Fully flexible Quality of Service (QoS) with first and second level schedulers designed for multiradio
- Single IPsec Tunnel includes all radio application traffic
- Unified transport operability
- SBTS designed from scratch as a multiradio solution
- High performance

Common Transport only supports IP-based radio protocols. ATM Iub and Dynamic Abis are not supported. Transport modes shown in Table 1: Transport modes supported in Single RAN are supported in parallel.

Table 1 Transport modes supported in Single RAN

Radio Access Technology	Transport Mode
LTE	S1/X2 over IP/Ethernet

Table 1 Transport modes supported in Single RAN (Cont.)

Radio Access Technology	Transport Mode
WCDMA	IP Iub over Ethernet or Time-Division Multiplexing (TDM)[1)]
GSM	Packet Abis over Ethernet or TDM[1)]
[1)] IP Iub or Packet Abis over TDM modes are only available on FSMF/FTIF HW and apply to both GSM and WCDMA.	

7.1 Transport interfaces in SBTS

Description of FSMF transport interfaces and the optional transmission sub-module (FTIF)

Flexi Multiradio 10 BTS System Module FSMF is equipped with two integrated transport interfaces: electrical Gigabit Ethernet (GE) interface (EIF1) and optical interface (EIF2/RF/6).

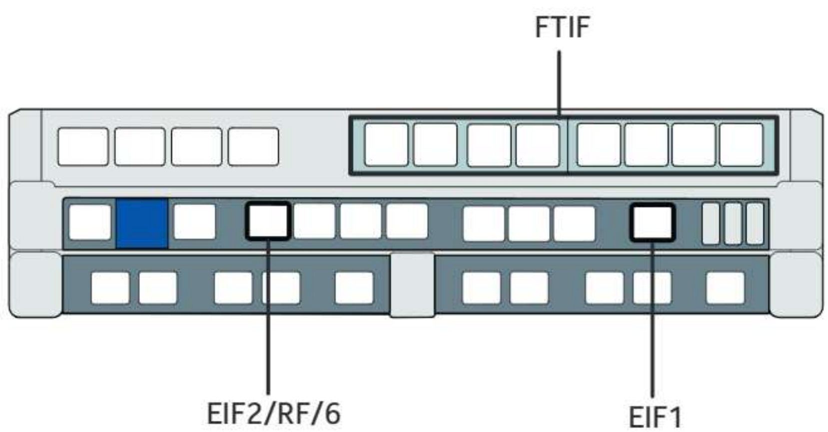
The latter is SW configurable for transport purposes or for RP3-01 interface. To operate in either (transport or RP3-01), it requires a Small Form-factor Pluggable (SFP). Both Ethernet interfaces provide a physical interface to the backhaul network.

Note: In SBTS, the optical interface (EIF2/RF/6) is available as transport interface EIF2 if not used for RP3-01 connection.

Flexi Multiradio 10 System Module FSMF is optimized for Ethernet Transport, and the HW supports the following integrated transport functions (without the optional transmission sub-module):

- 1 x 100/1000Base-T Ethernet port
- 1 x optional optical SFP (if not in use for RP3-01)

Figure 14 Flexi Multiradio 10 Base Station System Module and transport interfaces



Note: For all the technologies (GSM, WCDMA, LTE) it is possible to install an optional transmission sub-module (FTIF) to extend Flexi Multiradio 10 Base Station transport capabilities.

Flexi Multiradio 10 BTS Transmission Sub-Module

The FTIF transmission sub-module is required for the following purposes:

- Packet Abis over TDM or PDH synchronization
- Usage of optical ports on FSMF
- Multiple Ethernet ports are required
- Synchronous Ethernet Synchronization Output using Synchronous Ethernet as input

Flexi Multiradio 10 BTS Transmission Sub-Module (FTIF) has eight E1 interfaces and two Gigabit Ethernet Combo ports.

Figure 15 FTIF sub-module front panel - physical layer view

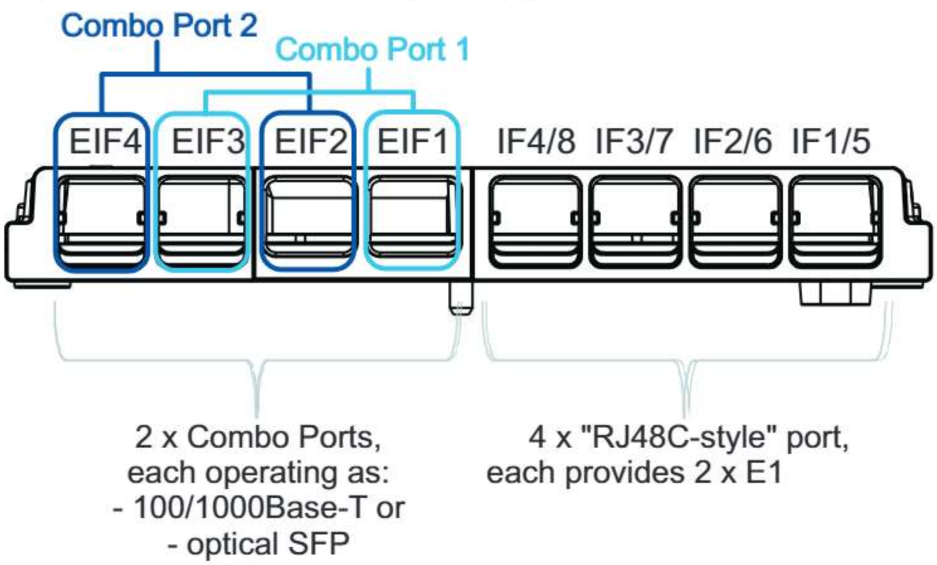
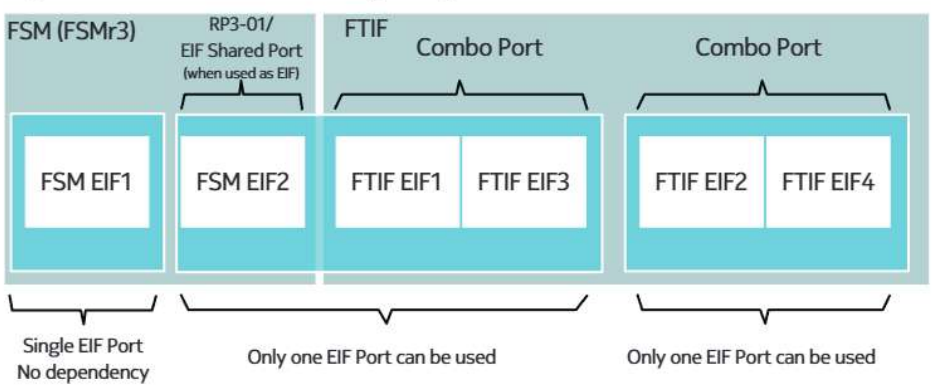


Figure 16 FTIF interfaces - logical layer view



EIF1/EIF3 and EIF2/EIF4 are paired as one combo port.

- The usage of EIF1 and EIF3 as well as EIF2 and EIF4 is mutually exclusive.
- The usage of EIF1/EIF3 on this FTIF and EIF2 on FSMF is mutually exclusive.

For more information on Flexi Multiradio 10 BTS Transmission Sub-Module (FTIF), see *Flexi Multiradio 10 Base Station Transmission Description*.

For more information on the usage of FTIF combo ports, see *SBTS System Parameters*.

Nokia AirScale System Module Indoor integrated transmission

The Nokia AirScale common unit ASIA is optimized for high-capacity Ethernet transport. The unit is equipped with three electrical 100/1000Base-T interfaces (EIF3-5) and two Small Form-factor Pluggable SFP/SFP+ slots (EIF1-2) that can be equipped with optional transceiver modules.

Figure 17 ASIA transport interfaces

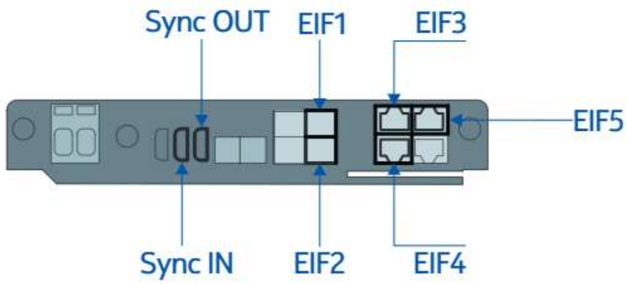


Table 2 ASIA transport interfaces - specification

Interface	Signals	Level
EIF1	1 Gbit/s 10 Gbit/s	1000Base-SX/LX/BX/ZX 10GBase-SR 10GBase-LR
EIF2	1 Gbit/s 10 Gbit/s	1000Base-SX/LX/BX/ZX 10GBase-SR 10GBase-LR
EIF3	100 Mbit/s 1 Gbit/s	100/1000Base-T
EIF4	100 Mbit/s 1 Gbit/s	100/1000Base-T
EIF5	100 Mbit/s 1 Gbit/s	100/1000Base-T

ASIA supports the following integrated transport functions:

- 3 x 100/1000 Base-T Ethernet port
- 2 x optional SFP+ (1/10GE optical)
- Ethernet-based chaining and switching across a maximum of five interfaces
- High-capacity IPsec, ASIA HW capability 5 Gbit/s (UL + DL)

ASIA supports the following synchronization inputs:

- IEEE 1588-2008 - through the transport interface
- Synchronous Ethernet - through the transport interface

- Pulse per Second and Time of Day (1PPS & ToD) - from GNSS receiver or another BTS, through the Sync IN interface
- 2.048 MHz - through the Sync IN interface

For more information, see *Nokia AirScale BTS Transmission Description*.

7.2 IP addresses in SBTS

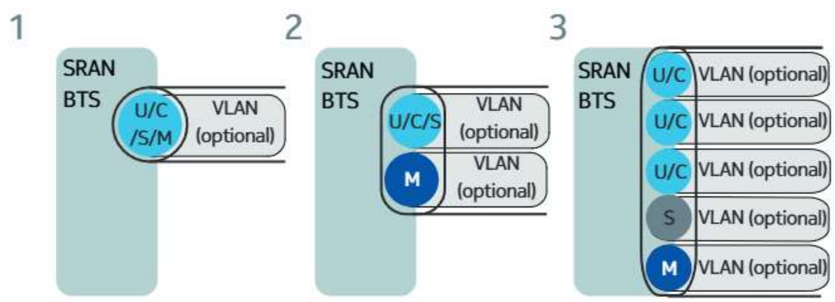
Overview of IP addressing in Single RAN BTS

In Single RAN, it is possible to assign applications to IP addresses with high flexibility. The SBTS has one termination point for all IP connections for all RATs. Virtual IP addresses or alias IP addresses can be used. IP addresses can be shared or dedicated across RATs and planes. The SBTS has exactly one M-plane IP address, which can be shared or dedicated with other applications.

Figure 18: IP addressing examples shows examples of IP addressing in SRAN, where:

1. Only one IP address is used for the SBTS.
2. The M-plane is separated from the U-/C-/S-planes.
3. One IP address is used for each U-/C-plane for each RAT, one dedicated IP address for S-plane, and one dedicated IP address for M-plane.

Figure 18 IP addressing examples



7.3 IP versions in SBTS

Supported IP versions in SBTS

The external transport interfaces of the SBTS support IPv4/IPv6 dual-stack. The explicit IPv6 or IPv4/IPv6 dual stack support of applications like U/C/S/M-plane is subject to separate features in later releases.

7.4 IP security in SBTS

Description of Single RAN transport security

Single RAN provides transport security based on IPsec, according to 3GPP TS 33.210 specifications. It offers data confidentiality and integrity protection, data origin authentication, and anti-replay protection using the ESP protocol (RFC4303). The SBTS establishes secure connections (IPsec tunnel mode) with one or multiple remote security gateway devices.

Full flexibility in terms of traffic flow to IPsec Security Association (SA) mapping is provided. Some examples of use cases are:

- Dedicated IPsec SAs exclusively used by the traffic of a certain RAT.
- Dedicated IPsec SAs exclusively used by a certain plane of a certain RAT.
- Shared IPsec SAs used for all traffic (common IPsec tunnel).

The SRAN transport security solution is compatible with the SON BTS autoconnection mechanism and other secure transport protocols (such as Transport Layer Security).

For more information on SRAN transport security, see *Configuring Security in SRAN*.

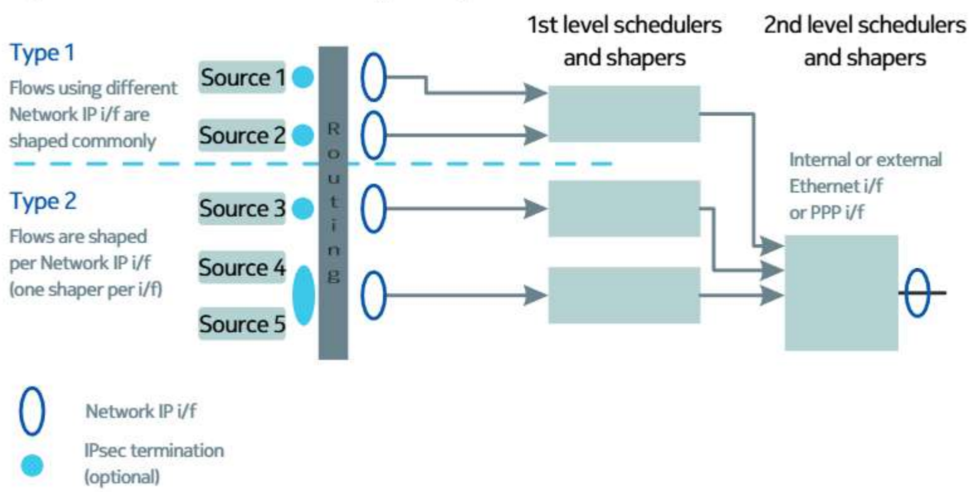
7.5 Transport Quality of Service in SBTS

Quality of Service in the SBTS supports two hierarchical levels of scheduling/shaping

Traffic flows can be freely allocated to first-level schedulers. First-level schedulers multiplex traffic streams coming from different RATs with certain QoS classes. They allow to prioritize, shape and limit flows or combination of flows according to the operator's preference. A high number of first-level schedulers help configure a high number of independent traffic streams and to shape them independently.

Second-level schedulers make sure that the outgoing traffic streams (for Ethernet interface or PPP group) fit into the outgoing pipe.

Figure 19 Two-level scheduling example



The Common Transport solution supports common mapping table for DSCP-to-PHB and DSCP-to-p-bits. The same QoS or priority can be applied to traffic streams coming from different RATs. In Single RAN, it needs to be done only once, instead of managing it three times independently.

7.6 Transport Admission and Congestion Control in SBTS

RAT-specific Admission and Congestion Control mechanisms are applicable in Single RAN

As each RAT has a dedicated static configured bandwidth for committed bitrate traffic and other measures, RAT-specific legacy Admission and Congestion Control mechanisms remain applicable and operate independently in Single RAN BTS. Existing dimensioning plans and rules are reused as the RAT-specific admission control and preemption mechanisms are reused.

Table 3 RAT-specific Admission and Congestion Control mechanisms

Radio Access Technology	Admission and Congestion Control mechanism
WCDMA	Connection Admission Control
LTE	Measurement Based Transport Admission Control
GSM	Packet Abis Congestion Control

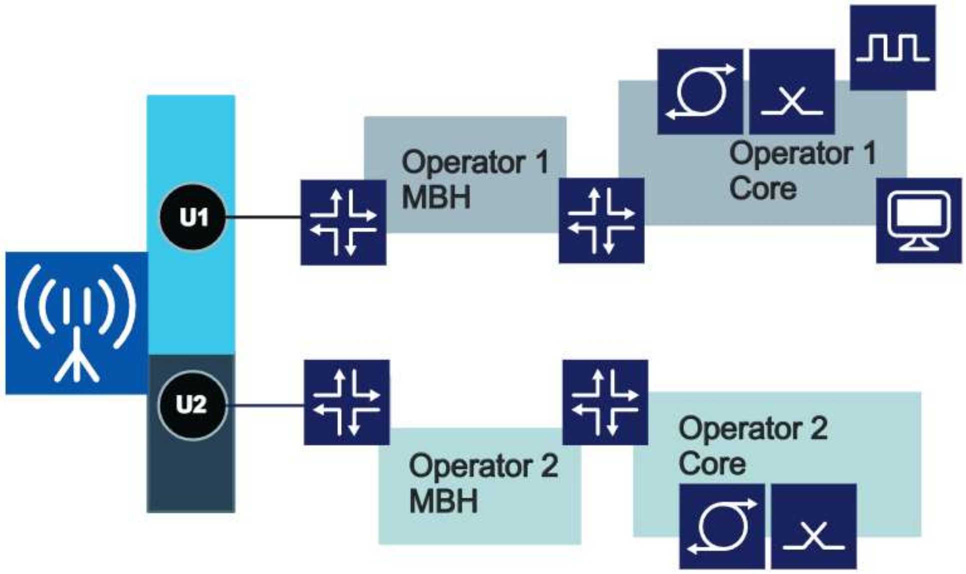
7.7 Support for network sharing

SBTS transport support for MORAN/MOCN network sharing

SBTS transport features support all requirements for MORAN/MOCN network sharing, like differentiation of operator-specific U-plane and C-plane traffic at IP or VLAN level.

The transport separation for LTE RAN sharing feature shown in the following diagram allows two LTE operators to share the same SBTS. The U-plane traffic of each operator (U1, U2) can either be allocated to the same L2 interface or to two separate ones as indicated in the diagram.

Figure 20 Transport separation for LTE RAN sharing



WCDMA Network Sharing support

In WCDMA, SBTS transport helps share the backhaul bandwidth of an SBTS between two operators. The two main use cases are:

- Fixed bandwidth sharing between two operators for DL and UL (with two VLANs).
- Dynamic bandwidth sharing between two operators for DL and UL (with one VLAN).

For more information, see the following feature descriptions:

WCDMA feature

- *RAN2647 - Iub Transport Solution for Network Sharing*

SRAN features

- *SR001026 - SBTS support for Network Sharing (MOCN, MORAN and MOBSS)*
- *SR000411 - Transport Separation for LTE RAN Sharing*
- *SR000398 - WCDMA U-Plane Traffic Differentiation*

7.8 Local Management Port in SBTS

One dedicated LMP exists in SBTS

The SBTS comes with one dedicated Local Management Port (LMP). This also applies for chained system modules, where the LMP is located on the system module that carries the transport functionality.

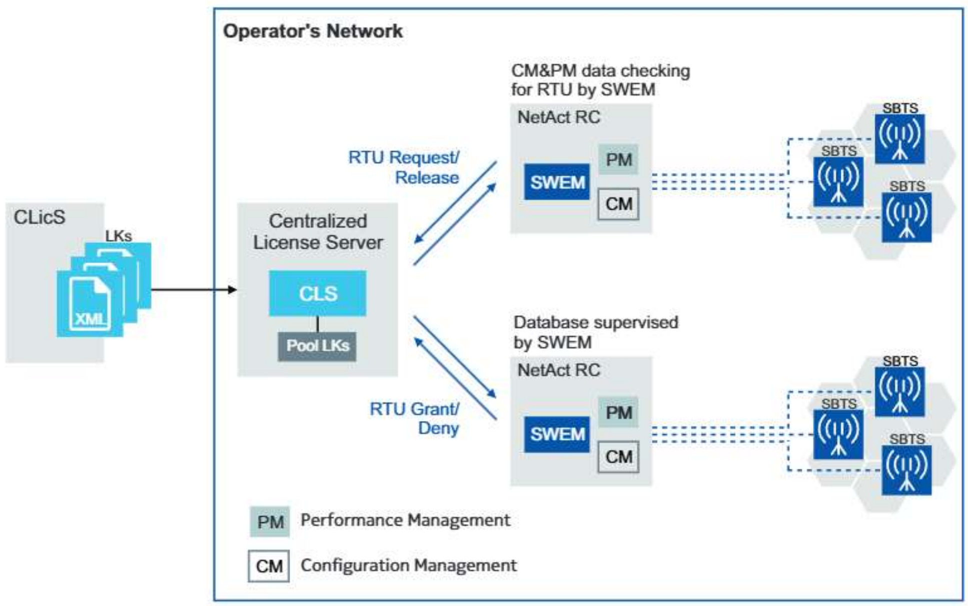
In case the SBTS is based on the Nokia AirScale BTS, the LMP is located on the Core Module ASIA.

8 Single RAN license management

Overview of the Single RAN license management

SRAN uses the same licensing framework as LTE and Nokia AirScale RNC, providing a unified aproach across Nokia products. After a customer order is received, the SW License Keys (LKs) can be retrieved from the Nokia Central Licensing System (CLicS), which generates SW License Keys. The LKs must be uploaded to the Centralized SW License Server (CLS). The LKs are assigned automatically to the Single RAN BTSs (SBTSs) according to the usage of SW LK protected sales items. The LKs are not installed on the SBTSs, but they are kept in the CLS and NetAct. There is one CLS for an entire operator network. The CLS cooperates with NetAct Regional Clusters (NetAct RCs) and SW Entitlement Managers (SWEMs).

Figure 21 Software License Keys concept in Single RAN



For more information on Single RAN license management, see Single RAN License Operation.

Note: The Single RAN licensing mechanism, described in the Single RAN License Operation document, applies only for SBTS. The existing SW licensing mechanism in the radio network elements (NEs), such as WBTS, RNC, BSC, and NetAct, does not change.