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SBTS Dimensioning Guideline

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Issue 15

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Nokia is committed to diversity and inclusion. We are continuously reviewing our customer documentation and consulting with standards bodies to ensure that terminology is inclusive and aligned with the industry. Our future customer documentation will be updated accordingly.

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Summary of changes

A list of changes between document issues. You can navigate through the respective changed topics.

Changes between issues 14B (2021-06-04, SRAN 21A) and 15 (2021-07-21, SRAN 21B)

Overview of the SBTS dimensioning

- The title of the document was changed from *SBTS Dimensioning* to *SBTS Dimensioning Guideline*.

AirScale site composition

- Configurations supported for SRAN 21B were added.

LTE cell capacity without the feature impact

- The *ABIC eCPRI mMIMO cell capacity for TDD* table was updated.
- A paragraph about each ABIA capacity plug-in unit supporting up to 4 cells each with 4 layer transmission in DL with 5/10/15/20 MHz each was added after the *ABIA cell capacity for FDD* table.
- The exemplary limitation on maximum cell amount in the note for tables *ABIO cell capacity for FDD*, *ABIN cell capacity for FDD*, *ABIO cell capacity for TDD*, and *ABIN cell capacity for TDD* was removed.
- The *ABIO cell capacity for TDD* and *ABIN cell capacity for TDD* tables were updated. A new row with info related to mMIMO was added.
- The *ABIO cell capacity for FDD* and *ABIN cell capacity for FDD* tables were updated.

Limits of a baseband pool

- The section title was changed from *Maximum supported RRC context* to *Limits of a baseband pool*.
- The *Built-in limits of a BB pool for TDD* table was added.
- The *Built-in limits of a BB pool for FDD* table was updated.

Intra-eNB fixed UL CoMP capacity on AirScale

- The *CB006754 TDD supported configurations in one BB pool (with BB pool activated)* and *CB006754 TDD supported configurations in one BB pool (with BB pool deactivated)* tables were added.
- The headers of the *LTE2104 TDD supported configurations in one BB pool (with BB pool activated)* and *LTE2104 TDD supported configurations in one BB pool (with BB pool deactivated)* tables were updated changing 8RX with 4RX.
- The content of the *LTE2104 TDD supported configurations in one BB pool (with BB pool deactivated)* table was updated changing 8RX with 4RX in the *4RX UL CoMP sets* column.

NB-IoT Cell Capacity for FSMF

- A paragraph about each ABIA capacity plug-in unit supporting up to 4 LTE cells with 4 layer transmission in DL with 5/10/15/20 MHz each plus 4 inband NB-IoT cells with equivalently 4TX4RX was added after *Cell capacity per HW board – guard band (LTE4499, LTE3570)* table.

Carrier Aggregation dimensioning for site configuration

- The *X2-based (AirScale) LTE FDD and TDD inter-eNB CA configuration dimensioning* table was updated.

C-plane pool dimensioning

- The *C-plane pools and BB pools from SRAN 21B* section was added.

AirScale traffic model

- The *Traffic model for ASIB/ASIL + 6 ABIN/ABIO configuration* table was added.
- The titles of the tables *Traffic model for ASIB/ASIL + ABIN/ABIO configuration* and *Traffic model for ASIB/ASIL + 3 ABIN/ABIO configuration* tables was updated: ASIL was added. The content of the tables was updated.

Changes between issues 14A (2021-03-26, SRAN 21A) and 14B (2021-06-04, SRAN 21A)

Balancing RACH load between LCGs configured on the same SBTS

- New procedure added.

Changes between issues 14 (2020-01-22, SRAN 21A) and 14A (2021-03-26, SRAN 21A)

Overview of the SBTS dimensioning

- The section has been restructured and updated.

LTE cell capacity without the feature impact

- The notes under the ABIO cell capacity for FDD/TDD and ABIN cell capacity for FDD/TDD tables have been updated.

NB-IoT cell capacity for AirScale

- The NB-IoT capacity tables have been restructured and updated.
- Mixed NB-IoT configurations A new section about NB-IoT mixed configurations has been added.

C-plane pool dimensioning

- The formula for the NB-IoT has been updated due to changes in measurements.

C-plane pool dimensioning

- A note about the C-plane capacity modeled by the key C-plane event frequency has been added.
- The number of events supported by the C-plane pool has been updated.

AirScale cell capacity

- A new table, ABIN baseband pooling for TDD, has been added.
- The tables have been grouped: FDD, then TDD related capacity.

1. Overview of the SBTS dimensioning

An overall view of the document content and its concepts

The *SBTS Dimensioning Guideline* document describes baseband (BB) dimensioning, SBTS site composition, transport dimensioning, and capacity licenses.

Dimensioning refers to the actions and resources (HW and SW) required to achieve the necessary capacity.

Capacity in a telecommunication network refers to the availability of the network to process the user traffic. This term addresses strictly the user traffic, not the signaling between the user equipment and the network.

The information on BB dimensioning and capacity refers to two types of system modules: Flexi Multiradio 10 BTS (FSMF) and Nokia AirScale BTS. Within these system modules, three technologies are configured: GSM, WCDMA, and LTE.

1.1 Baseband dimensioning

Overview of the baseband (BB) dimensioning in LTE, WCDMA and GSM

LTE baseband dimensioning

In LTE, the baseband capacity is expressed by the concept of cell sets, which describes supported configurations. Supported configurations are defined by baseband (BB) and radio frequency (RF) cell sets. One cell set is formed of one BB set and one or multiple RF sets. During the SBTS installation, the operator must ensure 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 BB configurations available to the customers. BB cell sets are independent configurations for the SBTS. BB cell sets depict 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 provide half subrack support.
- 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).

The BTS configurations in FSMF are defined as cell sets that can be combined with each other to build a full BTS configuration. The cell sets define usage of baseband (BB) resources of BB cards.

Table 1: BB cell sets on FSMF

BB cards	Cell set name
FSMF	BCS (Basic Cell Set)
FSMF + FBBC/A	ECS (Extended Cell Set)
FSMF + 2 x FBBC/A	XLCS (XL Cell Set)

Table 2: BB cell sets on ABIA

BB cards	Cell set name	BB pooling
(1/2) x ABIA	Basic Cell Set (BCS)	deactivated
1 x BB pool	Packed Cell Set (PCS)	activated
1 x ABIA	Extended Cell Set (ECS)	deactivated
2 x BB pool	Dual Packed Cell Set (DPCS)	activated
(3/2) x ABIA	XL Cell Set (XLCS)	deactivated
3 x BB pool	Triple Packed Cell Set (TPCS)	activated
4 x BB pool	Quad Packed Cell Set (QPCS)	activated
1 ECS = 2 x BCSs, 1 DPCS = 2 x PCSs, 1 XLCS = 3 x BCSs, 1 TPCS = 3 x PCSs, 1 QPCS = 4 x PCSs		

Table 3: BB cell sets on ABIO/ABIN

BB cards	Usage of baseband	Cell set name	BB pooling
ABIO	1 BB pool	BCS 1 - 6 RF ports	activated
	1 BB pool	BCS 2 – 3 RF ports	activated
	2 BB pools	ECS	activated
ABIN	2 BB pools	ECS	activated

> **Note:**
>
> In ABIO/ABIN, the BB pooling functionality must always be enabled.

The 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. The selected RF set impacts the number of carriers handled for each RAT.

> **Note:**
>
> For more information, see the *Reference Documentation/5G and SRAN Supported Configurations/SBTS Supported Configurations* document.

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

GSM baseband dimensioning

In GSM, the baseband capacity is expressed by the number of supported transceivers (TRXs), that can be served by specified BB resources. The GSM traffic can be located on ¼ ABIA, supporting 24 TRXs or up to ½ of ABIA, supporting 36 TRXs. The other ½ of the same ABIA can be used to serve LTE or WCDMA traffic.

In one FSMF core module, GSM can occupy ½ of FSMF total resources or ¾ of FSMF total resources. In the case where GSM occupies ½ of FSMF resources, one of four FSMF processors are dedicated to cover GSM traffic.

For more information, see the GSM baseband dimensioning in SBTS section.

WCDMA baseband dimensioning

In WCDMA, the baseband capacity is referred in subunits, used to process the WCDMA cells traffic.

The FSMF has 5.5 subunits. In case the FSMF is shared between technologies (WCDMA and GSM on one system module), the number of available subunits is 3.5. One subunit in an FSMF has a capacity of 96 channel elements (CEs) from Release 99 (Rel.99).

One extension baseband card (FBBA or FBBC) has six subunits.

A single Nokia AirScale BTS supports up to 24 cells with two-way RX Diversity (Div) and 12 with four-way RX Div.

In AirScale, the WCDMA traffic can be handled on ½ of ABIA (4 subunits), on ¾ of ABIA (6 subunits), or on the whole ABIA (8 subunits). The remaining resources of the same ABIA are used to handle either LTE or GSM traffic. In this case, LTE always occupies ½ ABIA or one BB pool.

For more information, see the WCDMA baseband dimensioning in SBTS section.

1.2 Common transport

Description of the common transport functionality

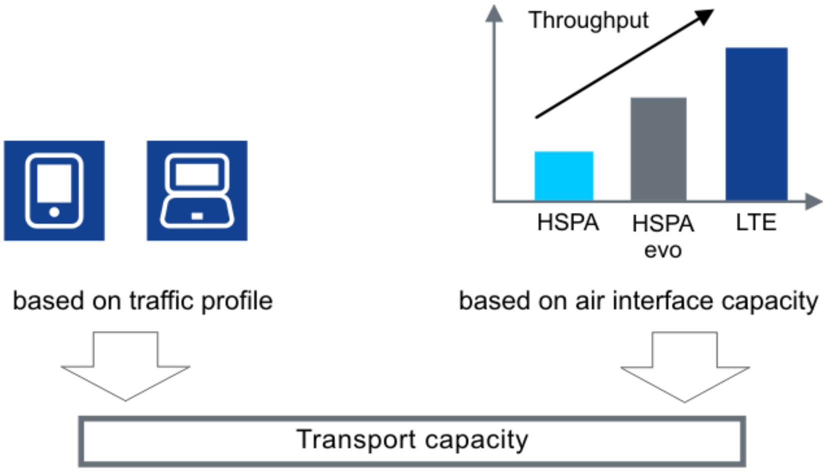
Common transport is one of the key functionalities introduced in Single RAN. Instead of having one transport for each RAT, there is only one shared transport entity in SBTS. Common transport can be connected to all three RAT application basebands or just one. The site appears on the transport layer as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

Network load is calculated separately for each RAT. The total network load is calculated as a sum of loads of GSM, WCDMA and LTE technologies. GSM is treated as a fallback for WCDMA in terms of voice services.

There are two possible approaches to common transport dimensioning in SBTS:

- Based on traffic profile (recommended)
- Based on air interface capabilities

Figure 1: Approaches to SBTS common transport dimensioning



For more information, see the Common transport dimensioning in SBTS section.

1.3 Capacity licenses

Centralized SW License Server (CLS) description

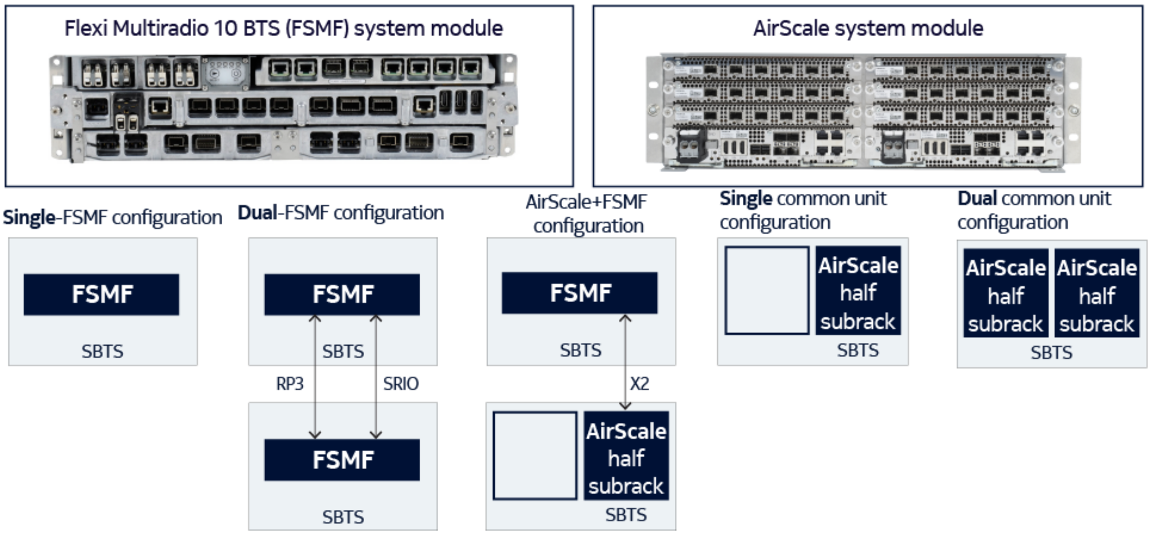
There is one CLS per operator network. SW license keys are not physically installed on the BTS, but are kept in the CLS. The CLS reserves and releases capacity for a specific feature based on a network element request and without manual work. Such behavior ensures that licensing smoothly follows changes in network management.

For more information on the CLS and central license management, see *Introduction to Centralized License Server* in the NetAct Cloud documentation.

2. SBTS site composition

Combinations of HW and RAT combinations supported by the SBTS

Figure 2: SBTS site composition



The figure above shows possible configurations of system modules:

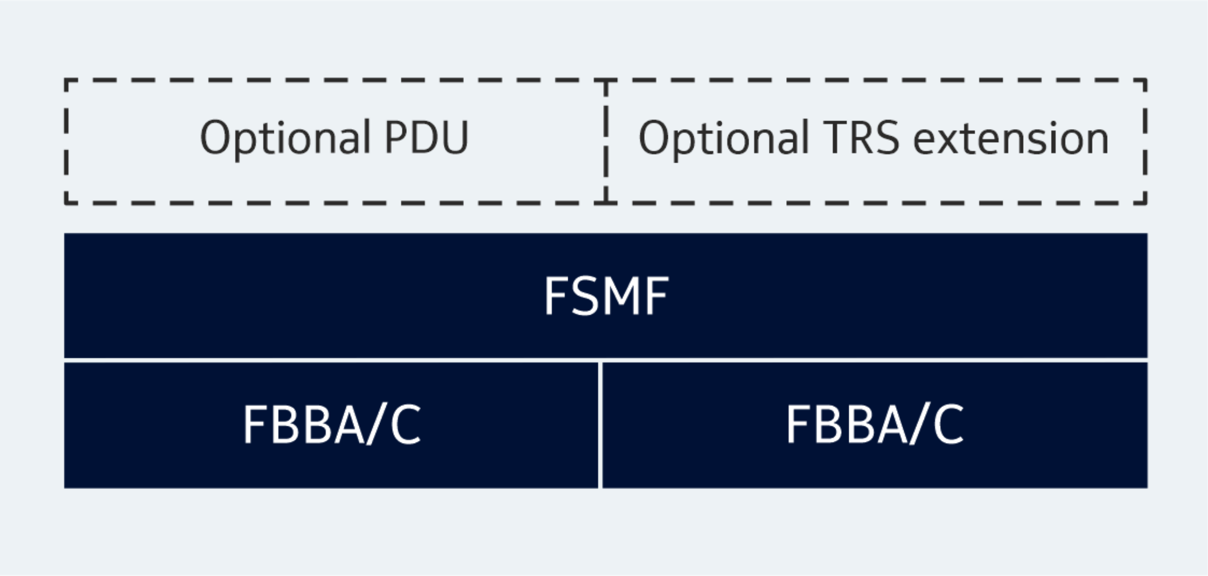
- Single-FSMF
- Dual-FSMF
- AirScale + FSMF
- Single-AirScale common unit
- Dual-AirScale common unit

2.1 FSMF site composition

The Flexi Multiradio 10 BTS system module has two main configurations: single-FSMF and dual-FSMF.

The Flexi 10 BTS (FSMF) is a lean SRAN site solution with system module sharing, fiber sharing, and RF sharing possibilities. It is a multi-radio platform for GSM, WCDMA, and LTE. FSMF baseband (BB) capacity can be shared between GSM and LTE, or GSM and WCDMA. FSMF or FBBC card baseband capacity can't be shared between LTE and WCDMA.

Figure 3: Flexi 10 BTS System Module



The FSMF baseband capacity can be shared between GSM and LTE, or GSM and WCDMA. FSMF or FBBA/FBBC card baseband capacity can be either LTE or WCDMA.

Single-FSMF

In the single-FSMF configuration, the maximum baseband capacity is limited to fully equipped FSMF system module (FSMF + 2 x FBBA/FBBC). The supported configurations are: GSM-LTE, GSM-WCDMA, WCDMA-LTE, and GSM-WCDMA-LTE.
In the system module sharing mode, GSM is allocated at the FSMF core only (not at FBBA/FBBC card).

Figure 4: GSM-LTE shared system module configuration

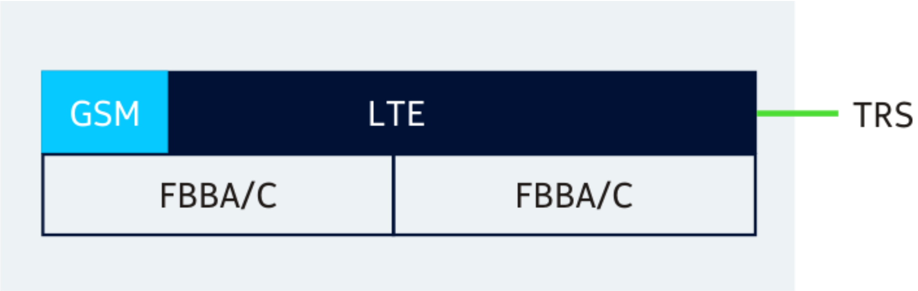


Table 4: GSM-LTE capacity (single FSMF)

Capacity extension submodule	GSM BB	LTE BB
-	24 TRXs	1 RCS
FBBA/C	24 TRXs	1 RCS + 1 BCS
2 x FBBA/C	24 TRXs	1 RCS + 2 BCS
2 x FBBA/C	24 TRXs	1 RCS + 1 ECS
Reduced cell set (RCS): • Up to 3 x 10 MHz LTE 2x2 MIMO with Coordinated Multi-Point (CoMP) in FSMF • Up to 4 x 10 MHz LTE 2x2 MIMO without CoMP in FSMF		
BCS = basic cell set, ECS = extended cell set, RCS = reduced cell set		

Figure 5: GSM-WCDMA shared system module configuration with WCDMA deployed on both FBBA/C

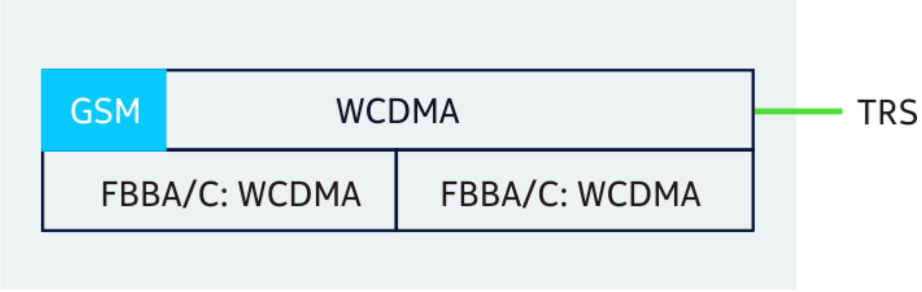


Table 5: GSM-WCDMA capacity (single FSMF)

Capacity extension submodule	GSM BB	WCDMA BB (number of subunits)
-	24 TRXs	3.5
FBBA/C	24 TRXs	9.5
2 x FBBA/C	24 TRXs	15.5
2 x FBBA/C	36 TRXs	14.5

Additional baseband resources for WCDMA can be allocated with FBBA/C cards.

Figure 6: WCDMA-LTE shared system module configuration with WCDMA and LTE deployed on both FBBA/C

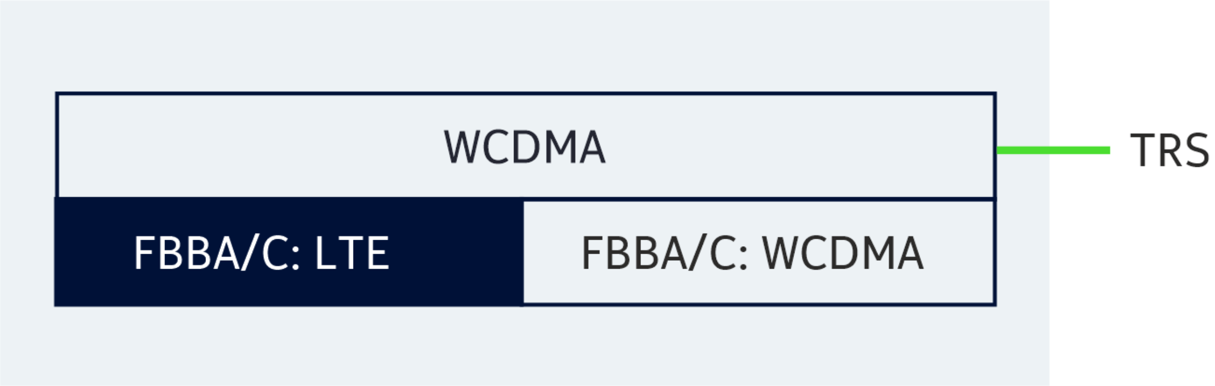


Table 6: WCDMA-LTE capacity (single FSMF)

Capacity extension submodule	WCDMA BB (number of subunits)	LTE BB
2 x FBBC	5.5	2 x BCS
2 x FBBC	5.5	1 x ECS
2 x FBBA/C	11.5	1 x BCS

BCS = basic cell set, ECS = extended cell set

Figure 7: GSM-WCDMA-LTE shared system module configuration

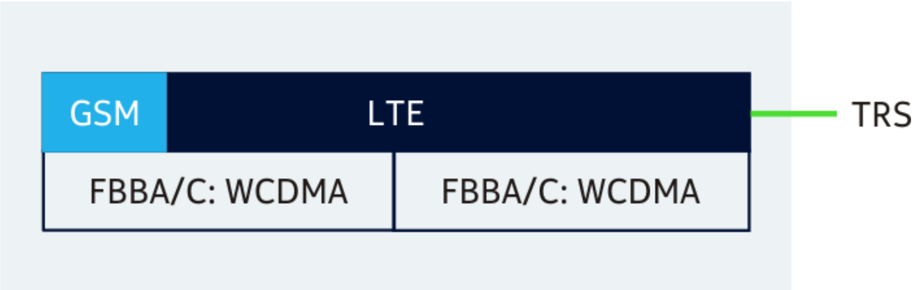


Table 7: GSM-WCDMA-LTE capacity (single FSMF)

Capacity extension submodule	GSM BB	WCDMA BB (number of subunits)	LTE BB
2 x FBBA/C	24 TRXs	11.5	1 x RCS
2 x FBBA/C	24 TRXs	9.5	1 x BCS
2 x FBBA/C	36 TRXs	8.5	1 x BCS

BCS = basic cell set, RCS = reduced cell set

The figures show some example configurations. For more information on all the supported configurations, please see the *Reference Documentation/5G and SRAN Supported Configurations/SBTS Supported Configurations* document.

Dual-FSMF configuration

In the dual-FSMF configuration, the maximum baseband capacity is limited to two fully equipped FSMF system modules working as a single SBTS. This is especially designed to handle large LTE configurations, for which there isn't enough capacity in the FSMF supporting GSM and WCDMA cells.

The SBTS capacity can be extended by using two system modules.

Figure 8: Dual-FSMF configuration

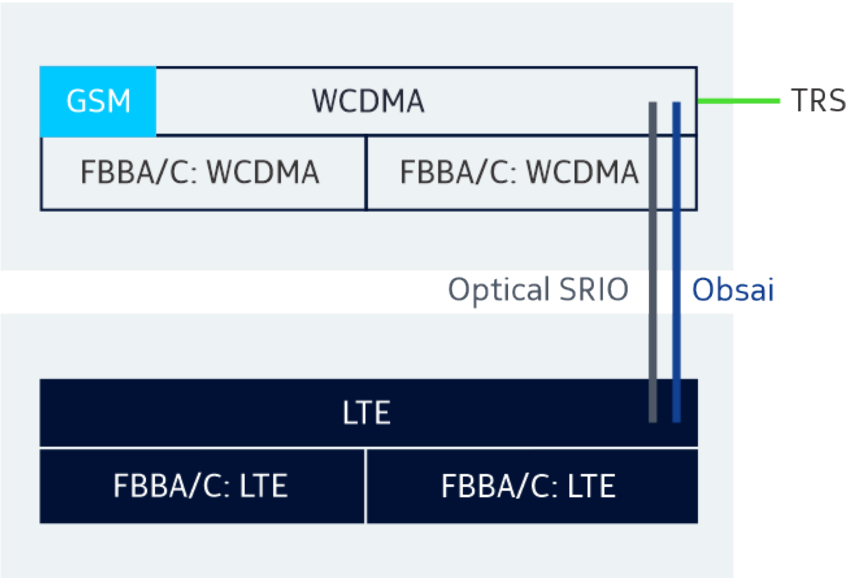


Table 8: WCDMA-LTE capacity (dual FSMF)

Capacity extension submodule	WCDMA BB (number of subunits)	LTE BB
4 x FBBA/C	17.5	3 x BCS
4 x FBBA/C	17.5	1 x ECS + 1 x BCS

BCS = basic cell set, ECS = extended cell set

Table 9: GSM-WCDMA-LTE capacity (dual FSMF)

Capacity extension submodule	GSM BB	WCDMA BB (number of subunits)	LTE BB
4 x FBBA/C	24 TRXs	15.5	3 x BCS
4 x FBBA/C	36 TRXs	14.5	3 x BCS
4 x FBBA/C	24 TRXs	15.5	1 x BCS + 1 x ECS
4 x FBBA/C	36 TRXs	14.5	1 x BCS + 1 x ECS

BCS = basic cell set, ECS = extended cell set

Dual-FSMF configuration rules:

- WCDMA and GSM applications are always deployed on the primary FSMF.
- LTE applications always use the secondary FSMF (without backhaul connection).
  - Up to 3 x basic cell set (BCS) or 1 x extended cell set (ECS) + 1 x BCS available.
- The connection between the FSMFs is supported only by the two-meter serial rapid I/O (sRIO) and Open Base Station Architecture Initiative (OBSAI) fibers (FUFAS or FSFL fibers).
  - Only one OBSAI and SRIO fiber can be used between the FSMFs.
  - OBSAI ports used for interconnection are defined by the cell set configuration.
- RF modules with LTE cells deployed are always connected to the secondary FSMF.

The BCS provides a maximum capacity of:

- Up to 6 x 10 MHz LTE 2 x 2 MIMO
- Up to 3 x 10 MHz LTE 4TX/4RX

> **Note:**
>
> 4T/4RX = 4 x 2 MIMO in TM4 or 4RX diversity mode

- Up to 3 x 20 MHz LTE 2 x 2 MIMO

The ECS provides a maximum capacity of up to 3 x 20 MHz LTE 4TX/4RX or 4 x 4 MIMO.

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

Cell set deployment rules:

- For BCS, LTE must be deployed on FSMF or FBBA/FBBC.
- For ECS, LTE must be deployed on FSMF and FBBA/FBBC or on two FBBA/FBBC cards.

For more information on SBTS configurations, see the *Reference Documentation/5G and SRAN Supported Configurations/SBTS Supported Configurations* document.

2.2 AirScale site composition

Description of the AirScale site composition with two main configurations: half subrack and full subrack

The Nokia AirScale system module is deployed indoor as well as outdoor, but a special cover is required for the outdoor capability.

The AirScale system module has the following components:

- Nokia AirScale system module indoor subrack (AMIA) or outdoor subrack (AMOB)
- Nokia AirScale system module common plug-in units (ASIA, ASIB, or ASIL)
- Nokia AirScale system module capacity plug-in units (ABIA, ABIC, ABIO or ABIN)

Half subrack configurations

The maximum baseband capacity is limited to fully equipped half of AirScale system module:

- One common plug-in unit
- Maximum three capacity plug-in units

Table 10: A summary of the half subrack supported configurations

Common plug-in unit	Supported mixtures of capacity plug-in units
ASIA	ABIA, ABIC
ASIB	• ABIA, ABIC • ABIA, ABIL • ABIA, ABIO, ABIN
ASIL	ABIA, ABIO, ABIN

For details on allowed RAT and fronthaul allocation in different capacity plug-in unit supported configurations, see the *Site composition* tab in the *Reference Documentation/5G and SRAN Supported Configurations/SBTS Supported Configurations* document.

The units may be deployed in any order, either in the left or right subrack half.

Full subrack configurations

The SBTS maximum baseband capacity is limited to fully equipped two halves of AirScale system module working as a single SBTS:

- Two common plug-in units
- Maximum six capacity plug-in units (up to three capacity plug-in units per each common plug-in unit)

Table 11: A summary of the full subrack supported configurations

Common plug-in unit	Supported mixtures of capacity plug-in units
ASIA + ASIA	ABIA
ASIB + ASIB	• ABIA • ABIA, ABIC • ABIA, ABIO, ABIN
ASIB + ASIA	ABIA
ASIL + ASIL	ABIA, ABIO, ABIN

For details on allowed RAT and fronthaul allocation in different capacity plug-in unit supported configurations, see the *Site composition* tab in the *Reference Documentation/5G and SRAN Supported Configurations/SBTS Supported Configurations* document.

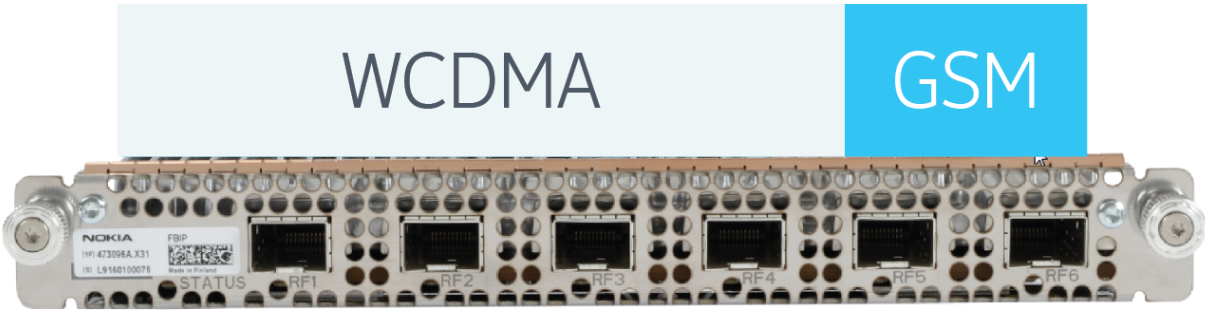
AirScale RAT sharing for ABIA

In SRAN, the AirScale Indoor system module supports the system module sharing functionality. A single BB card can be shared between two RATs. The AirScale system module baseband dimensioning rules are interconnected between technologies (GSM, WCDMA, and LTE per logical SBTS), because all technologies use ABIA cards.

WCDMA – GSM card sharing case (a):

- Six subunits for WCDMA
- Up to 24 TRXs with ¼ ABIA for GSM

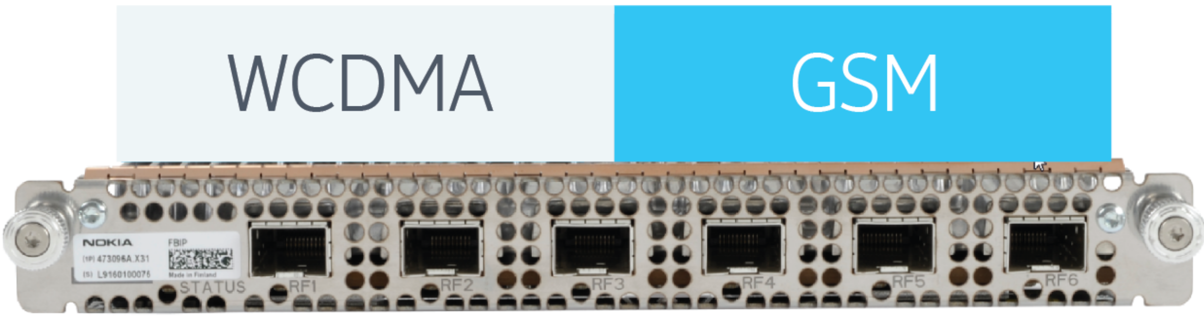
Figure 9: WCDMA – GSM card sharing case (a)



WCDMA – GSM card sharing case (b):

- Four subunits for WCDMA
- Up to 36 TRXs with ½ ABIA for GSM

Figure 10: WCDMA – GSM card sharing case (b)



WCDMA – LTE card sharing case:

- Four subunits for WCDMA
- Remaining half ABIA for LTE allocation

Figure 11: WCDMA – LTE card sharing case

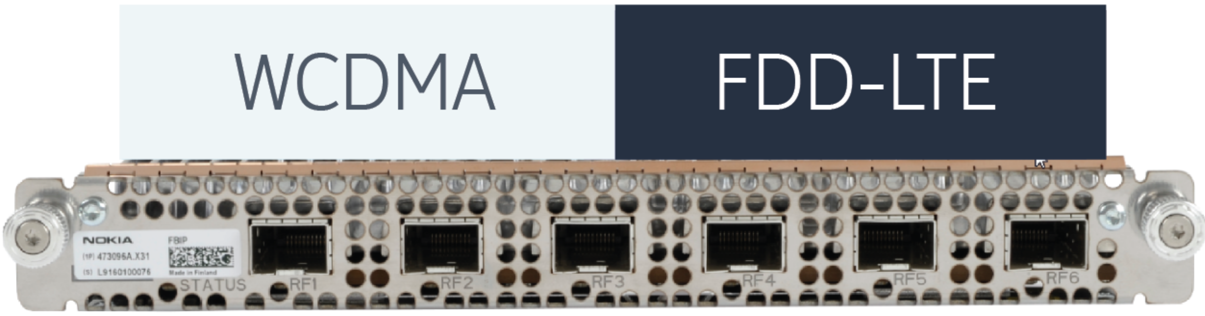


Figure 12: Example of FDD-LTE and WCDMA BB cards sharing (12 subunits)

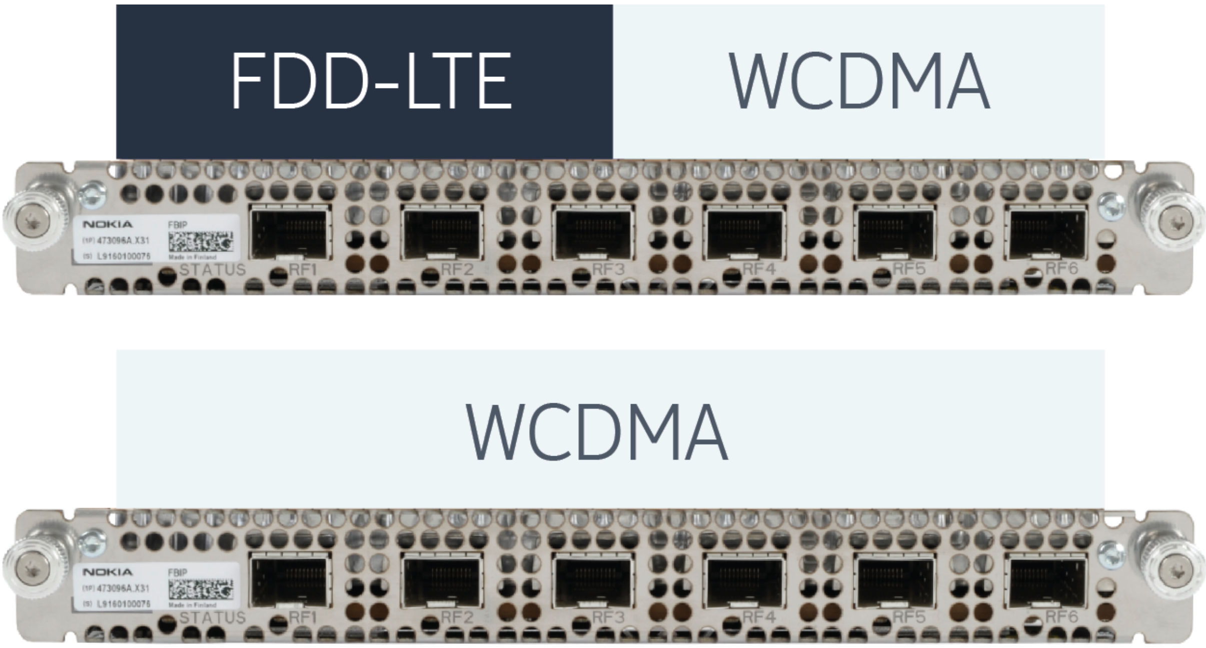


Table 12: AirScale capacity

	GSM	WCDMA	LTE	GSM/WCDMA	GSM/LTE	LTE/WCDMA
ABIA	24 TRXs (¼ ABIA) or 36 TRXs (½ ABIA)	8 subunits	1 x ECS or 1 x DPCS	24 TRXs / 6 subunits or 36 TRXs / 4 subunits	24 TRXs / 1 x BCS or 24 TRXs / 1 x PCS or 36 TRXs / 1 x BCS or 36 TRXs / 1 x PCS	1 x BCS / 4 subunits or 1 x PCS / 4 subunits
½ ABIA	24 TRXs (¼ ABIA) or 36 TRXs (½ ABIA)	4 subunits	1 x BCS or 1 x PCS	-	-	-

BCS = Basic Cell Set; PCS = Packed Cell Set; DPCS = Dual Packed Cell Set: ECS = extended cell set

Note:

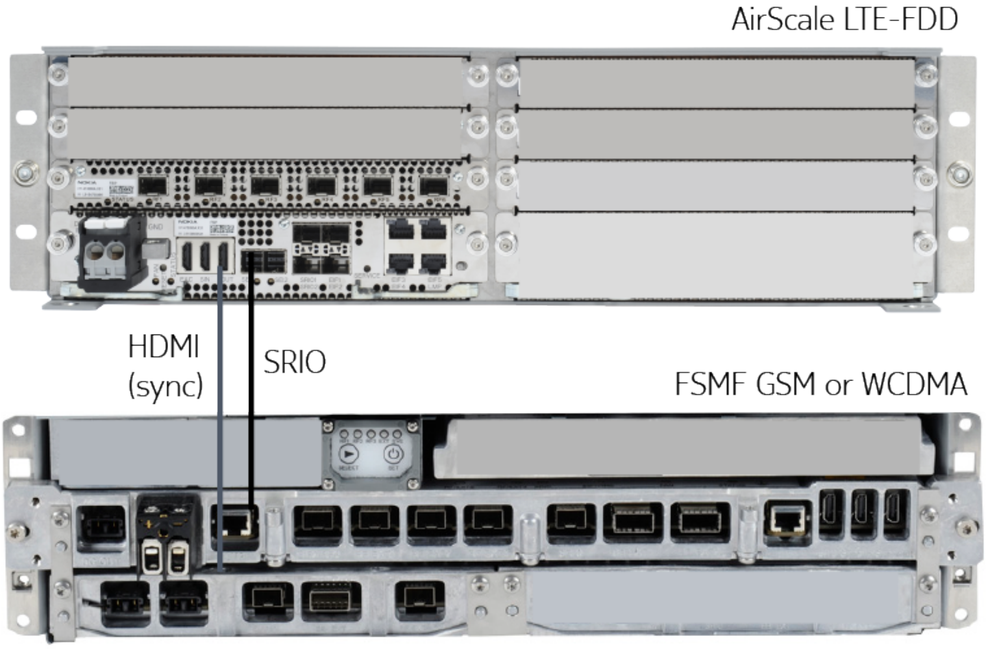
If the BB pooling functionality isn't activated, the cell capacity is less for LTE. For more information on the LTE cell capacity, see the *Reference Documentation/5G and SRAN Supported Configurations/SBTS Supported Configurations* document.

2.3 AirScale + FSMF site composition

Description of site composition using AirScale and FSMF system modules together as a single logical high-capacity SBTS with three (GSM, WCDMA and LTE) radio access technologies. The FSMF supports GSM, WCDMA or GSM+WCDMA, while AirScale supports only LTE FDD or LTE TDD.

The primary core consists of a half AirScale subrack (left or right) that has a common plug-in unit: ASIA or ASIB and up to three capacity plug-in units. The secondary core consists of a FSMF system module and up to two FBBA/FBBC extension modules.

Figure 13: Connections between the primary and secondary cores



3. Baseband dimensioning

Overall information about baseband (BB) dimensioning for different RATs

3.1 LTE baseband dimensioning in SBTS

Baseband (BB) dimensioning for Flexi Multiradio 10 BTS and AirScale system modules operating in LTE mode

3.1.1 LTE cell capacity without the feature impact

Tables presenting the cell capacity for FDD and TDD

FSMF cell capacity

Table 13: FSMF cell capacity for FDD

HW board	TX / RX	DL MIMO	Bandwidth (MHz)	Number of cells
FSMF / FBBA / FBBC	2 / 2, 2 / 4 *	2 x 2	5 / 10	6
FSMF / FBBA / FBBC	2 / 2, 2 / 4	2 x 2	15 / 20	3
FSMF	4 / 4	4 x 2	5 / 10	3
FSMF + FBBA / FBBC	4 / 4	4 x 2	15 / 20	3
FSMF + FBBA / FBBC	4 / 4	4 x 2	5 / 10	6
FSMF + 2 FBBA / FBBC or FSMF + FBBA + FBBC	4 / 4	4 x 2	5 / 10	9
FSMF + FBBA / FBBC	4 / 4	4 x 4, 4 x 2 **	5 / 10 / 15 / 20	3

Note:

* To achieve the same capacity for 2TX4RX as for 2TX2RX the `LNBTS_FDD` `Activate optimized baseband resource usage` (`actOptimizedBbUsage`) parameter needs to be set to `true`.

** DL MIMO 4 x 2 TM9 requires the same capacity as DL MIMO 4 x 4.

Table 14: FSMF and FSIH cell capacity for TDD

HW board	TX / RX	DL MIMO	Bandwidth (MHz)	Number of cells
FSMF / FBBA	2 / 2	2 x 2	10 / 15 / 20	3
	4 / 4	4 x 2, 4 x 4	10 / 15 / 20	1
	8 / 8	8 x 2	10 / 15 / 20	1
FSMF + FBBA	2 / 2	2 x 2	10 / 15 / 20	6
	4 / 4	4 x 2, 4 x 4	10 / 15 / 20	3
	8 / 8	8 x 2	10 / 15 / 20	2
FSMF + 2 FBBA	2 / 2	2 x 2	10 / 15 / 20	9
	4 / 4	4 x 2, 4 x 4	10 / 15 / 20	6
	8 / 8	8 x 2	10 / 15 / 20	3
FSMF / FBBA	2 / 2	2 x 2	10 / 15 / 20	4
	4 / 4	4 x 2, 4 x 4	10 / 15 / 20	3
	8 / 8	8 x 2	10 / 15 / 20	3
FSIH / FBIH	2 / 2	2 x 2	10 / 15 / 20	8
	4 / 4	4 x 2, 4 x 4	10 / 15 / 20	6
	8 / 8	8 x 2	10 / 15 / 20	6
FSIH + 2 FBIH	2 / 2	2 x 2	10 / 15 / 20	12
	4 / 4	4 x 2, 4 x 4	10 / 15 / 20	9
	8 / 8	8 x 2	10 / 15 / 20	9

Note:

2TX/4RX capacity is the same as 4TX/4RX.

AirScale cell capacity

Table 15: ABIA cell capacity for FDD

Cell bandwidth (MHz)	Antenna configuration (TX / RX)	Per BB pool	Per ABIA	Per BTS
5 / 10	2 / 2	8	16	96
15 / 20	2 / 2	6	12	72
5 / 10 and 15 / 20	2 / 2	4 + 4	16	96
5 / 10 and 15 / 20	4 / 4	2 + 2	8	48
5 / 10	4 / 4	6	12	72
15 / 20	4 / 4	3	6	36

Starting with the *LTE4265: Split L1 with Fixed Beam Sectorization for 16TRX FDD mMIMO* feature (from LTE 19 onward) and with the dynamic baseband pooling (provided by the *LTE2733: Baseband Pooling* feature) enabled, each ABIA capacity plug-in unit supports up to 4 cells with 4 layer transmission in DL with 5/10/15/20 MHz bandwidth.

Table 16: ABIO (either LTE or NB-IoT) cell capacity for FDD

Cell bandwidth (MHz)	Antenna configuration (TX / RX)	Cells (either LTE or NB-IoT) per BB pool	Cells (either LTE or NB-IoT) per ABIO	Cells (either LTE or NB-IoT) per BTS (6 x ABIO)
5 / 10 / 15 / 20	2 / 2	9	24	144
5 / 10	4 / 4	9	24	144
15 / 20	4 / 4	6	18	108

Note:

The BB pool can support a mix of cells with different antenna number and different bandwidths, according to following rules:

- Carriers with different bandwidths can be mixed freely in the same BB cell set.
- Cells with different TX/RX transmission schemes can be mixed freely in the same BB cell set cell.
- The maximum cell amount is defined by the dimensioning of the most demanding cell, considering the bandwidth and TX/RX transmission scheme.

Table 17: ABIN (either LTE or NB-IoT) cell capacity for FDD

Cell bandwidth (MHz)	Antenna configuration (TX / RX)	Cells (either LTE or NB-IoT) per BB pool	Cells (either LTE or NB-IoT) per ABIO	Cells (either LTE or NB-IoT) per BTS (6 x ABIO)
5 / 10 / 15 / 20	2 / 2	6	12	72
5 / 10	4 / 4	6	12	72
15 / 20	4 / 4	3 / 6*	9	54

*3 cells or maximum 6 cells per BB pool

Note:

The BB pool can support a mix of cells with different antenna number and different bandwidths, according to following rules:

- Carriers with different bandwidths can be mixed freely in the same BB cell set.
- Cells with different TX/RX transmission schemes can be mixed freely in the same BB cell set cell.
- The maximum cell amount is defined by the dimensioning of the most demanding cell, considering the bandwidth and TX/RX transmission scheme.

Table 18: ABIA cell capacity for TDD

Cell bandwidth (MHz)	Antenna configuration (TX / RX)	Per BB pool	Per ABIA	Per BTS	Plug-in unit
10 / 15 / 20	2 / 2, 4 / 4	3	6	36	ASIA / ASIB
10 / 15 / 20	8 / 8	2	4	24	ASIA / ASIB
10 / 20	32 / 32	-	1	6	ASIA
10 / 15 / 20	64 / 64	-	0,5	3	ASIA

Table 19: ABIC CPRI mMIMO cell capacity for TDD

Cell bandwidth (MHz)	Antenna configuration (TX / RX)	Per BB pool	Per ABIC	Per BTS
10 / 20	32 / 32	2	4	24
10 / 15 / 20	64 / 64	1	2	12

Table 20: ABIC eCPRI mMIMO cell capacity for TDD

Cell bandwidth (MHz)	Antenna configuration (TX / RX)	Per BB pool	Per ABIC	Per BTS
10 / 20	64 / 64	2	4	24

Table 21: ABIO cell capacity for TDD

Cell bandwidth (MHz)	Antenna configuration (TX / RX)	Per BB pool	Per ABIO	Per BTS (6 x ABIO)
10 / 15 / 20	2 / 2	4	8	48
10 / 15 / 20	4 / 4	4	8	48
10 / 15 / 20	8 / 8	4	8	48
20	64 / 64	3	6	36

Note:

The BB pool can support a mix of cells with different antenna number and different bandwidths, according to following rules:

- Carriers with different bandwidths can be mixed freely in the same BB cell set.
- Cells with different TX/RX transmission schemes can be mixed freely in the same BB cell set cell.
- The maximum cell amount is defined by the dimensioning of the most demanding cell, considering bandwidth and TX/RX transmission scheme.

Table 22: ABIN cell capacity for TDD

Cell bandwidth (MHz)	Antenna configuration (TX / RX)	Per BB pool	Per ABIN	Per BTS (6*ABIN)
10 / 15 / 20	2 / 2	2	4	24
10 / 15 / 20	4 / 4	2	4	24
10 / 15 / 20	8 / 8	2	4	24
20	64 / 64	2	3	18

Note:

The BB pool can support a mix of cells with different antenna number and different bandwidths, according to following rules:

- Carriers with different bandwidths can be mixed freely in the same BB cell set.
- Cells with different TX/RX transmission schemes can be mixed freely in the same BB cell set cell.
- The maximum cell amount is defined by the dimensioning of the most demanding cell, considering bandwidth and TX/RX transmission scheme.

3.1.2 Limits of a baseband pool

Built-in limits of a baseband (BB) pool and the maximum RRC context supported for FDD

and TDD

Table 23: Built-in limits of a BB pool for FDD

Resource	ABIA	ABIO	ABIN
RRC context	2520	3780	1890
Data radio bearers (DRBs)	7560	11340	5670
Complex DRBs (GBR)	960	1440	720
Physical random access channel (PRACH) Root Sequences X Antennas	512	512 / Layer 1 pool	512 / Layer 1 pool

Table 24: Built-in limits of a BB pool for TDD

Resource	ABIA	ABIO	ABIN
RRC context	1600	3780	1890
DRBs	4800	11340	5670
Complex DRBs (GBR)	600	800	400
PRACH Root Sequences X Antennas	64	256	256

Table 25: Peak RRC context per cell for FDD

Cell Bandwidth	Peak RRC context
5 MHz	850
10 MHz	1000
15 MHz	1250
20 MHz	1500

Note:

* This functionality is supported only when the sum of active users in all cells doesn't reach the limit per BB pool.

For more information on LTE baseband dimensioning in SBTS, see the *Reference Documentation/5G and SRAN Supported Configurations/SBTS Supported Configurations* document.

Table 26: Number of users per cell for FSMF for TDD

Configuration	Maximum number of active UEs per cell		
FSMF with Limited feature set	20 MHz	15 MHz	10 MHz
TDD Config1	800	800	550
TDD Config2	630	630	550
FSMF without Limited feature set	20 MHz	15 MHz	10 MHz
TDD Config1	600	600	400
TDD Config2	420	420	400
FSMF Supercell	20 MHz	15 MHz	10 MHz
TDD Config1	400	N/A	N/A
TDD Config2	400	N/A	N/A
FSMF HighSpeed	20 MHz	15 MHz	10 MHz
TDD Config1	400	N/A	N/A
TDD Config2	400	N/A	N/A

Table 27: Number of users per cell for AirScale for TDD

Configuration	Maximum number of active UEs per pool				Maximum number of active UEs per cell			
AirScale ABIA Normal Cell	20 MHz	15 MHz	10 MHz	5 MHz	20 MHz	15 MHz	10 MHz	5 MHz
TDD Config0	1200	1200	1200	576	400	400	400	192
TDD Config1	1600	1600	1600	900	1200	1200	600	300
TDD Config2	1600	1600	1600	900	1200	1200	600	300
AirScale ABIA SFN	20 MHz	15 MHz	10 MHz	5 MHz	20 MHz	15 MHz	10 MHz	5 MHz
TDD Config1	N/A	N/A	N/A	N/A	800	800	600	N/A
TDD Config2	N/A	N/A	N/A	N/A	800	800	600	N/A
AirScale ABIA HighSpeed	20 MHz	15 MHz	10 MHz	5 MHz	20 MHz	15 MHz	10 MHz	5 MHz
TDD Config1	N/A	N/A	N/A	N/A	400	400	400	N/A
TDD Config2	N/A	N/A	N/A	N/A	400	400	400	N/A
AirScale ABIA mMIMO	20 MHz	15 MHz	10 MHz	5 MHz	20 MHz	15 MHz	10 MHz	5 MHz
TDD Config2	1600	1600	1600	N/A	1200	1200	600	N/A

Note:

TDD Config 0 doesn't support the *LTE2615: Extended CQI period for high capacity cells* feature.

Note:

SRS configuration for maximum number of users per cell (TDD):

- `LNCEL_TDD` `SRS downlink MIMO mode dependant configuration` (`srsDlMimoModeDepConf`) `SRS bandwidth` (`srsBandwidth`) = `3hbw` (4PRB)
- `LNCEL_TDD` `SRS downlink MIMO mode dependant configuration` (`srsDlMimoModeDepConf`) `SRS periodicity of UE transmission` (`srsUePeriodicity`) = `80ms`
- `LNCEL_TDD` `SRS downlink MIMO mode dependant configuration` (`srsDlMimoModeDepConf`) `SRS transmission on 2 symbols of UpPTS act/deact` (`srsOnTwoSymUpPts`) = `true`

Table 28: Number of users per cell for AirScale CPRI mMIMO for TDD

Airscale ABIC CPRI mMIMO Configuration	Maximum number of active UEs per pool			Maximum number of active UEs per cell		
	20 MHz	15 MHz	10 MHz	20 MHz	15 MHz	10 MHz
TDD Config2	1600	1600	1200	1200	1200	600

Table 29: Layer number per cell for AirScale CPRI mMIMO for TDD

Airscale ABIC CPRI mMIMO Configuration	Layer number per pool			Layer number per cell		
	20 MHz	15 MHz	10 MHz	20 MHz	15 MHz	10 MHz
64TRX TDD Config2	DL 16 Layer UL 8 Layer	DL 16 Layer UL 8 Layer	DL 16 Layer UL 8 Layer	DL 16 Layer UL 8 Layer	DL 16 Layer UL 8 Layer	DL 16 Layer UL 8 Layer
32TRX TDD Config2	DL 16 Layer UL 8 Layer	N/A	DL 16 Layer UL 8 Layer	DL 8 Layer UL 4 Layer	DL 16 Layer UL 4 Layer	DL 16 Layer UL 4 Layer

Table 30: Number of users per cell for AirScale eCPRI mMIMO for TDD

Airscale ABIC eCPRI mMIMO Configuration	Maximum number of active UEs per pool			Maximum number of active UEs per cell		
	20 MHz	15 MHz	10 MHz	20 MHz	15 MHz	10 MHz
TDD Config2	1600	1600	1200	1200	1200	600

Table 31: Layer number per cell for AirScale eCPRI mMIMO for TDD

Airscale ABIC eCPRI mMIMO Configuration	Layer number per pool		Layer number per cell	
	20 MHz	10 MHz	20 MHz	10 MHz
64TRX TDD Config2	DL 20 Layer UL 16 Layer	DL 20 Layer UL 16 Layer	DL 20 Layer UL 8 Layer	DL 20 Layer UL 8 Layer

3.1.3 UL CoMP cell capacity

Feature impact on cell capacity

3.1.3.1 Inter-eNB flexible UL CoMP capacity on AirScale

Cell capacity details for Centralized Radio Access Network (CRAN) AirScale flexible uplink coordinated multipoint (UL CoMP) according to *LTE3897: Flexible Intra eNB UL CoMP* and *LTE3933: Flexible Inter eNB UL CoMP*.

Details on the cell capacity requirements for Centralized Radio Access Network (CRAN) deployments with flexible uplink coordinated multipoint (UL CoMP) on AirScale System Modules are as follows:

Table 32: CRAN AirScale flexible UL CoMP cell capacity

Bandwidth (MHz)	TX/RX	cells per BB pool	cells per ABIA	cells per eNB
5/10	2/2	4	8	48
15/20	2/2	3	6	36
5/10 and 15/20	2/2	3 or 4	6 or 8	40 (20+20)
5/10 and 15/20	4/4	3 or 4	6 or 8	40 (20+20)
5/10	4/4	4	8	48
15/20	4/4	3	6	36

3.1.3.2 Intra-eNB fixed UL CoMP capacity on AirScale

List of supported intra-eNB UL CoMP capacity and configurations on Nokia AirScale BTS

FDD configurations

With the introduction of the *LTE2733: Baseband Pooling* feature, the following intra-eNB UL Coordinated Multi-Point (CoMP) configurations are supported on FDD cells, introduced with the *LTE1402: Uplink Intra-eNB CoMP* and *LTE1691: Uplink intra-eNB CoMP 4RX* features.

A CoMP set consists of maximum 3 cells. The cells of an UL CoMP cell set must belong to one baseband (BB) pool, no matter if the baseband (BB) pooling is activated or not.

If UL CoMP set consisting of 3 cells each at 10 MHz at 2RX/2TX is activated, the following number of normal cells (not using UL CoMP) can be allocated to its BB pool:

- 3 normal 20 MHz cells at 2RX/2TX, or
- 3 normal 10 MHz cells at 2RX/2TX, or
- 3 normal 10 MHz cells at 4RX/4TX, or
- 1 normal 20 MHz cells at 4RX/4TX

If UL CoMP set consisting of 3 cells each at 20 MHz at 2RX/2TX is activated, the following number of normal cells can be allocated to its baseband pool:

- 3 normal 20 MHz cells at 2RX/2TX, or
- 3 normal 10 MHz cells at 2RX/2TX, or
- 3 normal 10 MHz cells at 4RX/4TX, or
- 1 normal 20 MHz cells at 4RX/4TX.

If the UL CoMP set consisting of 3 cells each at 10 MHz at 4RX/4TX is activated, the following number of normal cells can be allocated to its baseband pool:

- 3 normal 20 MHz cells at 2RX/2TX, or
- 1 normal 20 MHz cells at 4RX/4TX, or
- 3 normal 10 MHz cells at 2RX/2TX, or
- 3 normal 10 MHz cells at 4RX/4TX.

If the UL CoMP sets are activated without normal cells, the following combinations are allowed:

- 2 UL CoMP sets consisting of 3 cells each at 10 MHz at 2RX/2TX
- 2 UL CoMP sets consisting of 3 cells each at 20 MHz at 2RX/2TX
- 2 UL CoMP sets consisting of 3 cells each at 10 MHz at 4RX/4TX
- 1 UL CoMP set consisting of 3 cells each at 20 MHz at 4RX/4TX.

All available configurations are presented in the tables below:

Table 33: LTE1691 and LTE1402 configurations on AirScale in one BB pool (with BB pool activated)

UL CoMP cells	10 MHz 2RX/2TX	20 MHz 2RX/2TX	10 MHz 4RX/4TX	20 MHz 4RX/4TX
Normal cells				
-	2x 3 cells	2x 3 cells	2x 3 cells	3 cells
10MHz 2RX/2TX	3 cells + 3 cells	3 cells + 3 cells	3 cells + 3 cells	-
20MHz 2RX/2TX	3 cells + 3 cells	3 cells + 3 cells	3 cells + 3 cells	-
10MHz 4RX/4TX	3 cells + 3 cells	3 cells + 3 cells	3 cells + 3 cells	-
20MHz 4RX/4TX	1 cell + 3 cells	1 cell + 3 cells	1 cell + 3 cells	-

Note:

In the table above, a 20 MHz cell can be replaced by a 15 MHz cell and a 10 MHz cell can be replaced by a 5 MHz cell.

Table 34: LTE1691 and LTE1402 FDD configurations on half ABIA

5/ 10 MHz 2 RX/ 2 TX	15/ 20 MHz 2 RX/ 2 TX	5/ 10 MHz 4 RX/ 4 TX	15/20 MHz 4 RX/4 TX
3 cells	3 cells	2 cells	2 cells

TDD configurations

Table 35: LTE2128 TDD supported configurations in one BB pool

Configuration	8RX UL CoMP sets	8RX CoMP set with CA
ABIA	2 8RX CoMP sets with 2 cells	yes
	1 8RX CoMP set with 3 cells	yes
2 x ABIA	4 8RX CoMP sets with 2 cells	yes
	2 8RX CoMP sets with 3 cells	yes
3 x ABIA	6 8RX CoMP sets with 2 cells	yes
	4 8RX CoMP sets with 3 cells	yes

Table 36: LTE2104 TDD supported configurations in one BB pool (with BB pool activated)

Configuration	4RX UL CoMP sets	4RX CoMP set with CA
ABIA	3 4RX CoMP sets with 2 cells	yes
	2 4RX CoMP sets with 3 cells	yes
2 x ABIA	6 4RX CoMP sets with 2 cells	yes
	4 4RX CoMP sets with 3 cells	yes
3 x ABIA	9 4RX CoMP sets with 2 cells	yes
	6 4RX CoMP sets with 3 cells	yes

Table 37: LTE2104 TDD supported configurations in one BB pool (with BB pool deactivated)

Configuration	4RX UL CoMP sets	4RX CoMP set with CA
ABIA	2 4RX CoMP sets with 2 cells	yes
	1 4RX CoMP set with 3 cells	yes
2 x ABIA	4 4RX CoMP sets with 2 cells	yes
	2 4RX CoMP sets with 3 cells	yes
3 x ABIA	6 4RX CoMP sets with 2 cells	yes
	4 4RX CoMP sets with 3 cells	yes

Table 38: CB006754 TDD supported configurations in one BB pool (with BB pool activated)

Configuration	2RX UL CoMP sets	2RX CoMP set with CA
ABIA	3 2RX CoMP sets with 2 cells	yes
	2 2RX CoMP sets with 3 cells	yes
2 x ABIA	6 2RX CoMP sets with 2 cells	yes
	4 2RX CoMP sets with 3 cells	yes
3 x ABIA	9 2RX CoMP sets with 2 cells	yes
	6 2RX CoMP sets with 3 cells	yes

Table 39: CB006754 TDD supported configurations in one BB pool (with BB pool deactivated)

Configuration	2RX UL CoMP sets	2RX CoMP set with CA
ABIA	2 2RX CoMP sets with 2 cells	yes
	1 2RX CoMP set with 3 cells	yes
2 x ABIA	4 2RX CoMP sets with 2 cells	yes
	2 2RX CoMP sets with 3 cells	yes
3 x ABIA	6 2RX CoMP sets with 2 cells	yes
	4 2RX CoMP sets with 3 cells	yes

3.1.3.3 Intra-eNB fixed UL CoMP capacity on FSMF

List of available intra-eNB UL CoMP configurations on FSMF

The maximum number of cells and type of cells in a Coordinated Multi-Point (CoMP) set is limited by digital signal processor (DSP) capabilities. The tables below list supported type of CoMP cell and possibility of parallel activation of carrier aggregation (CA) on a given hardware configuration.

Table 40: LTE2128 TDD supported configurations

Configuration	8RX UL CoMP sets	8RX CoMP set with Carrier Aggregation
FSMF	Not supported	N/A
FSMF + 1 x FBBA	1 8RX CoMP set with 2 cells	No
FSMF + 2 x FBBA	1 8RX CoMP set with 2 or 3 cells	No
FSIH	1 8RX CoMP set with 2 or 3 cells	No
FSIH + 1 x FBIH	2 8RX CoMP sets with 2 or 3 cells	Yes
FSIH + 2 x FBIH	3 8RX CoMP sets with 2 or 3 cells	Yes

Table 41: LTE2104 TDD supported configurations

Configuration	4RX UL CoMP sets	4RX CoMP set with Carrier Aggregation
FSMF	1 4RX CoMP set with 2 cells	No
FSMF + 1 x FBBA	1 4RX CoMP set with 2 or 3 cells	No
	2 4RX CoMP set with 2 cells	Yes
FSMF + 2 x FBBA	all FSMF + 1 x FBBA configurations	Yes
	2 4RX CoMP set with 2 or 3 cells	Yes

Table 42: LTE1691 and LTE1402 FDD supported configurations

HW configuration	TX/RX	DL MIMO	Bandwidth	Number of CoMP cells
one BB card (FSMF or FBBA or FBBC)	2TX/2RX	2 x 2	5 / 10 MHz	6
one BB card (FSMF or FBBA or FBBC)	2TX/2RX	2 x 2	15 / 20 MHz	3
two BB cards (FSMF+FBBA or FSMF +FBBC)	4TX/4RX	4 x 4, 4 x 2	5 / 10 / 15 / 20 MHz	3
two BB cards (FSMF+FBBA or FSMF +FBBC)	2TX/4RX	2 x 2	5 / 10 / 15 / 20 MHz	3

Note:

When 2 x 4 RX cells of an UL CoMP cell set, it needs two BB cards (FSMF + FBBA or FSMF + FBBC) and the maximum cell number is 3.

Table 43: LTE1402 TDD supported configurations

HW Configuration	TX/RX	DL MIMO	Bandwidth	Number of CoMP cells
one BB card (FSMF or FBBA or FBBC)	2TX/2RX	2 x 2	10 / 15 / 20 MHz	3
one BB card (FSIH or FBIH)	2TX/2RX	2 x 2	10 / 15 / 20 MHz	3

Table 44: LTE1691 TDD supported configurations

Configuration	4RX UL CoMP sets	4RX CoMP set with Carrier Aggregation
FSMF	1 4RX CoMP set with 2 cells	No
FSMF + 1 x FBBA	1 4RX CoMP set with 2 or 3 cell	No
FSMF + 2 x FBBA	1 4RX CoMP set with 2 or 3 cell	No
FSIH	1 4RX CoMP set with 2 or 3 cells	No
FSIH + 1 x FBIH	2 4RX CoMP sets with 2 or 3 cells	Yes
FSIH + 2 x FBIH	3 4RX CoMP sets with 2 or 3 cells	Yes

3.1.4 NB IoT cell capacity

NB-IoT cell capacity

3.1.4.1 NB-IoT cell capacity for AirScale

Details on the AirScale cell capacity values per release

NB-IoT guard band/inband

Table 45: Cell capacity per pool (half ABIA)– guard band and inband with anchor carrier (LTE5205 and LTE5393)

Cell bandwidth	Antenna configuration	Number of LTE host cells	Number of NB-IoT cells
5/10 MHz	2RX	6	6
15/20 MHz	2RX	3	3
5/10 MHz	4RX	4	4
15/20 MHz	4RX	3	3

Note:

The *LTE5393* feature supports only the 15/20 MHz 4RX configuration.

Note:

NB-IoT guard band isn't supported in 5 MHz cells.

In addition, the following specific configuration is supported: 4RX, 2 * 20 MHz LTE host cells + 2 * NB-IoT cells + 10 MHz LTE cell per pool.

Table 46: Cell capacity per pool (half ABIA) – guard band and inband with anchor carrier and legacy UL CoMP (LTE5268 and LTE5393)

Cell bandwidth	Antenna configuration	Number of LTE host cells	Number of NB-IoT cells
5/10 MHz	2RX	3	3
15/20 MHz	2RX	3	3
5/10 MHz	4RX	3	3
15/20 MHz	4RX	3	3

Note:

NB-IoT guard band isn't supported in 5 MHz cells.

Table 47: Cell capacity per pool (half ABIA)– guard band and inband with anchor carrier and non-anchor carrier (LTE4036)

Cell bandwidth	Antenna configuration	Number of LTE host cells	Number of NB-IoT carriers
5/10 MHz	2RX	6	6
15/20 MHz	2RX	3	6
5/10 MHz	4RX	4	4
15/20 MHz	4RX	2	4

Note:

NB-IoT guard band isn't supported in 5 MHz cells.

Table 48: Cell capacity per pool (half ABIA)– guard band and inband with anchor carrier, non-anchor carrier, and fixed UL CoMP (LTE4036)

Cell bandwidth	Antenna configuration	Number of LTE host cells	Number of NB-IoT cells
5/10 MHz	2RX	3	6
15/20 MHz	2RX	3	6
5/10 MHz	4RX	3	4

Note:

NB-IoT guard band isn't supported in 5 MHz cells.

Table 49: Cell capacity per pool (half ABIA)– guard band and inband with anchor carrier, non-anchor carrier, and legacy UL CoMP (LTE4898)

Cell bandwidth	Antenna configuration	Number of LTE host cells	Number of NB-IoT carriers
5/10 MHz	4RX	3	4

Table 50: Cell capacity per pool (half ABIA) – inband in 3 MHz cell (LTE4196)

Cell bandwidth	Antenna configuration	Number of LTE host cells	Number of NB-IoT cells
3 MHz	2RX	4	4
3 MHz	4RX	3	3

Note:

The baseband (BB) pooling functionality isn't supported in 3 MHz cell.

Table 51: Cell capacity per ABIA – guard band and inband with anchor carrier and non-anchor carrier and flexible UL CoMP (LTE5329)

Number of BB pools	Cell bandwidth	Antenna configuration	Number of LTE host cells at Band A	Number of NB-IoT carriers	Number of wideband cells at Band B
1	5/10 MHz	4RX	2	4	1
2	5/10 MHz	4RX	1	2	2

Note:

NB-IoT guard band isn't supported in 5 MHz cells.

NB-IoT standalone

Table 52: Cell capacity per pool (half ABIA) – standalone (LTE3667)

Antenna configuration	Number of NB-IoT cells
2RX	8
4RX	4

Mixed NB-IoT configurations

In a two antenna configuration, the maximum number of wideband cells (cells with or without inband NB-IoT cells) and standalone NB-IoT cells is limited to 6 cells for 10 MHz or 3 cells for 20 MHz per BB pool. The total number of NB-IoT carriers is limited to six. For a four antenna configuration, the maximum number of wideband cells (cells with or without inband NB-IoT cells) and standalone NB-IoT cells is limited to 4 cells for 10 MHz or 3 cells for 20 MHz per BB pool. The total number of NB-IoT carriers is limited to four.

Table 53: Cell capacity per pool (half ABIA): mixed NB-IoT configurations

Cell bandwidth	Antenna configuration	Number of LTE host cells	Number of NB-IoT cells (guard-band or inband)
10 MHz	2RX2TR or 2RX1TX	6	6
20 MHz		3	3
10 MHz	4RX2TX or 4RX4TX	4	4
20 MHz		3	3

A wideband cell (cells with or without NB-IoT inband cells) can be replaced by one standalone cell with the same number of antennas.

3.1.4.2 NB-IoT Cell Capacity for FSMF

Details on the FSMF cell capacity values per release

NB-IoT guard band/inband

Table 54: Cell capacity per HW board – guard band (LTE4499, LTE3570)

HW board	Cell bandwidth	Antenna configuratio n	Number of LTE host cells	Number of NB-IoT cells
FSMF or FBBA / FBBC	10 MHz	2RX	3	3
FSMF or FBBA / FBBC	15/20 MHz	2RX	3	3
FSMF or FBBA / FBBC	10 MHz	4RX	3	3
FSMF and FBBA / FBBC *	15/20 MHz	4RX	3	3

Note:

NB-IoT guard band isn't supported in 5 MHz cells.

Note:

* Two HW boards are needed.

Table 55: Cell capacity per HW board – inband (LTE3071) and inband in 3 MHz cell (LTE4196)

HW board	Cell bandwidth	Antenna configuratio n	Number of LTE host cells	Number of NB-IoT cells
FSMF or FBBA / FBBC	5/10 MHz	2RX	3	3
FSMF or FBBA / FBBC	15/20 MHz	2RX	3	3
FSMF or FBBA / FBBC	5/10 MHz	4RX	3	3
FSMF and FBBA / FBBC *	15/20 MHz	4RX	3	3
FSMF or FBBA / FBBC	3 MHz	2RX	3	3
FSMF or FBBA / FBBC	3 MHz	4RX	3	3

Note:

- * Two HW boards are needed.
- Only anchor carrier is supported in 3MHz host cells

Table 56: Cell capacity per HW board – guard band and inband, with anchor carrier and legacy UL CoMP (LTE5268)

HW board	Cell bandwidth	Antenna configuration	Number of LTE host cells	Number of NB-IoT cells
FSMF or FBBA / FBBC	15/20 MHz	2RX	3	3

NB-IoT standalone

Table 57: Cell capacity per HW board – standalone (LTE3543)

HW board	Antenna configuration	Number of NB-IoT cells
FSMF or FBBA / FBBC	2RX	6
FSMF or FBBA / FBBC	4RX	3

Table 58: Cell capacity per HW board - standalone and legacy UL ComP (LTE4819)

HW board	Cell Bandwidth	Antenna configuration	Number of LTE cells	Number of NB-IoT cells
FSMF + FBBC	5/10 MHz	2TX4RX	3	3

3.1.5 Carrier Aggregation dimensioning for site configuration

Carrier Aggregation (CA) dimensioning values for site configuration

The aim of CA is to boost mean and peak user throughput by sending user data simultaneously over two or three carriers. To make the aggregation of carriers possible, a regular cell (primary cell (PCell)) is paired with an additional logical cell (secondary cell (SCell)) which overlaps the same site sector.

Table 59: SRIO-based (FSMF) LTE FDD and TDD inter-eNB CA configuration dimensioning

FDD eNB HW resource	LTE FDD PCell number	LTE TDD Scell bandwitdh
FSMF / FBBC (one FSP)	3* 10 MHz 2TX/2RX	90 MHz two layers
FSMF + FBBC / FBBA (two FSPs)	3 * 20 MHz 2TX/2RX or 2TX/4RX 3 * 10 MHz 4Tx4Rx 6 * 10 MHz 2Tx2Rx	120 MHz two layers
FSMF + FBBC / FBBA + FBBC (three FSPs)	3 * 20 MHz 4TX/4RX with 4 * 4 MIMO Two times following with two layers • 3 * 20 MHz 2TX/2RX or 2Tx4Rx • 3 * 10 MHz 4TX/4RX • 6 * 10 MHz 2TX/2RX	120 MHz two layers

Note:

- A 2TX/2RX cell can be replaced by a 1TX/2RX with the same cell bandwidth.
- Each LTE-FDD PCell can host one Narrowband IoT (NB IoT) inband or guardband. CAT-M can be added, without restrictions in terms of site configuration (legacy performance such as capacity and throughput is degraded accordingly).
- For more information, see *NB- IoT cell capacity for FSMF*.

Note:

For more information, see the *LTE2270: LTE TDD+FDD Inter eNB CA Basic BTS Configurations* feature description in the *Operating Documentation/Single RAN Features*.

Table 60: X2-based (AirScale) LTE FDD and TDD inter-eNB CA configuration dimensioning

Cell type	Supported number of cells per packed cell set with the *LTE3022/LTE4537*	Supported number of cells per packed cell set with the *LTE5425*
20 MHz 4Ant	2	2
10 MHz 4Ant	3	4
20 MHz 2Ant	3	4
10 MHz 2Ant	6	8
1 * 10 MHz + 2 * 20 MHz 4Ant	N/A	3
10 / 20 MHz mMIMO	N/A	2

Note:

- *LTE3022/SR001419: Inter-site Carrier Aggregation* only does post-checks. Cross-ABIA configurations are not supported. For more information, see the *LTE3022/SR001419: Inter-site Carrier Aggregation* feature description.
- Each LTE-FDD Pcell can host one NB-IoT inband or guardband. CAT-M can be added, without restrictions. For more information, see *NB-IoT cell capacity for AirScale*.

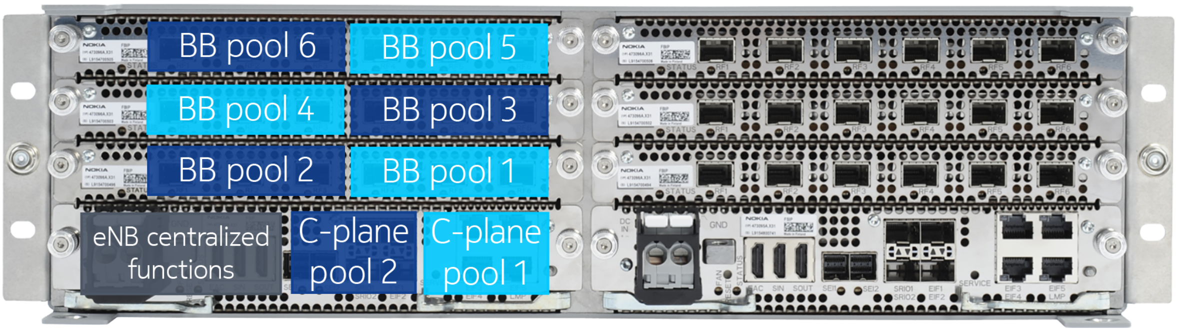
3.1.6 C-plane pool dimensioning

Overview of C-plane pool dimensioning for the AirScale system module, ABIA card BB pool mapping to an ASIA/ASIB C-plane pool, C-plane pool capacity, C-plane events, and C-plane pool balancing during normal load and heavy load.

BB to C-plane pool allocation for ASIA/ASIB/ASIL + ABIA configurations only

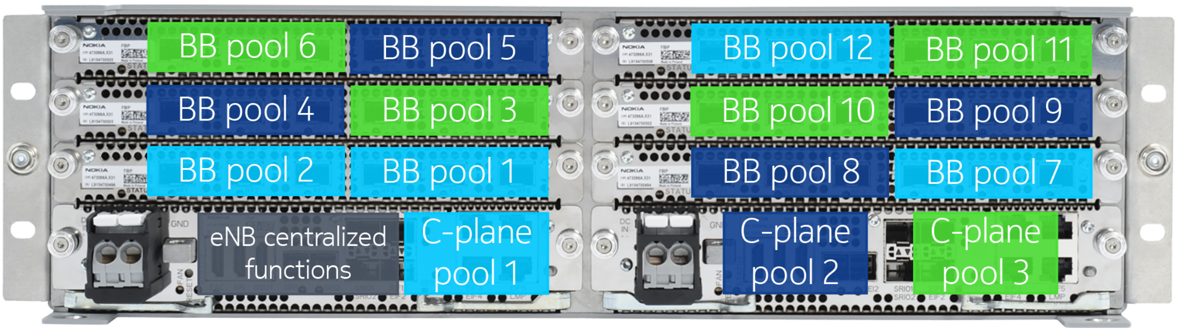
The following figure describe the method of distributing BB pools over C-plane pools in half subrack configurations.

Figure 14: Half subrack configuration



The following figure describe the method of distributing BB pools over C-plane pools in full subrack configurations.

Figure 15: Full subrack configuration



C-plane SW deployments:

- Two C-plane pools per half subrack
- Three C-plane pools per full subrack

The C-plane pool supports:

- 250 to 300 events per pool in half rack ASIA
- 300 to 400 events per pool in full rack ASIA
- 425 to 510 events per pool in half rack ASIB/ASIL
- 510 to 680 events per pool in full rack ASIB/ASIL

Note:

For more information about C-plane pool deployment from previous releases, see the *Baseband Pooling* document in Single RAN Operating Documentation.

C-plane pools and BB pools from SRAN 20B

With the *LTE5582: Optimized C-Plane Pool per ASIA/ASIB* feature activated, a new method of distributing BB pools over C-plane pools is enabled.

From SRAN 21B, support for ASIL is also added.

The features introducing this support work only for ASIA/ASIB/ASIL + ABIA configuration.

Figure 16: Half subrack configuration

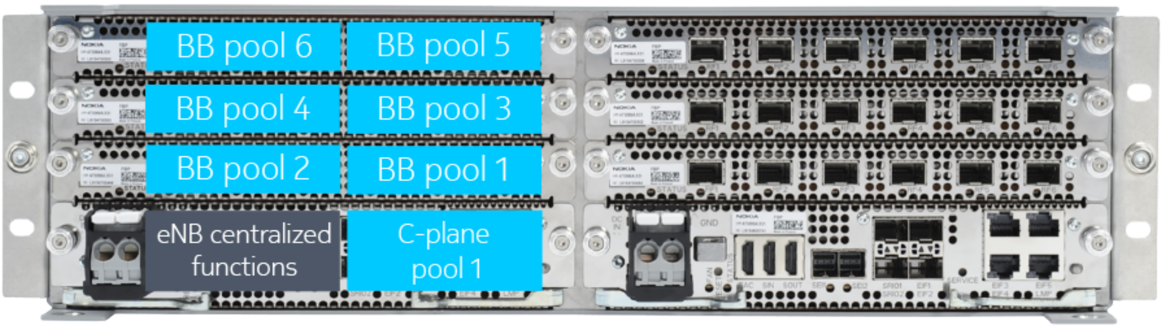
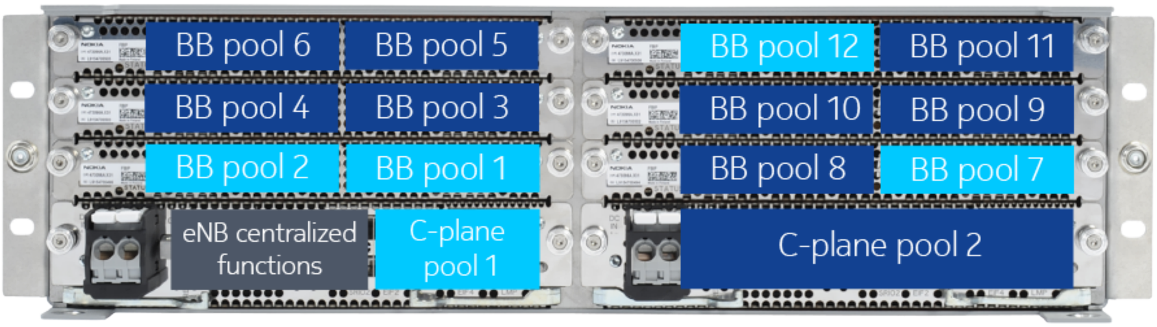


Figure 17: Full subrack configuration



C-plane SW deployments:

- Single C-plane pool per half subrack. Two C-plane pools are replaced by a single C-plane pool.
- Two C-plane pools per full subrack. No changes on the primary ASIA/ASIB and on the secondary ASIA/ASIB. Two C-plane pools are replaced by a single C-plane pool.

The C-plane pool supports the following:

- 850 events per C-plane pool 1 in half rack ASIA
- 300 to 400 events per C-plane pool 1, 600 to 800 events per C-plane pool 2 in full rack ASIA
- 850 to 1020 events per C-plane pool 1 in half rack ASIB/ASIL

- 510 to 680 events per C-plane pool 1, 1020 to 1360 events per C-plane pool 2 in full rack ASIB/ASIL

C-plane pools and BB pools from SRAN 21A for ABIO/ABIN configurations only

C-plane SW deployments:

- Each ABIO or ABIN has its own distributed C-plane pool on the BB card.
- The centralized C-plane is located in the primary ASIB

As a result, the C-plane capacity in terms of transactions per second for the BTS increases, by adding new ABIN/ABIO boards. The capacity of the remaining centralized C-plane components is sufficient to serve all distributed C-plane pools of the BTS.

The C-plane pool supports the following:

- Maximum 550 events per distributed C-plane pool
- Maximum 4208 events per centralized C-plane on ASIB (each distributed C-plane event uses 1 centralized C-plane event)

C-plane pools and BB pools from SRAN 21B for ABIO/ABIN configurations only

C-plane SW deployments:

- Each ABIN or ABIO has its own distributed C-plane pool on the BB card.
- The centralized C-plane is located in the primary ASIB/ASIL.

> **Note:**
>
> ASIL is supported from SRAN 21B onward.

As a result, the C-plane capacity in terms of transactions per second for the BTS increases, by adding new ABIN/ABIO boards. The capacity of the remaining centralized C-plane components is sufficient to serve all distributed C-plane pools of the BTS.

The C-plane pool supports the following:

- Maximum 700 events per distributed C-plane pool
- Maximum 4208 events per centralized C-plane on ASIB/ASIL (each distributed C-plane event uses 1 centralized C-plane event)

C-plane pools and capacity for ABIA configurations only

An ASIA/ASIB/ASIL contains up to two C-plane pools and all the cells are assigned to one of the pools.

There are two different types of C-plane capacity:

- Static C-plane capacity, represented by the number of RRC connected UEs, and equal to the U-plane capacity in terms of connected UEs
- Dynamic C-plane capacity, represented by the number of events (such as call setup, handover, and so on) per second, depending on the field situation:
  - With the *LTE5582* feature disabled
    - 250 to 300 events per pool in half rack ASIA
    - 300 to 400 events per pool in full rack ASIA
    - 425 to 510 events per pool in half rack ASIB/ASIL
    - 510 to 680 events per pool in full rack ASIB/ASIL
  - With the *LTE5582* feature enabled
    - 500 to 600 events per C-plane pool 1 in half rack ASIA
    - 300 to 400 events per C-plane pool 1, 600 to 800 events per C-plane pool 2 in full rack for ASIA
    - 850 to 1020 events per C-plane pool 1 in half rack ASIB/ASIL
    - 510 to 680 events per C-plane pool 1, 1020 to 1360 events per C-plane pool 2 in full rack for ASIB/ASIL

C-plane events at cell level and eNB level

The following figure shows C-plane events calculation methods at cell level.

Figure 18: C-plane events calculation methods at cell level

$$\text{UE state transition per second} = \frac{\text{M8013C18} + \text{M8013C19} + \text{M8013C13}}{\text{MEASUREMENT\_DURATION} \times 60}$$

$$\text{Bearer adds/deletes per second} = \frac{2 \times (\text{M8006C197} + \text{M8006C198} + \text{M8006C199} + \text{M8006C200} + \text{M8006C201} + \text{M8006C202} + \text{M8006C203} + \text{M8006C204} + \text{M8006C205})}{\text{MEASUREMENT\_DURATION} \times 60}$$

$$\text{Number of handovers per second} = \frac{\text{M8009C7} + 2 \times (\text{M8014C19} + \text{M8014C7})}{\text{MEASUREMENT\_DURATION} \times 60}$$

$$\text{Number of tracking area updates per second} = \frac{\text{M8013C17} - 2 \times \text{M8013C10}}{\text{MEASUREMENT\_DURATION} \times 60}$$

$$\text{Attach or detach per second} = \frac{2 \times \text{M8013C10}}{\text{MEASUREMENT\_DURATION} \times 60}$$

$$\text{Carrier aggregation configuration/deconfiguration} = \frac{\text{M8011C67} + \text{M8011C213}}{\text{MEASUREMENT\_DURATION} \times 60}$$

The following figure shows C-plane events calculation methods at cell level.

Figure 19: C-plane events calculation method at eNB level

$$\text{Paging (per eNB level)} = \frac{\text{M8000C11}}{\text{MEASUREMENT\_DURATION} \times 60}$$

Note:

The C-plane capacity modeled by the key C-plane event frequency is only an approximation, it isn't so comprehensive to capture the impact from every single C-plane event (failure cases aren't included, for example). The key driver events and their frequency are deployment and operator dependent, and traffic mixture varies from market to market.

Note:

- Paging events take place at eNB level and apply to all C-plane pools.
- MEASUREMENT_DURATION represents the performance measurement (PM) interval length and is typically 15 minutes. The sum of the Figure: C-plane events calculation methods at cell level and Figure: C-plane events calculation method at eNB level provides the number of events per second.
- Performance counter measurements provide an average view for a 15-minute window. Peak behavior is not captured.

C-plane additional events

As deployment increases, the C-plane capacity may be impacted by events related to:

- LTE-M
- NB-IoT
- EN-DC

Figure 20: Impact of events related to LTE-M on C-plane capacity

$$\text{LTE} - \text{M state transition} = \frac{2 \times \text{M8061C24}}{\text{MEASUREMENT\_DURATION} \times 60}$$

$$\text{LTE} - \text{M paging} = \frac{\text{M8061C59}}{\text{MEASUREMENT\_DURATION} \times 60}$$

Figure 21: Impact of events related to NB-IoT on C-plane capacity

$$\text{NB} - \text{IoT state transition} = \frac{(\text{M8200C43} + \text{M8200C45} + \text{M8200C46}) + (\text{M8201C3} + \text{M8201C4} + \text{M8201C5}) + (\text{M8201C6} + \text{M8201C7} + \text{M8201C8})}{\text{MEASUREMENT\_DURATION} \times 60}$$

$$\text{NB} - \text{IoT paging} = \frac{\text{M8066C20}}{\text{MEASUREMENT\_DURATION} \times 60}$$

Figure 22: Impact of events related to EN-DC on C-plane capacity

$$\text{Split bearer addition} = \frac{\text{M8080C34}}{\text{MEASUREMENT\_DURATION} \times 60}$$

$$\text{Split bearer release} = \frac{\text{M8080C45} + \text{M8080C47}}{\text{MEASUREMENT\_DURATION} \times 60}$$

> **Note:**
>
> Paging events take place at eNB level and apply to all C-plane pools.

C-plane pool allocation

Allocation of BB pools to C-plane pools is an internal eNB function that the operator cannot control, with the following exceptions:

- The load of the C-plane pools can be optimized in terms of the number of RRC connected or active users and C-plane transactions per second.
- The system can be tuned based on the operator needs. It is possible to allocate cells to dedicated BB or C-plane pools, or both, for public safety users, or to allocate strategic cells (for example, to provide radio coverage) to the most resilient BB and C-plane pools.

If the cell allocation to BB pools is not optimized, or the BB pools with a higher number of cells are mapped to the same C-plane pool, this may exceed the C-plane capacity. The *LTE1047: Control Plane Overload Handling* feature works as a defense mechanism when the C-plane overloads, to maintain product stability. Proactive features, including Access Class Barring (ACB) (such as *LTE1788: Automatic Access Class Barring*, *LTE1047: Control Plane Overload Handling* and *LTE1047: Control Plane Overload Handling*), should be deployed for load management.

> **Note:**
>
> For more information, see the *Baseband Pooling* document in Single RAN Operating Documentation.

C-plane pools and BB pools (mass event traffic)

Recommended actions in case of mass event traffic:

- ACB features (such as *LTE1788: Automatic Access Class Barring* and *LTE1047: Control Plane Overload Handling*) should be used to prevent overload.
- If a high load or a mass event is expected, the traffic should be balanced between available C-plane pools, so that no single C-plane pool carries too high of a traffic load. This can be done by assigning cells to BB pools mapped to C-plane pools. The assignment can be done either through priority allocation or manual allocation.
- The C-plane capacity can be increased through one of the following methods:
  - Balance the C-plane load via two ASIA/ASIB/ASIL full racks.
  - Activate the *LTE5582: Optimized C-Plane Pool per ASIA/ASIB* feature.
  - Use ASIB/ASIL instead of ASIA, which has 1.7 * ASIA C-plane capacity.

3.1.7 eNB traffic models

Types of supported eNB traffic models

3.1.7.1 AirScale traffic model

The number of control plane (C-plane) events per second supported by AirScale

Table 61: Traffic model for ASIB/ASIL + ABIN/ABIO configuration

C-plane event	Number of events per second
UE state transitions	302
bearer / addition / release	4
handovers	51
timing advance (TA) updates	15
paging at S1	178
attach / detach	6
carrier aggregation (CA) configure / deconfigure	115

Table 62: Traffic model for ASIB/ASIL + 3 ABIN/ABIO configuration

C-plane event	Number of events per second
UE state transitions	903
bearer / addition / release	12
handovers	153
TA updates	45
paging at S1	534
attach /detach	18
CA configure / deconfigure	345

Table 63: Traffic model for ASIB/ASIL + 6 ABIO/ABIN configuration

C-plane event	Number of events per second
UE state transitions	1810
bearer / addition / release	23
handovers	305
TA updates	92
paging at S1	1069
attach / detach	38
CA configure / deconfigure	687

Table 64: Traffic model for 1x ASIA configuration

C-plane event	Number of events per second
UE state transitions	365
bearer / addition / release	5
handovers	61
TA updates	18
paging at S1	216
attach / detach	7
CA configure / deconfigure	140

Note:

Table: Traffic model for 1x ASIA configuration presents the capacity for one ASIA. A full rack capacity is two times that of a half rack, while the ASIB/ASIL capacity is 1.7 times that of ASIA.

A conventional ASIA deployment contains twice as many C-plane pools, each rated at 300 events per second. Table: Traffic model for 1x ASIA configuration presents the traffic intensity beyond the rated capacity set to accommodate instantaneous traffic variation.

3.1.7.2 Flexi Multiradio 10 eNB traffic model

The amount of C-plane events per sec supported by Flexi Multiradio 10

Table 65: Flexi Multiradio 10 eNB Traffic model

C-plane event	Number of events per second
Ue State Transitions	88.6
Bearer Addition/Release	6.6
Handovers	31.7
TA Updates	37.9
Paging at S1	44.3
Attach/Detach	0.2

- eNB C-plane capacity is measured by call processing event per sec
- Flexi Multiradio 10 supports up to 200 C-plane events per sec as defined by above traffic model
  - FSMF + FBBx supports up to 400 C-plane events
  - FSMF + 2 x FBBx supports up to 600 C-plane events

3.2 WCDMA baseband dimensioning in SBTS

Flexi 10 BTS System Module and AirScale Indoor System Module baseband dimensioning

3.2.1 Fundamentals of Flexi Multiradio 10 BTS baseband dimensioning

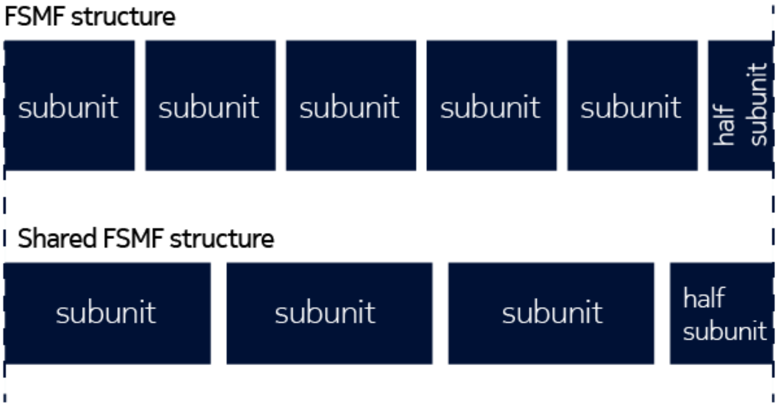
Number of subunits available in Flexi Multiradio 10 BTS system module. Impact of different factors on FSMF baseband capacity.

Baseband capacity

Flexi Multiradio 10 BTS provides up to 18 cell capacity with two-way RX Div in single FSMF and nine cell capacity with four-way RX Div. The output power options are 8/ 15/ 20/ 30/ 40/ 60 W or 80 W, depending on the RF module.

Baseband capacity is represented by subunits. One subunit in an FSMF has a capacity of 96 channel elements (CEs) from Release 99 (Rel.99). The FSMF has 5.5 subunits. In case the FSMF is shared between technologies (WCDMA and GSM on one system module), the number of available subunits is 3.5.

Figure 23: FSMF capacity for WCDMA



FBBA/C has six subunits.

Subunits are used for processing:

- Common Control Channel
- Rel.99 traffic
- HSDPA cells, users, and throughput
- HSUPA users and throughput

Table 66: Number of subunits available for WCDMA in FSMF and FBBA/C extension baseband cards

FSMF	FBBA/C	FBBA/C	Number of subunits available for WCDMA
WCDMA	-	-	5.5
WCDMA	WCDMA	-	11.5
WCDMA	WCDMA	WCDMA	17.5
WCDMA/GSM	-	-	3.5
WCDMA/GSM	WCDMA	-	9.5
WCDMA/GSM	WCDMA	WCDMA	15.5
WCDMA	LTE	LTE	5.5
WCDMA	LTE	WCDMA	11.5
WCDMA/GSM	LTE	LTE	3.5
WCDMA/GSM	LTE	WCDMA	9.5
LTE/GSM	LTE	WCDMA	5.5

Flexi 10 BTS System Module available capacity

The Flexi 10 BTS system module capacity can be extended with up to two extension baseband cards (FBBA/C), which are optional. FSMF and with up to two FBBA/C extension baseband cards are one pool of common baseband resources for traffic processing, unless local cell grouping is used. In the last case, each local cell group (LCG) is a pool of baseband resources for traffic processing from LCG cells.

Table 67: Number of subunits available in Flexi 10 BTS system module

Flexi 10 BTS system module	Extension baseband cards	Number of subunits
FSMF	-	5.5
FSMF	FBBA	11.5
FSMF	FBBA + FBBA	17.5

The system module baseband capacity available for traffic may be further impacted by the following:

- Additional CCCH resources
- Local cell group HSPA settings
- HSDPA subunits
- Number of activated interference cancellation units (PIC pools)
- Number of local cell groups with the *RAN3374: Narrowband Interference Cancellation* (NBIC) feature activated
- Number of local cell groups with at least one cell that has either *SR002014: SRAN Dynamic Spectrum Sharing GSM+WCDMA* feature or *SR002167: Dynamic Spectrum Sharing WCDMA+LTE* feature activated
- Static HSUPA allocation
- Static high-speed forward access channel (HS-FACH) allocation

> **Note:**
>
> For more information about dynamic spectrum sharing (DSS), see the following documents:
>
> - *Operating Documentation/Single RAN Features/GSM-WCDMA Dynamic Spectrum Sharing Features*
> - *Operating Documentation/Single RAN Features/WCDMA-LTE Dynamic Spectrum Sharing Features*
> - *Operating Documentation/5G Features/LTE-NR Dynamic Spectrum Sharing Features*

The available baseband capacity (subunits) for traffic usage after the activation of HSDPA, PIC, NBIC and DSS after the allocation of static HSUPA, or additional CCCH resources can be calculated using the formula below:

Figure 24: Number of available subunits

$$\text{Number of available subunits} = \text{number\_of\_subunits} - \text{HSDPA\_subunits} - \text{subunits\_for\_PIC\_pool} - \text{subunits\_for\_NBIC} - \text{subunits\_for\_static\_HSUPA} - \text{subunits\_for\_additional\_CCCH} - \text{subunits\_for\_HS\_FACH}$$

where:

Number_of_available_subunits	subunits initially available for user traffic in the system module. The number is based on Table: Number of subunits available for WCDMA in FSMF and FBBA/C extension baseband cards and Table: Number of subunits available in Flexi 10 BTS system module
subunits_for_PIC_pool	number of commissioned interference cancellation subunits

subunits_for_NBIC	number of subunits for NBIC
subunits_for_DSS	number of subunits for DSS
subunits_for_static_HSUPA	number of HSUPA static commissioned subunits
subunits_for_additional_CCCH	number of subunits allocated for additional CCCH processing (CCCH pools)
subunits_for_HS_FACH	number of subunits statically allocated for HS-FACH users

> **Note:**
> The SBTS does not have installed physical LKs. Instead, these are handled by the Operations Support System (OSS).

Available subunits (pure traffic subunits) can be used for Rel.99 dedicated channel (DCH) users, HSDPA users (Associated DCH (A-DCH)/signaling radio bearer(SRB)), and HSUPA users (HSUPA scheduler).

Figure 25: Example presenting an FSMF, one normal HSPA LCG, 12 HSPA cells and one interference cancelation unit

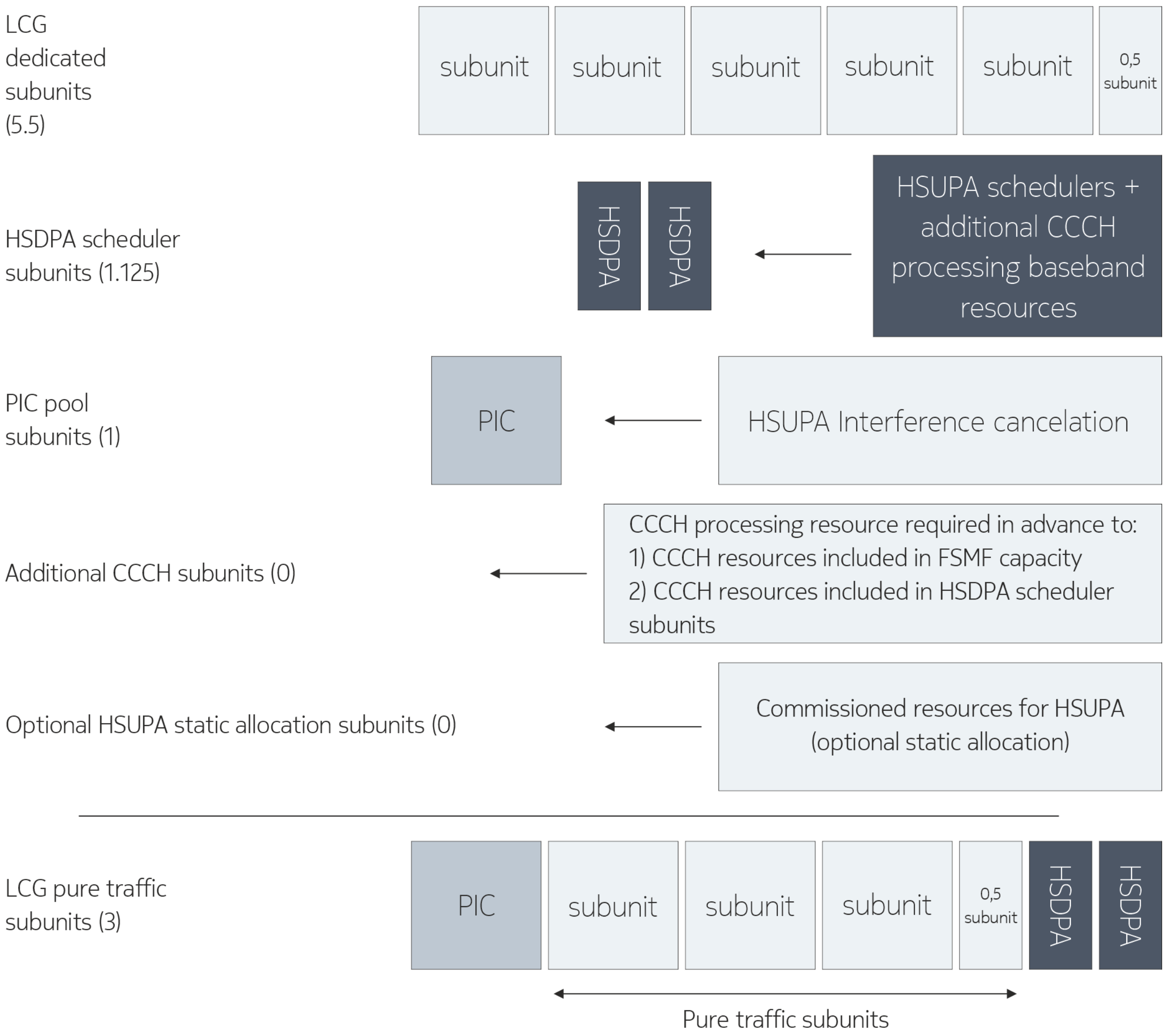


Table 68: Number of subunits available per SBTS with one FSMF with single LCG

HSPA settings per LCG	FSMF	FSMF + FBBA	FSMF + 2xFBBA
Rel.99 only	5.5	11.5	17.5
Small HSPA	4.875	10.875	16.875
Normal HSPA	4.375	10.375	16.375

Table 69: Number of HSDPA subunits required for the second and every next LCG

HSPA settings per LCG	HSDPA subunits
Rel.99 only	0 subunit
Small HSPA	0.625 subunit
Normal HSPA	1.125 subunit

> **Note:**
> 0.5 subunit must be added to the presented figures for CCCH processing. Each LCG requires CCCH resources.

Rel.99 CE system module capacity

The available baseband capacity referred to in Rel.99 CEs after the activation of HSDPA and PIC, and after the allocation of static HSUPA or the additional CCCH resources, can be calculated using the formula below:

Figure 26: System Module Rel.99 CE capacity

$$\text{System\_module\_Rel99\_CE\_capacity} = \text{Min}\,(\text{\#commissioned\_Rel99\_CEs};\ \text{Rel99\_CE\_subunit\_capacity} \times \text{Number\_of\_available\_subunits})$$

where:

#commissioned_Rel.99_CEs	number of available Rel.99 CE licenses
Rel.99_CE_subunit_capacity	Rel.99 CE subunit capacity
number_of_available_subunits	subunits available after activation of HSDPA, PIC, NBIC, and after allocation of static HSUPA or additional CCCH resources. The value is based on Table: Number of subunits available per SBTS with one FSMF with single LCG and Table: Number of HSDPA subunits required for the second and every next LCG

As far as Rel.99 CE capacity is concerned, the FSMF subunit has 96 Rel.99 CEs.

3.2.2 Fundamentals of Nokia AirScale BTS baseband dimensioning

Capacity obtained due to different Nokia AirScale system module hardware configuration

AirScale system module baseband capacity

A single Nokia AirScale BTS supports up to 24 cells with two-way RX Diversity (Div) and 12 with four-way RX Div.

The available AirScale Indoor System Module WCDMA baseband resources can be split into independent baseband (BB) pools called local cell groups (LCG).

The LCG is a pool of baseband resources dedicated for traffic and Common Control Channels (CCCH) processing from the respective cells. The `WNCELG` `Access Baseband Capacity` (`accessBbCapacity`) parameter is used to define the LCG baseband capacity. The available system module baseband capacity can be split into a number of LCGs.

Each LCG supports up to 12 two-way RX Div cells and six four-way RX Div. Up to four LCGs can be created during SBTS commissioning. Another LCG is created when the number of cells is higher than 12, or more HSPA schedulers are needed (each LCG has its own HSUPA and HSDPA schedulers). More than one LCG is used in the Multi-Operator RAN (MORAN) case.

With the SRAN 18 SP release, the Nokia AirScale BTS can use one ASIA card and up to three ABIA cards. With the introduction of the *SR001621: SRAN cell sets allocation on full AirScale module* feature in the SRAN 17A maintenance package, the Nokia AirScale BTS supports two ASIA cards and up to six ABIA cards a single SBTS. WCDMA does not support baseband pooling between the half subracks since the baseband resources are not shared between cores.

In case WCDMA related RF units are connected to two ABIAs (for example, when the *SR002075: Support for Configuration with WCDMA Radio Modules Connected to Two ABIAs* feature is used) within one half-subrack of an AirScale system module, there is a limitation on the number of WCDMA cells configured in the RF units connected to these two ABIAs. There can be up to 16 (two-way RX Div) WCDMA cells configured on each RF unit (with WCDMA cells) connected to those two ABIAs. Still, a maximum of 24 WCDMA cells (two-way RX Div) is supported for whole SBTS.

The WCDMA baseband capacity is represented by subunits. Each ABIA card provides a capacity of eight subunits.

Table 70: WCDMA capacity correspondence with AirScale Indoor System Module HW configuration

HW configuration	WCDMA capacity
1 x ASIA + 1 x ABIA	8 subunits
1 x ASIA + 2 x ABIA	16 subunits
1 x ASIA + 3 x ABIA	24 subunits
2 x ASIA + 4 x ABIA	32 subunits
2 x ASIA + 5 x ABIA	40 subunits
2 x ASIA + 6 x ABIA	48 subunits

Subunits are used for processing:
- Common Control Channel (CCCH)
- Release 99 (Rel.99) traffic
- HSDPA cells, users, and throughput
- HSUPA cells, users, and throughput
- Interference cancelation (parallel interference cancelation (PIC) pool allocation)

The LCG baseband capacity is configured during the SBTS commissioning. The smallest LCG size is of four subunits (half ABIA card), while the maximum size is 24 subunits (three ABIA cards), located in the same half subrack. The LCG baseband capacity is configurable with two subunits per step.

Each LCG has statically allocated baseband resources, while the remaining part is used for dynamic traffic allocation (Rel.99, high-speed uplink packet access (HSUPA) users, and HSUPA throughput).

The LCG baseband capacity available for traffic can be further impacted by the following:
- Additional CCCH resources
- High-speed downlink packet access (HSDPA) scheduler resources
- The number of activated interference cancellation units (PIC pools)
- The number of local cell groups with the *RAN3374: Narrowband Interference Cancellation* feature activated
- The number of local cell groups with at least one cell that has either *SR002014: SRAN Dynamic Spectrum Sharing GSM+WCDMA* feature or *SR002167: Dynamic Spectrum Sharing WCDMA+LTE* feature activated
- Static HSUPA allocation
- Static HS-FACH uplink allocation

> **Note:**
>
> For more information about dynamic spectrum sharing (DSS), see the following documents:
>
> - *Operating Documentation/Single RAN Features/GSM-WCDMA Dynamic Spectrum Sharing Features*
> - *Operating Documentation/Single RAN Features/WCDMA-LTE Dynamic Spectrum Sharing Features*
> - *Operating Documentation/5G Features/LTE-NR Dynamic Spectrum Sharing Features*

The static baseband allocation is done during the system module startup. The remaining subunits after the static BB allocation (pure traffic subunits) can be used for Rel.99 DCH users, HSDPA users associated dedicated channel (A-DCH)/signaling radio bearer (SRB), and HSUPA users and throughput.

There are two HSDPA scheduler allocation scenarios that depend on the LCG baseband capacity variant:

- LCG with baseband capacity of four subunits
- LCG with baseband capacity of more than four subunits (for instance, six subunits, or eight subunits, or ten subunits, and so on)

The LCG with four subunits baseband capacity requires 1,125 subunits for the HSDPA scheduler, allowing the activation of one HSDPA scheduler.

The LCG that has more than four subunits baseband capacity requires 1,625 subunits for the HSDPA scheduler, allowing the activation of up to three HSDPA schedulers.

Baseband resources allocated for the HSDPA schedulers can also be used for the CCCH processing. This means that for the basic cell configurations, there is no need to allocate any additional baseband resources for the CCCH processing.

The Table: Examples of WCDMA capacity allocation subunits (1x LCG scenario) presents examples of WCDMA AirScale system module capacity allocation and the maximum number of HSPA or R99 users determined by the available BB capacity and single LCG HSPA users capacity.

Table 71: HSDPA scheduler allocation scenarios

LCG baseband capacity	Maximum number of cells per LCG	HSDPA scheduler baseband resources	Number of HSDPA schedulers	CCCH pool available with HSDPA baseband resources
4 subunits	Up to 12 cells (up to 6 HSPA cells)	1,125 subunits	1	2 CCCH pools
More than 4 subunits	Up to 12 cells (Rel.99 or HSPA cells)	1,625 subunits	1 or 2 or 3	3 CCCH pools

Table 72: Examples of WCDMA capacity allocation subunits (1x LCG scenario)

WCDMA available capacity	Baseband capacity for pure traffic use	Maximum amount of HSUPA users (F-DPCH)	Maximum amount of HSUPA users (non-F-DPCH)	Maximum amount of Rel.99 CE
4 subunits (0,5 x ABIA)	2,875 subunits	220	154	276
6 subunits (0,75 x ABIA)	4,375 subunits	340	238	420
8 subunits (1 x ABIA)	6,375 subunits	500	350	612
10 subunits (1,25 x ABIA)	8,375 subunits	620	462	804
12 subunits (1,5 x ABIA)	10,375 subunits	620	574	996
14 subunits (1,75 x ABIA)	12,375 subunits	620	620	1188
16 subunits (2 x ABIA)	14,375 subunits	620	620	1380
18subunits (2,25 x ABIA)	16,375 subunits	620	620	1572
20 subunits (2,5 x ABIA)	18,375 subunits	620	620	1764
22 subunits (2,75 x ABIA)	20,375 subunits	620	620	1956
24 subunits (3 x ABIA)	22,375 subunits	620	620	2148

Note:

Regarding the LCG baseband capacity, the table above presents one LCG case allowing a maximum reach of 620 HSPA users. To achieve more than 620 HSPA users per SBTS, another LCG must be created.

3.2.2.1 Balancing RACH load between LCGs configured on the same SBTS

Instructions to prevent digital signal processor (DSP) crashes leading to site unavailability due to an unbalanced random access channel (RACH) load between the LCGs configured on the same SBTS

Purpose

An unbalanced random access channel (RACH) load between the LCGs configured on the same SBTS may lead to digital signal processor crashes, leading further to site unavailability. To reduce the unavailability risks in such scenario, Nokia recommends to perform the following LCG RACH load dimensioning procedure.

Procedure

1 Collect the following counters from LCGs configured on the same SBTS, for last seven days:

- `M5000C456` `NUMBER OF SUCCESSFULLY ACKNOWLEDGED R99 RACH PREAMBLES`
- `M5000C457` `NUMBER OF NEGATIVELY ACKNOWLEDGED R99 RACH PREAMBLES`

2 Calculate the following values:

- `Average_SUM_M5000C457` as sum of the `M5000C457` counter hourly values, averaged for over 7 days.
- `Average_SUM_M5000C456` as sum of the `M5000C456` counter hourly values, averaged for over 7 days.

3 Compare the calculated values and proceed as follows:

Select from the available options

- If `Average_SUM_M5000C457` < 0.1 * `Average_SUM_M5000C456` proceed to next step.
- If `Average_SUM_M5000C457` >= 0.1 * `Average_SUM_M5000C456` then you must check the RACH Preamble Decoding failures before considering the re-dimensioning described in this procedure.

4 Calculate the following values:

- `Average_SUM_M5000C456_all_LCG1_cells` as sum of the `M5000C456` counter hourly values for all cells mapped to LCG1, averaged for over 7 days.

- `Average_SUM_M5000C456_all_LCG2_cells` as sum of the `M5000C456` counter hourly values for all cells mapped to LCG2, averaged for over 7 days.

5 Compare the calculated values, and, if any of the following conditions is met, proceed to next step.

- `Average_SUM_M5000C456_all_LCG1_cells` >= 4 * `Average_SUM_M5000C456_all_LCG2_cells`
- `Average_SUM_M5000C456_all_LCG2_cells` >= 4 * `Average_SUM_M5000C456_all_LCG1_cells`

6 Re-dimension the LCGs by redistributing the WCELLs between LCGs.

Select from the available options

- Move a subset of cells from high RACH load LCG to the lower RACH load LCG.
- Create a new LCG using WebEM Commissioning Wizard and move a subset of cells from high RACH load LCG to the newly created LCG.

Result

RACH load is redistributed to avoid uneven loading.

3.2.3 Common Control Channels dimensioning

Common Control Channels (CCCH) resources in FSMF and AirScale Indoor System Module. The formula to calculate required RHE per cell.

General information

The following downlink (DL) Common Control Channels are supported per cell in the SBTS:

- 1 x Primary – Synchronization Channel (P-SCH)
- 1 x Secondary – Synchronization Channel (S-SCH)
- 1 x Primary – Common Control Physical Channel (P-CCPCH)
- 1 x Primary – Common Pilot Channel (P-CPICH)
- 1 x Paging Indicator Channel (PICH)
- 1 x Acquisition Indicator Channel (AICH)
- 3 x Secondary Common Control Physical Channel (S-SCCPCH)

In the uplink (UL), resources for processing the Random Access Channel (RACH) preamble signatures are required per cell. RACH preamble signatures are used for both RACH users and High Speed forward access channel (HS CELL_FACH) users.

The extended cell

Cells with ranges higher than 20 km are called extended cells. The basic principles for extended cells in the SBTS are as follows:

- CCCH pool and CCCH PS licence key (LK) dimensioning rules are the same as in the case of non-extended cell range.
- One or several cells in the SBTS (supported configurations) can be configured as extended cells.
- An extended cell is tested up to 240 km.

CCCH dimensioning details

The CCCH baseband resources for signature processing of RACH preambles, for RACH and HS CELL_FACH users, are called CCCH pools. One CCCH pool has a capacity of 480 RACH Handler Elements (RHE).

A certain number of CCCH pools is required, depending on:

- Cell range
- Number of signatures for RACH preambles
- RX diversity
- Number of cells in the local cell group

CCCH resources in FSMF

An FSMF HW capacity contains one CCCH pool (480 RACH Handler Element (RHE). The FSMF HSDPA scheduler baseband resources (HSDPA subunits) include CCCH pools for additional CCCH processing.

Table 73: Number of CCCH pools and RHE capacity in the FSMF HSDPA scheduler subunits

LCG HSPA configuration	#HSDPA schedulers	#HSUPA schedulers	HSDPA subunits	#CCCH pools in HSDPA subunits	#RHE in HSDPA subunits
Rel.99 only	0	0	0	0	0
Small HSPA	1	1	0.625	1	480
Normal HSPA	2	1	1.125	2	960

If additional HSDPA subunits are allocated, they contain CCCH resources that can be used for CCCH processing.

Whenever it is required from the CCCH point of view, CCCH pools from high-speed downlink packet access (HSDPA) subunits are used for CCCH processing.

Whenever it is required from the CCCH point of view, and CCCH pools from HSDPA subunits are not sufficient, additional CCCH pools on top of HSDPA subunits are allocated.

One commissioned CCCH processing set enables one CCCH pool included in the HSDPA subunits. Each commissioned CCCH processing set requires one processing set license key (CCCH PS LK), which is handled by the operating support system (OSS).

One additional CCCH pool consumes 0.5 subunit.

Every local cell group (LCG) that has Narrowband Interference Cancellation (NBIC) activated, gets one additional CCCH pool. This additional CCCH pool from NBIC resources is enabled for use with one CCCH PS LK.

Every LCG that has dynamic spectrum sharing (DSS) activated, gets two additional CCCH pools, on top of NBIC. Those additional CCCH pools from DSS resources are enabled for use with two CCCH PS LKs.

A four-subunit AirScale system module LCG gets two additional CCCH pools but one subunit is needed for the NBIC allocation. In such case, these additional CCCH pools from NBIC resources require two CCCH PS LKs to be used for CCCH processing.

> **Note:**
>
> For more information about Dynamic Spectrum Sharing, see Dynamic spectrum sharing.

Every system module in the SBTS configuration has one CCCH PS (480 RHE) included in the HW price, which does not require any license. One CCCH processing set is available by default per each AirScale system module and does not require any configuration.

Each LCG in the AirScale system module contains CCCH baseband processing resources (named CCCH pools) included in the HSDPA scheduler baseband capacity.

The AirScale Indoor System Module LCG has a number of two or three CCCH pools included in the HSDPA subunits.

Additional CCCH pools (on top of the CCCH pools from the HSDPA scheduler baseband resources) are allocated when needed.

Additional CCCH pools or CCCH pools from the HSDPA scheduler baseband resources are enabled when they are licensed with CCCH PS LK.

A single pool of CCCH provides a capacity of 48 RACH resources, which are common for all assigned cells. One RACH resource is used to process one RACH message during 10 ms physical random access channel (PRACH) radio frame.

In case of 20 ms RACH transmission time interval (TTI), one RACH message consumes two RACH resources.

Table 74: LCG dimensioning

LCG baseband capacity	Maximum number of cells per LCG	CCCH pool available with HSDPA baseband resources	RHE
4 subunits	Up to 12 cells (maximum 6 HSPA cells)	2 CCCH pools	960
More than 4 subunits	Up to 12 cells (R99 or HSPA cells)	3 CCCH pools	1440

Common features for Flexi Multiradio 10 BTS and Nokia AirScale BTS

The CCCH resources are LCG specific. Each LCG must have CCCH resources (CCCH pools) for cells that are mapped to a particular LCG.

The RHE is a resource of a CCCH pool that is used for processing the RACH channel of a cell within an LCG.

The required RHE per cell in an LCG is calculated with the following formula:

`#RHE_per_cell` = `CellRange` * `#Signatures` * `RxDiv`

where:

- #RHE_per_cell – number of required RACH Handler Elements per single cell (max 480)
- CellRange – cell range, referred to in kilometers, rounded up to a whole integer divisible by five
- #Signatures – number of signatures for RACH preambles
- RXDiv – RX Diversity. Takes a value of two for two-way RX Div or four in case of four-way RX Div

One CCCH pool supports the following number of cells (four RACH signatures per cell are assumed):

- 3 cells/20 km two-way RX Div
  (#RHE_per_cell=20 * 4 * 2 = 160 RHE; 3 cells require 3 * 160 RHE = 480 RHE)
- 6 cells/10 km two-way RX Div
  (#RHE_per_cell = 10 * 4 * 2 = 80 RHE; 6 cells require 6 * 80 RHE = 480 RHE)
- 3 cells/10 km four-way RX Div
  (#RHE_per_cell = 10 * 4 * 4 = 160 RHE; 3 cells require 3 * 160 RHE = 480 RHE

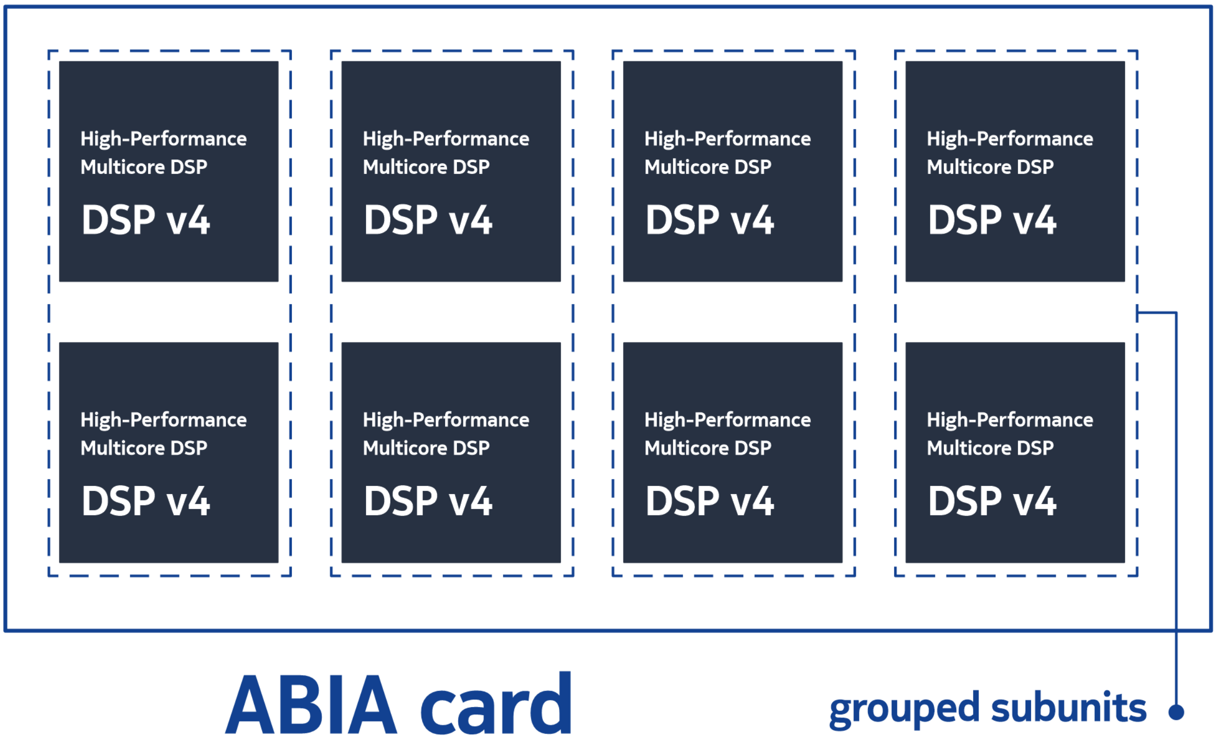
Other numbers of cells per CCCH pool are also supported.

The following is a list of basic configurations that are served with one CCCH pool included in the system modules HW capacity, and do not require any additional resources for CCCH processing:

- 1 x System Module: 3 cells/20 km two-way RX Div
- 1 x System Module: 6 cells/10 km two-way RX Div

Whenever the CCCH resources included in the HSDPA subunits are not enough, additional CCCH resources are allocated with granularity of 0,5 subunit (one CCCH pool). In Nokia AirScale BTS, baseband subunits are grouped by two. Only one CCCH pool can be allocated per group (two subunits). Each Paging Indicator Channel (PIC) activation excludes additional CCCH processing resources allocated in the grouped subunit. Only one PIC pool can be associated per baseband subunits group.

Figure 27: Six subunits Digital Signal Processor (DSP) group



To activate the CCCH pools, the proper amount of CCCH processing sets must be configured. One CCCH processing set is available by default per each AirScale system module and does not require any configurations.

CCCH resource allocation

The CCCH resources are LCG specific. Each LCG must have CCCH resources (CCCH pools) for the cells that are mapped to a particular LCG.

The CCCH resources included in the SBTS HW are not connected to a particular system module. In case of an SBTS with one system module and multiple LCGs, the CCCH resources included in the HW capacity are assigned to LCG1. LCG2, LCG3, and LCG4 require at least one CCCH pool.

In case of a dual-core AirScale, the `WNCELG` `System Module Distinguished Name` (`smodDN`) parameter identifies the half subrack where the HW resources are allocated for the LCG.

LCG baseband capacity is defined with the `WNCELG` `Access Baseband Capacity` (`accessBbCapacity`) parameter. The sum of `accessBbCapacity` that points to the same `smodDN` must be `100`.

Example of BB capacity distribution in LCGs

Primary core:

- LCG1 - accessBbCapacity = 40%
- LCG2 - accessBbCapacity = 60%
- Sum = 100%

Secondary core:

- LCG3 - accessBbCapacity = 100%
- Sum = 100%

Required CCCH resources for basic configurations

The number of signatures for RACH preambles is defined with the RNC/WBTS/WCEL RACH and HS-RACH Preamble Signatures(RACHPreambleSignatures) parameter. It specifies the number of signatures used for RACH users and HS CELL_FACH users (*RAN1913: High Speed Cell_FACH*). The FSMF summarizes the required number of subunits and CCCH license keys (FSMF) for some of the cell configurations.

Table 75: Normal HSPA LCG configurations

	CellRange	5	10	15	20	5	10	15	20
Cells	Signatures / RX Div	2	2	2	2	4	4	4	4
3	4	-\-	-\-	-\-	-\-	-\-	-\-	1\-	2\-
6	4	-\-	-\-	1\-	1\-	-\-	1\-	2\-	5\1
9	4	-\-	1\-	2\-	2\-	1\-	2\-	4\1	8\2.5
12	4	-\-	1\-	2\-	3\0.5	1\-	3\0.5	5\1.5	11\4
3	8	-\-	-\-	1\-	2\-	-\-	2\-	2\0	N/A
6	8	-\-	1\-	2\-	5\1	1\-	5\1	5\1.5	N/A
9	8	1\-	2\-	4\1	8\2.5	2\-	8\2.5	8\3	N/A
12	8	1\-	3\0.5	5\1.5	11\4	3\0.5	11\4	11\4.5	N/A

The table above presents the number of CCCH processing set LKs divided by the number of additional subunits required for CCCH processing, versus the number of cells, cell range (km), RX Div mode and number of RACH preamble signatures in the FSMF normal HSPA LCG.

Small HSPA local cell group

Table 76: Small HSPA LCG configurations

	CellRange	5	10	15	20	5	10	15	20
Cells	Signatures / RX Div	2	2	2	2	4	4	4	4
3	4	-\-	-\-	-\-	-\-	-\-	-\-	1\-	2\-
6	4	-\-	-\-	1\-	1\-	-\-	1\-	2\0.5	5\1.5
3	8	-\-	-\-	1\-	2\-	-\-	2\-	2\0.5	N/A
6	8	-\-	1\-	2\0.5	5\1.5	1\-	5\1.5	5\2	N/A

The table above presents the number of CCCH processing set LKs divided by the number of additional subunits required for CCCH processing, versus the number of cells, cell range (km), RX Div mode and number of RACH preamble signatures in FSMF small HSPA LCG.

Note:

One CCCH PS LK per FSMF is included in the HW price, which is shown in Table: Small HSPA LCG configurations. One CCCH PS LK and 0.5 subunit must be added to the presented figures in case of LCG2, LCG3, and LCG4 in FSMF. In case of LCG1, the number of CCCH PS LKs and the number of additional required subunits are directly applicable.

3.2.4 Dedicated channel (DCH) dimensioning

The amount of baseband resources required per one R99 traffic. Allocating UL and DL with different bit rates.

For baseband dimensioning purposes, a certain number of Release 99 channel elements (Rel.99 CE) per active DCH user is required. Baseband resources are required per DCH active user in no handover state, and per DCH user in soft handover state. Additional baseband resources are not required for users in softer handover state or in compressed mode.

The number of Rel.99 CE depends on the radio access bearer (RAB) data rate and minimum spreading factor (SF). The table Baseband resources required per one Rel.99 traffic channel presents the required number of R99 CE per each active connection for a basic set of RABs.

The *RAN3372: High Rate HD Voice* feature extends the support of adaptive multi-rate (AMR) codecs with wideband adaptive multi-rate (WB-AMR) codec 23.85 kbps. WB-AMR provides significantly superior voice quality. As the resource required to support higher rate codecs is higher as well, these higher rates are used when there are enough resources. The following table also provides details on the required resources for WB-AMR.

Table 77: Baseband resources required per one Rel.99 traffic channel

RAB	Traffic class	CS /PS	Max Rates for each RAB, kbps	Min SF UL	Min SF DL	Required Rel.99 CE per connection UL	Required Rel.99 CE per connection DL
AMR Speech	Conversational	CS	1.2	64	128	1	1
AMR Speech	Conversational	CS	7.95	64	128	1	1
AMR Speech	Conversational	CS	5.9	64	128	1	1
AMR Speech	Conversational	CS	4.75	64	128	1	1
AMR Speech	Conversational	CS	23.85	32	64	2	1
AMR Speech	Conversational	CS	12.65	64	128	1	1
AMR Speech	Conversational	CS	8.85	64	128	1	1
AMR Speech	Conversational	CS	6.65	64	128	1	1
Packet	Interactive/ Background	PS	16	64	128	1	1
Packet	Interactive/ Background	PS	32	32	64	2	2
Packet	Interactive/ Background	PS	64	16	32	4	4

RAB	Traffic class	CS /PS	Max Rates for each RAB, kbps	Min SF UL	Min SF DL	Required Rel.99 CE per connection UL	Required Rel.99 CE per connection DL
Packet	Interactive/ Background	PS	128	8	16	4	4
Packet	Interactive/ Background	PS	256	4	8	6	6
Packet	Interactive/ Background	PS	384	4	8	8	8
UDI	Conversational	CS	64	16	32	4	4
Streaming	Streaming	CS	57.6	16	32	4	4
Streaming	Streaming	CS	14.4	64	128	1	1

`Asymmetric UL/DL Rel.99 CE allocation`

Asymmetric UL/DL allocation means that the UL and DL directions have different bit rate requirements. The rule for allocating resources for asymmetric bit rates is based on a higher data rate requirement, but Rel.99 CE reservations are done separately for UL/DL. For example, if the UL bearer is 64 kbps and the DL bearer is 384 kbps, the Rel.99 CE reservation is four R99 CE in UL and eight Rel.99 CE in DL.

UL and DL resources must be allocated inside one subunit, but there is no direct connection between UL and DL resource allocation. In other words, UL and DL resources do not need to be allocated symmetrically across subunit UL and DL capacity.

3.2.5 HSDPA dimensioning

Features supported by the high-speed downlink packet access (HSDPA) scheduler. The number of supported users based on the enabled capacity license. Impact of the RNC-specific `Frame timing offset of a cell(Tcell)` **parameter on dual-band (DB) and dual-cell (DC)-HSDPA features.**

HSDPA scheduler

The HSDPA scheduler provides high throughput capability. From the baseband perspective, achievable HSDPA throughput further depends on the activated features (for example, *RAN1906: Dual-Cell HSDPA 42Mbps*, *RAN2179: Dual Band HSDPA 42Mbps*) and HSDPA throughput commissioning.

The HSDPA scheduler provides a high number of user capability. The achievable number of active HSDPA users further depends on the activated features (*RAN2124: HSPA 128 Users Per Cell*, *RAN2869: HSPA Subscriber Increase*).

The HSDPA scheduler does not consume any Release 99 channel elements (Rel.99 CE) license keys (LKs).

The HSDPA scheduler supports 64 quadrature amplitude modulation (QAM), DC-HSDPA, and DB-HSDPA features.

The number of supported users per cell, depending on the enabled capacity license, is as follows:

- Up to 208 users per cell (*RAN2869: HSPA Subscriber Increase*)
- Up to 180 users per cell (*RAN3179: HSDPA HS-FACH Enhanced Queuing*)
- Up to 128 users per cell (*RAN2124: HSPA 128 Users per Cell*)
- Up to 72 users per cell (*RAN1686: HSPA 72 Users per Cell*)

HSDPA and DC/DB-HSDPA users (*RAN3067: Flexible HSDPA Carriers Allocation: Carrier Aggregation (CA) DC/DB-HSDPA*) as well as High Speed forward access channel (HS CELL_FACH) DL users are included in the per-cell limits listed above.

A single HSDPA scheduler supports up to six cells.

The HSDPA scheduler for features are as follows:

- The HSDPA scheduler is LCG specific. It supports cells only from its own LCG.
- Up to three schedulers per LCG are supported when the LCG has more than four subunits of baseband capacity. An LCG that has only four subunits supports one HSDPA scheduler and therefore up to six HSPA cells.
- Enhanced Virtual Antenna Mapping ((E-)VAM) (*RAN2482: Enhanced Virtual Antenna Mapping*) cells require more HSDPA subunits compared to non-(E-)VAM cells.
- VAM cells and E-VAM cells require the same amount of baseband resources from the HSDPA scheduler point of view.
- Non-(E-)VAM and (E-)VAM cells require the same amount of baseband resources from the HSDPA scheduler point of view.

The scheduler contains CCCH resources (CCCH pools) that may be used for CCCH processing when those are enabled with a CCCH PS LK.

Table 78: Required HSDPA subunits for HSDPA schedulers versus LCG configurations (Flexi Multiradio 10 BTS)

LCG HSPA configuration	Number of HSDPA schedulers	Maximum number of supported HSDPA cells	HSDPA subunits
R99 Only	0	0	0
Small HSPA	1	6	0.625
Normal HSPA	2	12	1.125

The table below presents the required baseband resources for HSDPA schedulers per LCG HSPA configuration. Assumptions: non-(E-)VAM cells, 10 km cell range, two-way RX Div and the RNC-specific `RACH and HS-RACH Preamble Signatures (RACHPreambleSignatures)` parameter value is `4`.

Table 79: Required HSDPA subunits for HSDPA schedulers per LCG versus LCG HSPA configuration (Flexi Multiradio 10 BTS)

LCG HSPA configuration	1st LCG: HSDPA subunits/additional CCCH pools	2nd and next LCG: HSDPA subunits[1) / additional CCCH pools[2)]
Small	0.625/1	0.625/1
Normal	1.125/2	1.125/2

[1)] Additional 0.5 subunit (one CCCH pool/480 RHE) for CCCH processing must be added to the presented figures in the second and following local cell groups (LCGs).

[2)] If needed, CCCH pools can be used when CCCH PS LKs are available.

Table: Required HSDPA subunits for HSDPA schedulers per LCG versus LCG HSPA configuration and number of cells (Flexi Multiradio 10 BTS) presents the required baseband resources for HSDPA schedulers per LCG for a typical number of cells and for available LCG HSPA configurations. Assumptions: (E-)VAM cells, 10 km cell range, two-way RX Div and the RNC-specific `RACH and HS-RACH Preamble Signatures (RACHPreambleSignatures)` parameter value is `4`.

Table 80: Required HSDPA subunits for HSDPA schedulers per LCG versus LCG HSPA configuration and number of cells (Flexi Multiradio 10 BTS)

LCG HSPA configuration	Maximum number of supported HSPA cells per LCG	1st LCG: HSDPA subunits/additional CCCH pools	2nd and next LCG: HSDPA subunits[1] / additional CCCH pools[2]
Small	Up to 4	0.625/1	0.625/1
Small	5-6	1.125/2	1.125/2
Normal	Up to 6	1.125/2	1.125/2
Normal	7 – 8	1.625/3	1.625/3
Normal	9 – 10	2.125/4	2.125/4
Normal	11 - 12	2.625/5	2.625/5

1) Additional 0.5 subunit for CCCH (one CCCH pool/480 RHE) processing needs to be added to the presented figures in the second and following LCGs.

2) If needed, CCCH pools can be used when CCCH PS LKs are available.

Note:

The FSMF supports up to 18 cells.

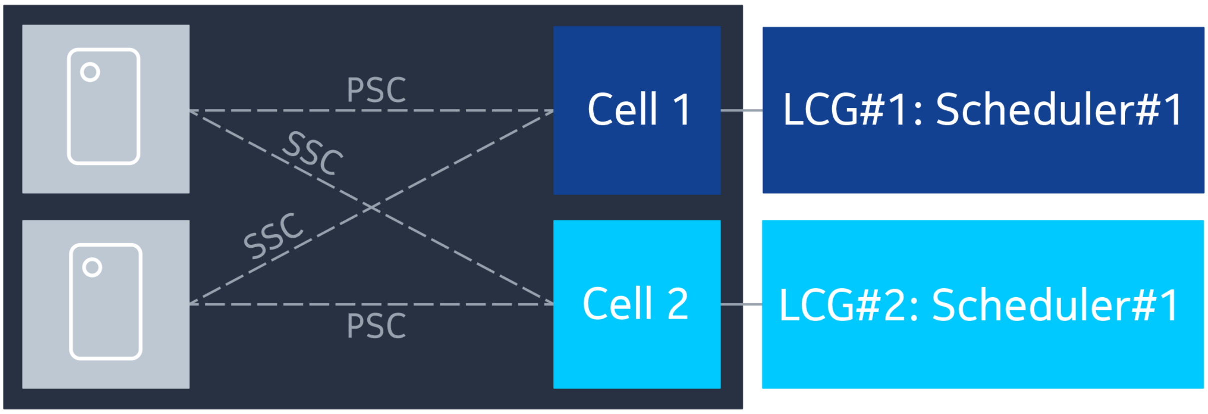
HSDPA users

One HSDPA scheduler has 240 scheduling units. The resources are used as follows:

- One HSDPA user or one DB/DC-HSDPA user consumes one scheduling unit from the scheduler.
- One HSDPA user in High Speed CELL_FACH state consumes one scheduling unit from the scheduler.
- *RAN3067: Flexible HSDPA Carriers Allocation*: One CA DB/DC-HSDPA user consumes:
  - one scheduling unit from the scheduler handling the primary carrier of that user
  - 0.5 scheduling unit from the scheduler handling the secondary carrier of that user

  Which in total gives 1.5 scheduling units per one user, in total per SBTS with two HSDPA schedulers (assuming that the CA DB/DC-HSDPA user is receiving data from two HSDPA schedulers from two different LCGs)

Figure 28: Example of carrier aggregation DB/DC-HSDPA UEs connected via primary serving cell (PSC) and secondary serving cell (SSC)



The maximum number of CA DB/DC-HSDPA users per SBTS is calculated with the following formula:

`Max_#CA_HSDPA_users_BTS`= 1/1.5 x 240 x `#schedulers`

where:

- `Max_#CA_HSDPA_users_BTS` - maximum number of CA DB/DC-HSDPA users per SBTS
- `#schedulers` - number of HSDPA schedulers (CA requires at least two schedulers in the SBTS)

Table 81: CA DB/DC HSDPA users capacity (Flexi Multiradio 10 BTS)

Number of HSDPA schedulers per SBTS	Maximum number of CA DB/DC-HSDPA users per SBTS
1	N/A
2	320
3	480
4	640

Example

One hundred HSDPA active users and 50 DC users consume Round_up (100 * 1 + 50 * 1.25) = Round_up (100 + 62.5) = 163 scheduling units.
Therefore, additionally 240 - 163 = 77 scheduling units are unused allowing for allocation of additional 77 HSDPA users or Round_down (77 / 1.25) = 61 DC users.

Table 82: CA DC user capacity (Nokia AirScale BTS)

Number of HSDPA schedulers in an LCG	Number of CA DC users per LCG
1	160
2	320
3	480

> **Note:**
>
> This is the LCG level capacity considering that all users handled by schedulers are CA DC users. For mixed profiles (SC/DC and CA DC/DB users combined), the number of supported users equals to:
>
> `[(# primary carriers for CA DC/DB) + (0.5 * # 2nd carriers for CA DC/DB)] <= (240 * number of HSDPA schedulers in LCG)` unit of load, where one unit is the load required to handle one SC user in a core.

HS CELL_FACH users

One HSDPA user in High Speed CELL_FACH state consumes one scheduling unit.

In addition, one scheduling unit is reserved per HS_FACH enabled cell (*RAN1637: HS Cell_FACH DL* required). Each HS_FACH enabled cell consumes one scheduling unit. Thus, an HSDPA scheduler with six cells, where each cell is HS_FACH enabled, has 240 – 6 = 234 scheduling units.

Multi-RAB users

One HSDPA scheduler supports 240 radio access bearers (RABs). For example, in case of one multi-RAB UE with ongoing HSDPA data download and simultaneous HSDPA web browsing, one scheduler can support 238 single-RAB users in addition to one Multi-RAB user with two HSDPA RABs.

HSDPA Rel.99 CE consumption for A-DCH and DL SRB

An HSDPA active user consumes Rel.99 CEs for DL signaling radio bearer (SRB) processing and dedicated channel (DCH) return channel processing associated dedicated channel (A-DCH) for UL.

SRB and A-DCH R99 CEs for traffic from the respective cells are allocated on the same system module where the HSDPA scheduler processes the respective cells.

In case of the HSDPA user with high-speed uplink packet access (HSUPA) UL return channel, Rel.99 CEs are not consumed at all.

The A-DCH consumption depends on the DCH data rate.

Associated UL/DL DCH

The Associated UL/DL DCH of the HSDPA user employs the capacity in the same way as a normal DCH.

Table 83: Associated DCH and Rel.99 CE usage

User data	Rel.99 CE required in UL / Min SF	Rel.99 CE required in DL / Min SF
PS 16 kbps	1/SF64*	1/SF128**
PS 64 kbps	4/SF16	1/SF128**
PS 128 kbps	4/SF8	1/SF128**
PS 384 kbps	8/SF4	1/SF128**

Note:

* If spreading factor (SF) is 32, two Rel.99 CEs are required in UL.

** One Rel.99 CE for DL signaling (SRB) is required per HSDPA user.

Tcell grouping

From the HSDPA point of view, the RNC-specific `Frame timing offset of a cell` (`Tcell`) parameter is used to indicate which cell is processed by which scheduler. Tcell groups are handled by the schedulers in the following way:

Table 84: `Tcell` values handled by HSDPA schedulers (Flexi Multiradio 10 BTS)

`Tcell` values group	Scheduler 1	Scheduler 2
`Tcell` values from group 1	0, 1, 2	N/A
`Tcell` values from group 2	N/A	3, 4, 5
`Tcell` values from group 3	6, 7, 8	N/A
`Tcell` values from group 4	N/A	9

Table 85: `Tcell` grouping (Nokia AirScale BTS)

LCG type	Scheduler number	`Tcell` group values
LCG with 4 subunits baseband capacity	Scheduler #1	Tcell group 1 and 3 (values: 0, 1, 2 and 6 ,7 ,8)
LCG with more than 4 subunits baseband capacity	Scheduler #1	Tcell group 1 (value 0, 1, 2)
	Scheduler #2	Tcell group 2 and 4 (values: 3, 4, 5 and 9)
	Scheduler #3	Tcell group 3 (values: 6, 7, 8)

With one scheduler and one Tcell group, up to six cells per Tcell group are supported. With one scheduler and two Tcell groups, up to three cells per Tcell group are supported (up to six cells are still supported in total).

The same `Tcell` values can be used by different cells if those are allocated to different frequency layers.

DB/DC-HSDPA `Tcell` settings

The DB as well as DC-HSDPA features require both cells from one sector to have the same value for the RNC-specific `Frame timing offset of a cell (Tcell)` parameter. With the DB or DC functionality, two cells from the same sector must be served by one system module and one scheduler, and belong to the same LCG. When both cells from the DC-HSDPA sector are in one band, those must be from adjacent frequencies. The DB-HSDPA enables DC functionality with two cells from different frequency bands.

The `M5000` counters indicating scheduled HSDPA users are Tcell group specific. Tcell grouping may affect counter behavior.

Figure 29: System module example of Tcell configurations (1LCG) (1/2)

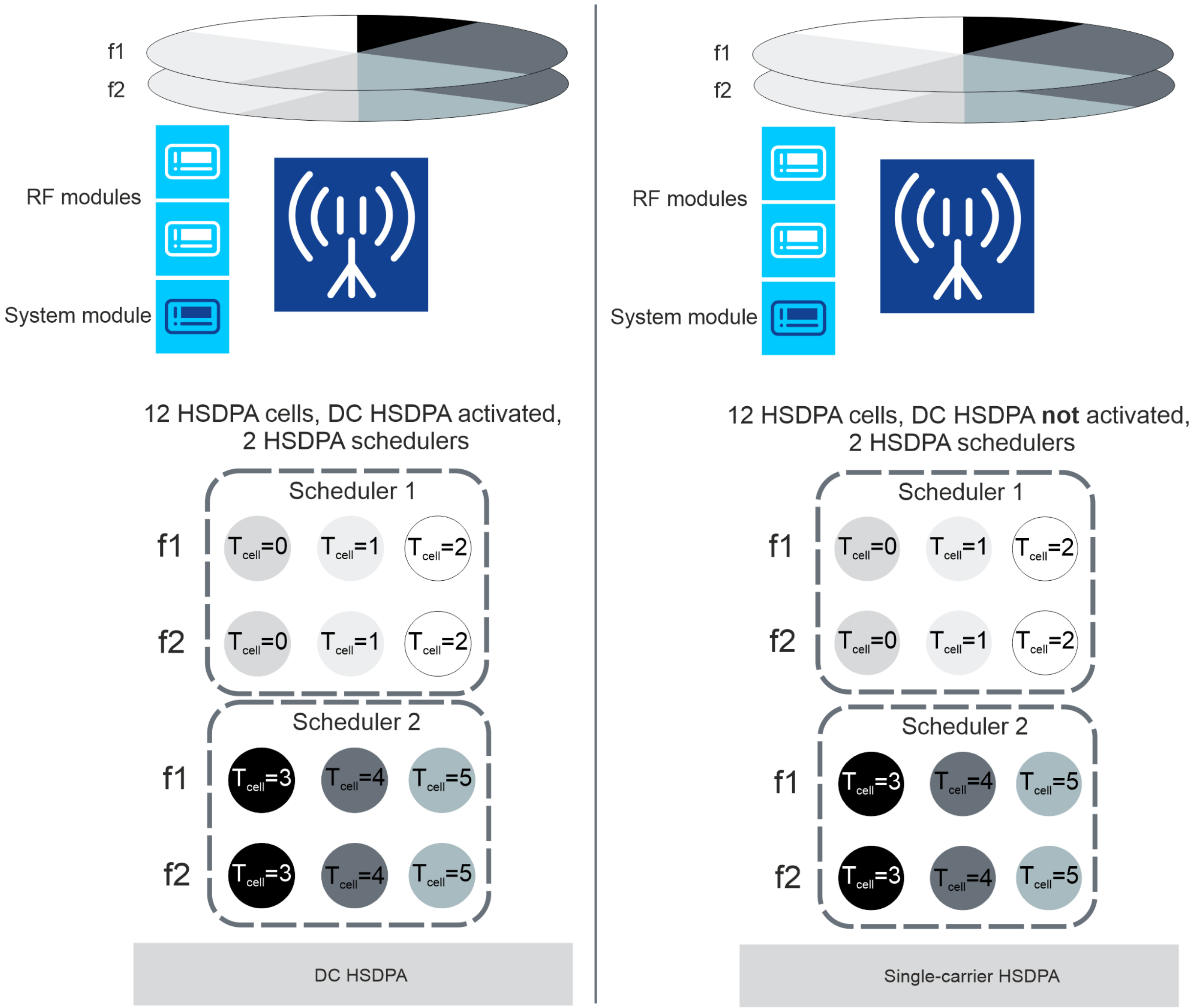
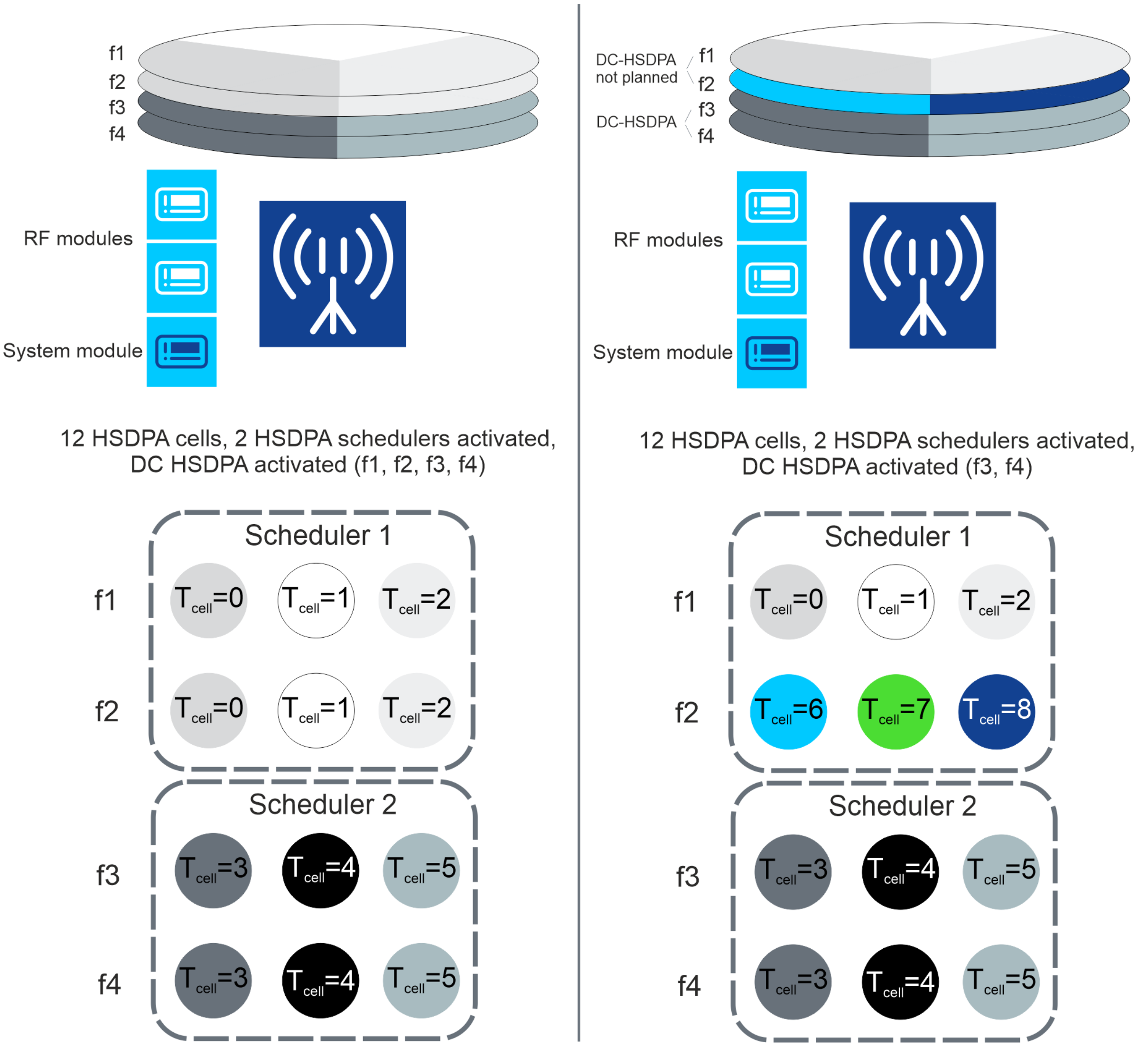


Figure 30: System module example of Tcell configurations (1LCG) (2/2)



CA DB/DC-HSDPA Tcell settings

The *RAN3067: Flexible HSDPA Carriers Allocation* feature enables DB/DC-HSDPA with the primary serving cell and the secondary serving cell mapped to two separate LCGs, and thus handled by two separate schedulers. In this case, the CA DB/DC-HSDPA UE is connected via the primary serving cell and the secondary serving cell mapped to one sector, but different LCG. Both primary and secondary serving cells must have the same Tcell value. When *RAN3067: Flexible HSDPA Carriers Allocation* is enabled, one scheduler supports only one of the two Tcell groups.

Table 86: `Tcell` values handled by HSDPA schedulers when RAN3067: Flexible HSDPA Carriers Allocation is enabled

`Tcell` Values	Scheduler 1	Scheduler 2
`Tcell` Values from Group 1[1)]	0, 1, 2	N/A
`Tcell` Values from Group 2[2)]	N/A	3, 4, 5
`Tcell` Values from Group 3[3)]	6, 7, 8	N/A
`Tcell` Values from Group 4[4)]	N/A	9

Note:

The table above exemplifies `Tcell`parameter values handled by HSDPA schedulers for Flexi Multiradio 10 BTS.

Note:

1. `Tcell` values 0, 1, 2 are allowed only if values 6, 7, 8 are not in use by Scheduler 1 in an LCG.
2. `Tcell` values 3, 4, 5 are allowed only if value 9 is not in use by Scheduler 2 in an LCG.
3. `Tcell` values 6, 7, 8 are allowed only if values 0, 1, 2 are not in use by Scheduler 1 in an LCG.
4. `Tcell` value 9 is allowed only if values 3, 4, 5 are not in use by Scheduler 2 in an LCG.

Simultaneous HSDPA users in a TTI

An HSDPA scheduler supports a number of users per transmission time interval (TTI), depending on the feature activation:

- *RAN3269: Optimized HSDPA Scheduler* active.
  Up to 24 HSDPA users per scheduler can be code multiplexed, and thus served simultaneously.
  If the cells of a scheduler are mapped to only one Tcell group, the scheduler supports up to six cells and can select up to 24 users dynamically from the cells that have users eligible for the transmission in the TTI.
  If the cells are mapped to two Tcell groups within the same scheduler, the scheduler supports up to three cells per Tcell group. It can select up to 12 users per Tcell group dynamically from the cells within the Tcell group that has users eligible for the transmission in the TTI.

- *RAN3269: Optimized HSDPA Scheduler* not active.
  Up to 12 HSDPA users per scheduler can be code multiplexed and thus served simultaneously.
  If the cells of a scheduler are mapped to only one Tcell group, the scheduler supports up to six cells and can select up to 12 users dynamically from the cells that have users eligible for the transmission in the TTI (*RAN3067: Flexible HSDPA Carriers Allocation*). The scheduler supports 18 users in the TTI, where 12 are from the primary serving cells and the remaining six are from the secondary serving cells.
  If the cells are mapped to two Tcell groups within the same scheduler, the scheduler supports up to three cells per Tcell group and can select up to six users per Tcell group dynamically from the cells within the Tcell group that has users eligible for the transmission in the TTI.

With the *RAN3269: Optimized HSDPA Scheduler* feature, the scheduler supports up to 100% more users per TTI (up to 12 delta users). Twelve delta users are selected from the users with small packets (one Packet Data Unit (PDU)), without PDU assembly. For example, PDU retransmission, high-speed shared control channel (HS-SCCH) order and HS-FACH users that have small packets to transmit.

3.2.6 HSUPA dimensioning

The high-speed uplink packet access (HSUPA) throughput dependency on activated features, Capacity Limitation parameters and available baseband resources. Calculating the required number of subunits for mixed user type cases.

HSUPA is a WCDMA key feature, which provides high data rate transmission to support multimedia services for the WCDMA RAN. HSUPA is supported only with the coexistence of high-speed downlink packet access (HSDPA). HSUPA is activated per local cell group (LCG). In case of an SBTS with one system module, HSUPA is activated per LCG and is supported in multiple LCGs.

HSUPA scheduler

The HSUPA scheduler supports high throughputs and a high number of active users. The HSUPA active user is served in Cell Dedicated Channel (CELL_DCH). HSUPA is also used in *RAN1913: High Speed Cell_FACH*.

The HSUPA throughputs (CELL_DCH) depend on:

- the activated features (for example, *RAN981: HSUPA 5.8 Mbps*, *RAN1702: Frequency*

Domain Equalizer, HSUPA 16QAM, *RAN1905: Dual Cell HSUPA*)
- the number of HSUPA users allowed in the SBTS, based on the Capacity Limitation parameters sent by NetAct
- the available baseband resources.

The number of HSUPA users actively served in the SBTS may depend on available baseband resources as well as actively used features (*RAN1201: Fractional DPCH*).

One HSUPA scheduler is available with one LCG. Additional LCGs provide additional HSUPA schedulers.

HSUPA traffic impact on available capacity

The HSUPA traffic is processed by the HSUPA scheduler as follows:

- The activation of the HSUPA scheduler has no impact on the available baseband capacity.
- Active HSUPA users and a total HSUPA scheduler throughput have impact on the available baseband capacity. In case of active HSUPA users, the HSUPA scheduler in the system module consumes HSUPA resource steps.
- The HSUPA resource step is a baseband capacity equivalent of 0.125 subunits.
- Release 99 channel elements (R99 CE) are not consumed by the HSUPA active user allocations (neither by the data channels or signaling radio bearer (SRB)) in the system module.
- The impact of active HSUPA users on available baseband capacity depends on the number of HSUPA users and HSUPA scheduler throughput, as well as if the HSUPA user is actively using the following features:
  - HSUPA 2 ms transmission time interval (TTI)
  - HSUPA 10 ms TTI
  - fractional downlink physical channel (F-DPCH) (*RAN1201: Fractional DPCH*)
  - *RAN3259: HSUPA Baseband Boost for non-FDPCH Users*

The HSUPA active users and throughput impact on the available baseband capacity is presented in the excel *Flexi Multiradio 10 BTS and Nokia AirScale BTS HSUPA Capacity Tables* in Single RAN Operating Documentation.

The subunit usage can change on a TTI basis. In one TTI, a UE transmits with 16 quadrature amplitude modulation (QAM), while in the other TTI, a lower modulation order is used. For example, 16 QAM usage depends on the radio conditions or the amount of data in the UE buffer.

HSUPA dynamic resource reservation

The baseband capacity is reserved for the HSUPA dynamically, as needed basis. If there are active HSUPA users in the LCG, a certain number of HSUPA resource steps are reserved. If the throughput or the number of users decreases, or both, the reserved resources can get released, depending on the baseband resource situation in the SBTS. If there is a need for baseband resources for higher-priority traffic (for example DCH traffic), the SBTS releases the resources faster.

If there is no baseband congestion, the HSUPA resource might not get released fast. This is done to keep the HSUPA resources ready to use, especially for users with bursty transmission. This improves latency, round trip time and end-user experience as well as instant UE throughput. Therefore, a subunit utilization indicator may appear high, but this does not necessarily indicate that the SBTS baseband resources have reached maximum capacity. The dynamic allocation of baseband resources keeps the HSUPA subunit utilization on a high level, although more users can be served additionally. By allocating extra (not used) subunits for the users, the scheduling changes are much faster (on the scale of scheduling periods), as there is no immediate need for HW allocation changes and the new serving grants can be provided to the UEs immediately.

For information about capacity usage monitoring, see the *WCDMA RAN Operating Documentation/WCDMA RAN System/Managing WCDMA RAN Capacity* document.

If there are no active HSUPA users in the LCG, there is no dynamic baseband resource reservation.

If there is an increase in the number of active HSUPA users or the HSUPA scheduler throughput or both, the resource steps are also reserved (allocated) accordingly. To allocate the next HSUPA resource step, an additional free capacity of 12 R99 CEs is needed.

These 12 R99 CEs can constitute any licensed R99 CEs in any system module. The required six R99 CE free on top of the HSUPA resource step is to avoid a ping-pong effect in reserving and freeing HSUPA resource steps. This action is needed so that the HSUPA resource step is not requested back immediately after its allocation.

When the free channel capacity drops below eight, the Resource Manager starts to release resources used by HSUPA.

HSUPA required resource dimensioning

To calculate the required number of subunits for mixed user type cases (F-DPCH/no-FDPCH/2ms TTI/10msTTI users, 16QAM, DC-HSUPA), the following rule is applied.

`HSUPA_Subunits` = `F-DPCH_2msTTI_subunits` + `no-FDPCH_10msTTI_subunits +` `16QAM_2msTTI_subunits` + `HS_Cell_FACH_UL_(RAN1913)_users`

where:

- `F-DPCH_2msTTI_subunits` – subunits required for the HSUPA F-DPCH 2 ms TTI users, calculated from the HSUPA dimensioning tables (See *Flexi Multiradio 10 BTS and Nokia AirScale BTS HSUPA capacity tables*)
- `F-DPCH_10msTTI_subunits` – subunits required for the HSUPA F-DPCH 10 ms TTI users, calculated from the HSUPA dimensioning tables (See *Flexi Multiradio 10 BTS and Nokia AirScale BTS HSUPA capacity tables*)
- `No-F-DPCH_2msTTI_subunits` – subunits required for the HSUPA no-F-DPCH 2 ms TTI users, calculated from the HSUPA dimensioning tables (See *Flexi Multiradio 10 BTS and Nokia AirScale BTS HSUPA capacity tables*)
- `No-F-DPCH_10msTTI_subunits` – subunits required for the HSUPA no-F-DPCH 10 ms TTI users, calculated from the HSUPA dimensioning tables (See *Flexi Multiradio 10 BTS and Nokia AirScale BTS HSUPA capacity tables*)
- `16QAM_2msTTI_subunits` – subunits required for the UEs simultaneously transmitting with 16QAM modulation
- `HS_Cell_FACH_UL_(RAN1913)_users` – subunits required for the *RAN1913: High Speed Cell_FACH* (HS Cell_FACH UL)

In some cases, the rule presented above leads to overestimation of the baseband resources. For more information, see *Flexi Multiradio 10 BTS and Nokia AirScale BTS HSUPA capacity tables*.

Narrowband interference cancellation (NBIC)

The *RAN3374: Narrowband Interference Cancellation* feature impacts WDCMA BB dimensioning. Narrowband interference within the SBTS receiving band is detected and filtered out automatically and dynamically. Externally, narrowband interference within the uplink receiving band at SBTS level can destroy the cell's performance altogether. With the NBIC feature, the high cost of finding and removing the external source can be avoided, as the cell's performance remains the same in spite of the interference spikes. More than three times larger cell coverage can be maintained for the site, proportional with the magnitude of narrowband interference. NBIC is supported with FSMF and AirScale Indoor System Module.

The *RAN3374: Narrowband Interference Cancellation* feature is activated on LCG level with the `WNCELG` `Narrowband Interference Cancellation enabled` (`nbicEnabled`) parameter when:

- LCG has up to six cells two-way RX Div or up to three cells four-way RX Div

- LCG `WNCELG` `HSPA setting` (`hspaSetting`) parameter value is set to `HSPA Normal` or `R99 only` (valid for FSMF only)

On SBTS level, the sum of the existing PIC pools plus the activated NBIC LCGs must be lower than or equal to four. Thus, the maximum number of supported NBIC LCGs depends on the number of activated PIC pools as presented in the following table.

Table 87: Maximum number of supported SBTS configurations with NBIC and PIC

Number of PIC pools per SBTS	Maximum number of supported NBIC LCGs per SBTS
0	4
1	3
2	2
3	1
4	0

NBIC cannot be activated:

- In the LCG that has a mix of two-way RX Div cells and four-way RX Div cells
- In LCG with the `WNCELG` `HSPA setting` (`hspaSetting`) parameter value set to `HSPA Small`

Activation of NBIC in LCG requires static reservation of 0.5 subunit for NBIC resource processing. This 0.5 subunit is used for NBIC feature processing and is not available for DCH, HSUPA or High Speed Random Access Channel (HS-RACH) processing. The impact of NBIC activation on available baseband capacity is presented in the following table.

Table 88: Number of subunits reserved from the LCG capacity after NBIC activation (FSMF)

LCG `HSPA settings`	Total cost in terms of static resource consumption per LCG after NBIC activation
`Normal HSPA`	0.5 subunit
`R99 only`	0.5 subunit

Table 89: Number of subunits reserved from the LCG capacity after NBIC activation (AirScale Indoor System Module)

LCG subunits	Total cost in terms of static resource consumption per LCG after NBIC activation
LCG with four subunits baseband capacity	1 subunit
LCG with more than four subunits baseband capacity	0.5 subunit

Dynamic spectrum sharing

DSS allows the spectrum to be shared dynamically between 2G, 3G, 4G or 5G technologies based on the needs of the end user to improve spectrum utilization. With DSS, operators don't need to split the available spectrum or have dedicated spectrum for either technology, but, instead spectrum is dynamically shared, based on traffic demand.

The DSS functionality covers spectrum sharing between the following technologies:
- GSM and WCDMA
- GSM and LTE
- WCDMA and LTE
- LTE and 5G

> **Note:**
>
> For more information regarding each DSS technology, see *Dynamic Spectrum Sharing Features* document.

Enhanced HSUPA interference cancellation feature dimensioning (PIC pools)

To achieve the high HSUPA throughput, the following interference cancellation (IC) features are recommended:
- *RAN1308: HSUPA Interference Cancellation Receiver*
- *RAN2250: Enhanced HSUPA IC*

RAN2250: Enhanced HSUPA IC requires *RAN1308: HSUPA Interference Cancellation Receiver*. *RAN2250: Enhanced HSUPA IC* has no impact on baseband dimensioning.

The IC is performed with PIC pool units. With the `WNCEL` `PIC Pool` (`picPool`) commissioning parameter, the operator can activate the required number of PIC pools, and then perform cell mapping to the PIC pools.

Four-way RX Div is supported with the interference cancellation feature on FSMF or AirScale Indoor System Module, provided that the *RAN3046: Interference Cancellation for 4RX* feature is enabled.

Interference cancellation unit (PIC pool)

PIC pool unit mapping rules:

- Up to six cells with two-way RX Div can be mapped to one PIC pool unit and interference cancellation is performed in six cells at the same time.
- Up to three cells with four-way RX Div can be mapped to one PIC pool unit and interference cancellation is performed in three cells at the same time.
- Cells from the same frequency layer within the LCG must be mapped to the same PIC pool unit.
- In AirScale Indoor System Module, one PIC pool unit consumes one subunit capacity. PIC allocation excludes CCCH pool allocation in the same group.
- In AirScale Indoor System Module, only one PIC pool can be associated per baseband subunit group.
- In AirScale Indoor System Module, each PIC activation excludes additional CCCH processing resource allocation in grouped subunits.

Every PIC pool supports a mix of cells with different RX Div.

General:

- A maximum of four PIC pools in the SBTS
- A maximum of six cells (two-way RX) in the PIC pool
- A maximum of three cells (four-way RX) in the PIC pool
- A maximum of three PIC pools per LCG
- A maximum of two PIC pools per BB card (ABIA/FBBA/C cards)

> **Note:**
>
> If NBIC *(RAN3374: Narrowband Interference Cancellation)* is activated in the LCG, a mix of cells with different RX Div mode is not supported. For more details, see Narrowband interference cancellation (NBIC).

A commissioned PIC pool is successfully allocated in FSMF System Module baseband capacity only if, after PIC pool allocation, there is a minimum of baseband resource capacity available for DCH/HSUPA traffic processing. Otherwise, the BTS reports the fault `0145`: `Resource block not available`. The minimum baseband resource capacity mentioned above is required to guarantee minimum DCH/HSUPA capacity and depends on the DSP internal deployment. However, in case one PIC pool is allocated in single FSMF with 1 x LCG, the number of additional CCCH pools must not be higher than the values defined in the following table.

Table 90: Maximum number of additional CCCH pools, assuming that one PIC pool is commissioned and allocated

FSMF WCDMA capacity	FMSF LCG configuration	#CCCH pools included in HW	#CCCH pools from HSDPA scheduler resources	Maximum number of additional CCCH pools	Maximum number of PIC pools commissioned and successfully allocated
5.5 subunits	Normal HSPA	1	2	3	1
5.5 subunits	Small HSPA	1	1	4	1

If the number of additional CCCH pools is higher than the values defined in the table above, the commissioned PIC pool is not allocated and the BTS reports fault `0145` `Resource block not available`. The required number of CCCH pools is a result of dimensioning of the RHE.

If the number of subunits for WCDMA capacity is higher or lower than 5.5 subunits, then the maximum number of additional Common Control Channels (CCCH) pools can be decreased or increased respectively on a 1:1 ratio. For example: if the number of WCDMA subunits is 6.5, then the maximum number of additional CCCH pools parameter can be increased by 1 or the number of PIC pools can be increased by 1.

Example: Calculating the maximum number of supported cells based on the following BTS configuration:

- FSMF with 1 x LCG Normal HSPA
- 1 x PIC pool commissioned
- Cell configuration: 60-km cell range, four-way RACH signatures, two-way RX Div

Solution steps:

- The required number of RHE per cell = 60 * 4* 2 = 480 RHE
- One CCCH pool supports 480 RHE, hence one CCCH pool per cell is required

- To serve six cells, a total of six CCCH pools are required:
  - Two CCCH pools are included in HSDPA scheduler resources (see Table: Number of CCCH pools and RHE capacity in the FSMF HSDPA scheduler subunits) and one CCCH pool is included in the FSMF HW (see CCCH resources in FSMF).
  - Three additional CCCH pools are needed. However, three additional CCCH pools is more than the limit defined in Table: Maximum number of additional CCCH pools, assuming that one PIC pool is commissioned and allocated. Therefore, with one PIC pool allocated, up to five cells are supported.

> **Note:**
>
> For details on CCCH and RHE dimensioning, see Common Control Channels dimensioning.

PIC dimensioning details for Nokia AirScale BTS

If RF units with WCDMA cells are connected only to one ABIA in AirScale half-subrack (core), then:

- If 32 or fewer WCDMA RXes are configured in total in a given AirScale half-subrack, then there can be up to four PIC pools configured in that half-subrack.
- If more than 32 WCDMA RXes are configured in a given AirScale half-subrack, then it's possible to configure whole PIC pools 1 and 2 (each can have in total 12 RXes in a maximum of six cells) and reduced PIC pool 3 (with up to 8 RXes in a maximum of six cells) in that half-subrack.

If RF units with WCDMA cells are connected to two ABIAs in AirScale half-subrack (core), when the *SR002075: Support for Configuration with WCDMA Radio Modules Connected to Two ABIAs* feature is used, then:

- In case both ABIAs with connected WCDMA RF units have WCDMA baseband allocated on them, the PIC feature is not supported in any LCG allocated in that half-subrack. PIC pools commissioned in that half-subrack are ignored.
- In case at least one of these ABIAs with connected WCDMA RF units does not have WCDMA baseband allocated (for example, there is LTE baseband and/or GSM baseband allocated only), it is possible to configure two whole PIC pools (each can have in total 12 RXes in a maximum of six cells) and a third, reduced PIC pool (with up to 8 RXes in a maximum of six cells) in that AirScale half-subrack.

High Speed Cell_FACH feature dimensioning

The *RAN1913: High Speed Cell_FACH* feature consumes baseband resources for the HS Cell_FACH UL user processing. Using the `WNCELG` `Min number of HSUPA resource steps for HS-RACH users`(`minNumOfHsRachResourceStepsRes`) and `WNCELG` `Max number of HSUPA resource steps for HS-RACH users` (`maxNumOfHsRachResourceStepsRes`) parameters, the operator can define the allocation of baseband resources for the HS Cell_FACH UL users. Baseband resource allocation is done in steps:

- Up to eight steps are available for each LCG.
- A single step provides baseband capacity for 10 HS Cell_FACH UL users.
- A single step corresponds to the baseband capacity equivalent of a single HSUPA resource step: 0.125 subunit.
- A maximum of 80 HS Cell_FACH UL users can be served in the LCG, which corresponds to eight HSUPA resource steps.
- If the *RAN2518: High Speed Cell_FACH Enhanced* feature is deactivated, up to four steps can be effectively used (up to 40 HS Cell_FACH UL users). If *RAN2518* is activated, up to eight steps can be used (up to 80 HS Cell_FACH UL users).
- If the *RAN3280: Dynamic Baseband for HS RACH* feature is activated, the allocation of baseband resources for HS Cell_FACH UL is done automatically and dynamically, depending on the HS Cell_FACH UL traffic. This is done using the `WNCELG` `Min number of HSUPA resource steps for HS-RACH users` (`minNumOfHsRachResourceStepsRes`) and `WNCELG` `Max number of HSUPA resource steps for HS-RACH users` (`maxNumOfHsRachResourceStepsRes`) parameters. At runtime, additional resources up to `WNCELG` `Max number of HSUPA resource steps for HS-RACH users` (`maxNumOfHsRachResourceStepsRes`) are gradually allocated with resolution on a single HSUPA resource step. Allocation is triggered if already allocated baseband resources are lower than the configured common enhanced dedicated transport channel (E-DCH) resources for the HS Cell_FACH UL users, considering the number of preambles that are Not Acknowledged (NACK-ed). Gradual release of resources down to `WNCELG` `Min number of HSUPA resource steps for HS-RACH users` (`minNumOfHsRachResourceStepsRes`) with one HSUPA resource step resolution is triggered based on the runtime resource usage when allocated baseband resource capacity is higher than the average active amount of common E-DCH resources. Both parameters can be modified online without SBTS reset.
- If the *RAN3280: Dynamic Baseband for HS RACH* feature is not active, the allocation of baseband resources for the HS Cell_FACH UL is done statically and is not dependent on the HS Cell_FACH UL traffic. This is done using the `WNCELG` `Min number of HSUPA resource steps for HS-RACH users` (`minNumOfHsRachResourceStepsRes`) and

WNCELG Max number of HSUPA resource steps for HS-RACH users (maxNumOfHsRachResourceStepsRes) parameters. In this case, both parameters have the same value. The default values of these parameters are different.

The WNCELG Min number of HSUPA resource steps for HS-RACH users (minNumOfHsRachResourceStepsRes) parameter has a default value of 0 and the WNCELG Max number of HSUPA resource steps for HS-RACH users (maxNumOfHsRachResourceStepsRes) has a default value of 1 (regardless of the *RAN3280: Dynamic Baseband for HS RACH* feature activation status), which means that no static baseband resource allocation is done. In this case, when the RNC configures the HS Cell_FACH UL users in the cell (it means common E-DCH resources are reserved for HS-Cell FACH UL cell), the SBTS attempts to dynamically allocate one HSUPA resource step in the LCG for HS Cell_FACH UL users (supporting a maximum of 10 users in the LCG). If the baseband capacity is available, one resource step is allocated for the HS Cell_FACH UL. If the baseband capacity is not available, the HS Cell_FACH UL setup from the RNC is rejected. *RAN1637: High Speed Cell_FACH DL* users do not require any baseband resource reservation.

Dual-Cell HSUPA feature dimensioning

Rules for Dual-Cell HSUPA (DC-HSUPA) feature dimensioning:

- A DC-HSUPA user is seen as two single-carrier HSUPA (SC-HSUPA) users from the maximum number of users per HSUPA scheduler. For example, with one DC-HSUPA user, the HSUPA scheduler in the LCG supports a maximum of 618 SC-HSUPA users.
- A DC-HSUPA user is counted only in the primary cell from the WBTS Maximum number of E-DCHs in the cell (MaxNumberEDCHCell) parameter point of view.
- A DC-HSUPA user is counted only once per LCG from the WBTS Maximum number of E-DCHs in the local cell group (MaxNumberEDCHLCG) parameter point of view.
- A single LCG configuration supports up to 310 DC-HSUPA users in the LCG.
- Both DC-HSUPA cells must be within the same LCG.
- Up to 10 DC-HSUPA users are supported per cell.
- DC-HSUPA operation is supported only with F-DPCH and 2 ms TTI.
- A DC-HSUPA user is seen as two SC-HSUPA users from the HSUPA resource consumption point of view. In *Flexi Multiradio 10 BTS and Nokia AirScale BTS HSUPA capacity tables*:
  - The HSUPA users per scheduler column defines SC-HSUPA users, thus one DC-HSUPA user is counted as two SC-HSUPA users.
  - The Baseband minimum decoding capacity row defines the capacity that the

SBTS shares for all the cells in the LCG.

- *RAN3067: Flexible HSDPA Carriers Allocation* and *RAN1905: DC-HSUPA* cannot be enabled simultaneously.

HSUPA 16 QAM feature dimensioning

Up to three UEs transmitting with 16 QAM modulation can be allocated in one subunit as presented in the following table.

Table 91: FSMF subunit HSUPA UE allocation

Number of HSUPA 16 QAM transmitting users	Required subunits (FSMF)
1	0.375*
2	0.625
3	0.875

> **Note:**
>
> *One 16 QAM UE consumes 0.375 subunit with throughput between 4.2 Mbps and 11 Mbps. 16 QAM is not used with throughput < 4.2 Mbps. In this case, dimensioning is done based on the HSUPA dimensioning tables (*Flexi Multiradio 10 BTS and Nokia AirScale BTS HSUPA capacity tables*).
> Subunit utilization can change on a TTI base. In the first TTI, the UE transmits with 16 QAM modulation. In the second TTI, different modulation can be used, depending on the radio conditions or the amount of data in the UE buffer.

3.2.7 Multi RAB

Multi RAB and its classification

A call of a single user with multiple (up to four) services active simultaneously is a multi-RAB call. For example, a UE actively downloading data via the High Speed Downlink Packet Access (HSDPA) service while having simultaneous Adaptive Multi-Rate (AMR) voice call, has a multi-RAB service with two Radio Access Bearers (RABs) established: HSDPA RAB + AMR RAB. The general classification of multi-RAB calls is as follows:

- HSDPA + AMR call

- HSUPA + AMR call
- HSUPA/HSDPA + HSUPA/HSDPA call
- DCH + DCH call

HSPA + AMR call resource allocation

If the AMR DCH service is established while the UE has an active HSPA connection, the AMR service is processed with already allocated HSUPA resources. The AMR service of a multi-RAB call does not require any additional baseband resources for processing, neither release 99 channel elements (R99 CE) license keys (LKs) are required in UL or DL.

The setup of an AMR service with ongoing HSPA connection may have an impact on available baseband resources, depending if the UE actively uses the fractional downlink physical channel (F-DPCH) feature:

- HSPA non-FDPCH connection: the newly established AMR service of the multi-RAB call does not have any impact on available baseband resources.
- HSPA FDPCH connection: if the AMR service of multi-RAB call is newly set up, the HSUPA connection is considered as HSUPA non-FDPCH from the baseband resource consumption point of view.

DCH + DCH call resource allocation

Each DCH service of a multi-RAB call requires separate R99 CE baseband resources in UL or DL for processing. In case of a multi-RAB call, an equivalent amount of R99 CEs is consumed as in the case of separate DCH single-RAB calls.

For example, 64/64 kbps + 64/128 kbps multi-RAB baseband resource reservation is the same as baseband resource reservation for 64/64 kbps and 64/128 kbps single RABs.

3.3 GSM baseband dimensioning in SBTS

Overview on the required number of transceivers (TRXs) on AirScale and FSMF

In GSM, the capacity is expressed by max number of TRXs, which can be served by specified baseband resources.

GSM usage of BB resources within FSMF

Table 92: GSM capacity within FSMF

BB plug-in unit	GSM	GSM/WCDMA	GSM/LTE	GSM/WCDMA/LTE
FSMF	24 TRXs or 36 TRXs	24 TRXs / 3.5 subunits or 36 TRXs / 2.5 subunits	24 TRXs / 1 RCS	-
FBBA/C	-	-	-	-
FSMF + FBBA/C	-	24 TRXs / 9.5 subunits or 36TRXs / 8.5 subunits	24 TRXs / (1 RCS +1 BCS)	24 TRXs / 5.5 subunits / 1 RCS or 24 TRXs / 3.5 subunits/ 1 BCS or 36 TRXs / 2.5 subunits / 1 BCS
FSMF + 2 x FBBA/C	-	24 TRXs / 15.5 subunits or 36 TRXs / 14.5 subunits	24 TRXs / 1 RCS + 1 ECS or 24 TRXs / 1 RCS+2 BCS or 36 TRXs / 2 BCS or 36 TRXs / 1 ECS	24 TRXs / 11.5 subunits / 1 RCS or 24 TRXs / 5.5 subunits / 1 RCS + 1BCS or 24 TRXs / 3.5 subunits / 2 BCS or 24 TRXs / 3.5 subunits / 1 ECS or 36 TRXs / 1 ECS or 36 TRXs / 2 BCS

In one FSMF core module, GSM can occupy ½ of FSMF total resources or ¾ of FSMF total resources. In the case where GSM occupies ½ of FSMF resources, 1 of 4 FSMF processors are dedicated to cover GSM traffic. In this case, the following number of TRXs are supported:

- Up to 24 TRXs (1TX/1RX, 1TX/2RX configuration)
- Up to 8 TRXs (1TX/1RX, 1TX/2RX configuration) + 8 TRXs (2TX/2RX, 1TX/4RX, 2TX/4RX configuration)
- Up to 8 TRXs (2TX/2RX, 1TX/4RX, 2TX/4RX configuration)

When GSM occupies ¾ of FSMF resources, 3 of 4 FSMF processors are dedicated to cover GSM traffic. In this case, the following number of TRXs are supported:

- Up to 36 TRXs (1TX/1RX, 1TX/2RX configuration)
- Up to 12 TRXs (1TX/1RX, 1TX/2RX configuration) + 12 TRXs (2TX/2RX, 1TX/4RX, 2TX/4RX
- Up to 12 TRXs (2TX/2RX, 1TX/4RX, 2TX/4RX configuration)

GSM usage of BB resources within ABIA

GSM traffic can be located on ¼ ABIA, supporting 24TRXs or up to ½ of ABIA, supporting 36 TRXs. The remaining resources of the same ABIA can be used to serve LTE or WCDMA traffic.

Table 93: GSM capacity within ABIA

BB plug-in unit	GSM	GSM-WCDMA	GSM-LTE
ABIA	24 TRXs (¼ of ABIA) or 36 TRXs (½ of ABIA)	24 TRXs / 6 subunits or 36 TRXs / 4 subunits	24 TRXs / 1 x BCS or 24 TRXs / 1 x PCS or 36 TRXs / 1 x BCS or 36 TRXs / 1 x PCS
½ ABIA	24 TRXs (¼ of ABIA) or 36 TRXs (½ of ABIA)	-	-

When GSM occupies ¼ of ABIA resources, the following number of TRXs are supported:

- Up to 24 TRXs (1TX/1RX, 1TX/2RX configuration)
- Up to 8 TRXs (1TX/1RX, 1TX/2RX configuration) + 8 TRXs (with 2TX/2RX, 1TX/4RX, 2TX/4RX configuration)
- Up to 8 TRXs (2TX/2RX, 1TX/4RX, 2TX/4RX configuration)

When GSM occupies ½ of ABIA resources, the following number of TRXs are supported:

- Up to 36 TRXs (1TX/1RX, 1TX/2RX configuration)
- Up to 12 TRXs (1TX/1RX, 1TX/2RX configuration) + 12TRX (with 2TX/2RX, 1TX/4RX, 2TX/4RX configuration)
- Up to 12 TRXs (2TX/2RX, 1TX/4RX, 2TX/4RX configuration)

For more information on GSM baseband dimensioning in SBTS, see the *Operating*

Documentation/GSM in Single RAN/BTS EDGE Dimensioning document.

4. Common transport dimensioning in SBTS

How to dimension the common transport network in SBTS

4.1 SBTS common transport dimensioning process

Concept of common transport and the method of computing network load

Single RAN introduces the concept of common transport. Instead of having one transport for each RAT, there is only one shared transport entity in SBTS.

Network load is calculated separately for each RAT. The total network load is calculated as a sum of loads of GSM, WCDMA and LTE technologies. GSM is treated as a fallback for WCDMA in terms of voice services.

There are two possible approaches to common transport dimensioning in SBTS:

- Based on traffic profile (recommended)
- Based on air interface capabilities

4.2 Dimensioning based on traffic profile (recommended)

Traffic profile dimensioning benefits

Dimensioning based on traffic profile has the following benefits:

- It is adapted to actual needs.
- Quality of Service (QoS) parameters are taken into account, which improves performance.

A traffic profile must be provided by the operator. If a traffic profile is not available, a default Nokia traffic profile is used.

4.3 Dimensioning based on air interface capabilities

Dimensioning methods for air interface capabilites

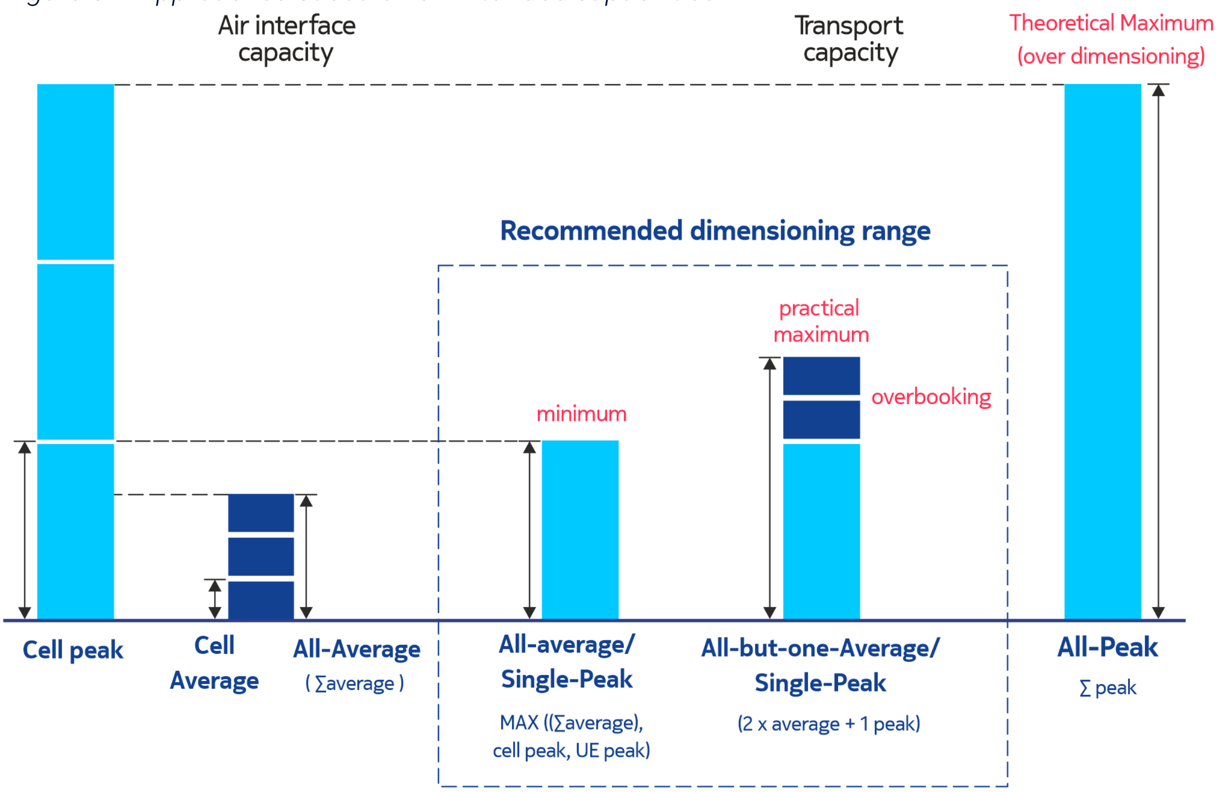
Dimensioning based on air interface capabilities has the following benefits:

- It is a simple and straightforward calculation.
- It can be used if a traffic profile is not available.

There are three approaches to dimensioning based on air interface capabilities, each based on different assumptions:

- All-Average
  The backhaul connection supports the aggregated average capacity of all cells. The average capacity is determined under realistic air interface conditions and multiple users per cell.
- All-Average/Single-Peak
  The backhaul connection supports the aggregated average capacity of all cells or the peak capacity of one cell (whichever has the greater value).
- All-Peak
  The backhaul connection supports the aggregated peak capacity of all cells. The peak capacity is determined under ideal air interface conditions and with a single user per cell. This approach leads to over-dimensioning, which usually generates extra costs.

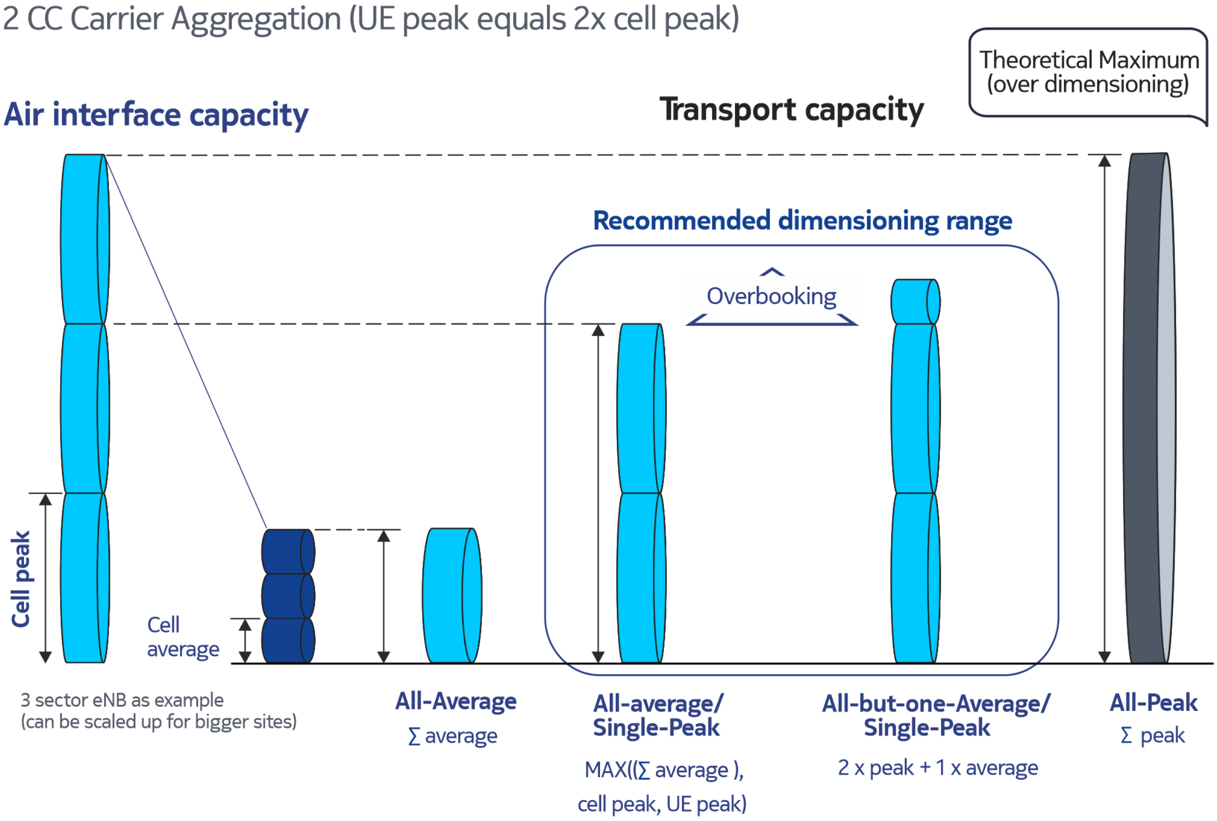
Figure 31: Approaches based on air interface capabilities



The table above presents the recommended dimensioning range. As an example, a three-sector base station is used. However, it is scalable to base stations having more than three sectors.

The All-Average/Single-Peak approach is a good way to optimize both performance and costs. However, it may lead to over-dimensioning for sites with low utilization, and under-dimensioning for hot spots.

Figure 32: Dimensioning based on air interface capacity with carrier aggregation



The carrier aggregation introduces the UE peak. At least a single UE peak must be transported via the backhaul network. This peak is determined by the sum of carriers being aggregated (as the two carriers shown in the figure above).

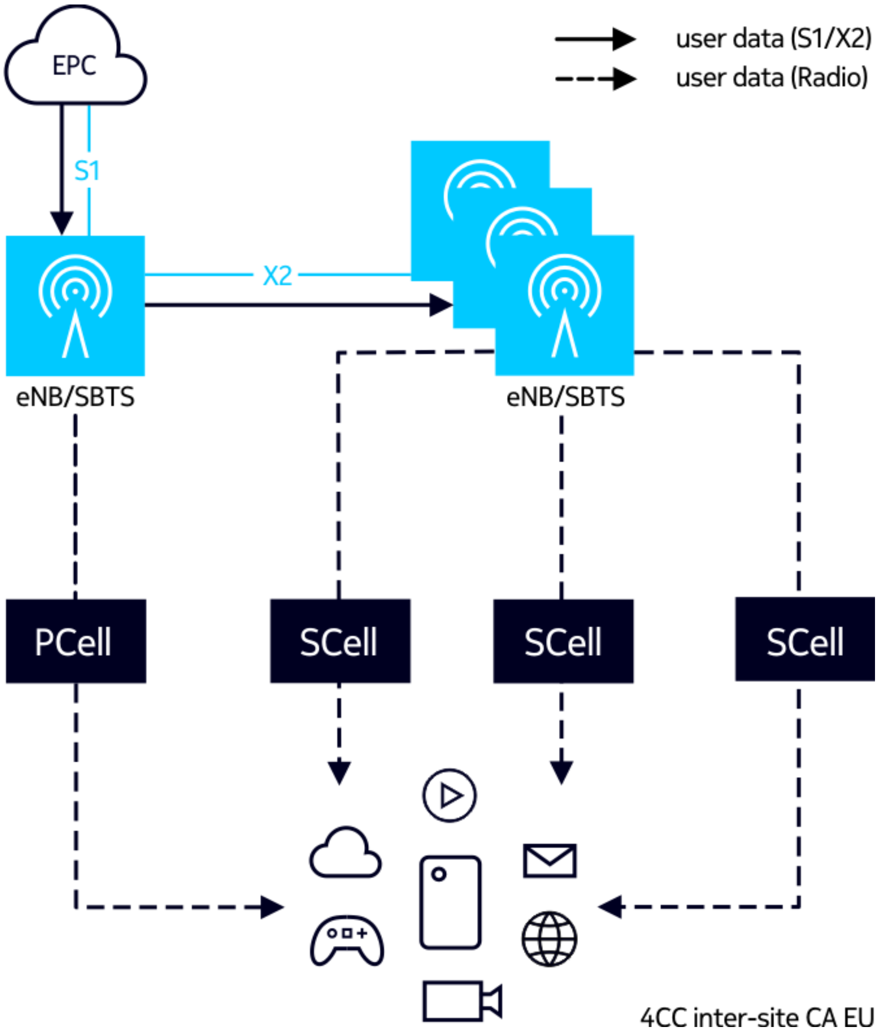
The *LTE3022/SR001419: Inter-site Carrier Aggregation* feature extends the existing carrier aggregation functionality by allowing the aggregation of additional secondary cells (SCells) hosted by remote eNBs/SBTSs connected over the X2 interface.

Inter-site carrier aggregation (CA) is possible only in downlink, and for a maximum of five component carriers (CC) in FDD mode or for a maximum of four CCs in the mixed mode (2 FDD + 2 TDD). The maximum number of eNBs/SBTSs involved in a single inter-site CA operation is four.

Due to inter-site CA, additional traffic is observed on the S1 interface (PCell) and on the X2 interfaces. Interface dimensioning must consider this extra traffic.

The traffic split among the CCs in downlink is realized by the data scheduler in the master eNB/SBTS (the one hosting the primary cell (PCell)). The entire traffic due to inter-site CA is processed first in the master eNB/SBTS before it gets dispatched to the other eNBs/SBTSs over the X2 interface.

Figure 33: Inter-site carrier aggregation



The eNB/SBTS that is chosen as PCell faces additional traffic in downlink (S1-U) and uplink (X2-U). The SCell's total downlink traffic does not change, nor does the inter-site CA traffic for total cell capacity. As such, the total amount of SCell traffic is just moving from S1-U to a sum of S1-U and X2-U. The selection of the PCell is also distributed across the eNB/SBTS and the expected percentage of inter-site CA calls is fairly moderate. This results in an increase of the total downlink and uplink traffic, although not to a significant amount. Precise dimensioning can be done only by taking into account several assumptions and configuration parameters.

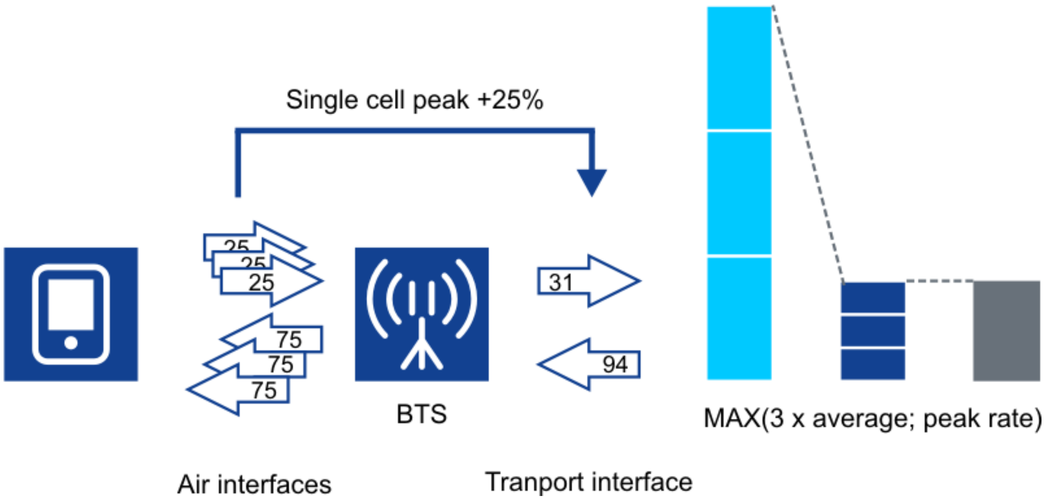
4.4 Transport overhead and dimensioning example

Network load calculation based on air interface and transport overhead

When calculating network load, the air interface overhead and transport overhead must be taken into account. Typically, transport overhead amounts to 27% of the packet size increase, 2% of which results from air interface overhead. If IPsec is not in use, transport overhead amounts to 15%.

> **Note:**
>
> The overhead depends on the average packet size, which can vary from traffic profile to traffic profile. The overhead increases further when IPv6 is used.

Figure 34: Example of SBTS common transport dimensioning based on air interface capabilities without LTE carrier aggregation



Transport in downlink direction:

- 75 Mbit/s net PHY peak rate per cell (64 quadrature amplitude modulation (QAM) 2 x 2 MIMO)
- 17 Mbit/s net PHY average rate per cell

Transport in uplink direction:

- 25 Mbit/s net PHY peak rate per cell (16 QAM)
- 7 Mbit/s net PHY average rate per cell

Transport overhead (Ethernet layer, with IPsec):

- Air interface overhead (PDCP/RLC) -2%
- Transport overhead (GTP-U, UDP, IPv4, Eht) +15%
- IPsec overhead: +12%
- Total (on top air interface capacity) +25%

MAX((Σ average), cell peak, UE peak) = MAX(3 * 7; 25) = 25 Mbit/s

MAX((Σ average), cell peak, UE peak) = MAX(3 * 17; 75) = 75 Mbit/s

25 * (1 + 0.25) = 31 Mbit/s

75 * (1 + 0.25) = 94 Mbit/s

In case carrier aggregation is used, the possible UE peak exceeds the cell peak, since several cell peaks are combined.

4.5 Estimation of C-Plane, M-Plane and S-Plane bit rates

C-plane, M-Plane and S-plane bit rate estimation methods

Control Plane (C-Plane) bit rate:

- Depends on user activity and mobility.
- During calculation, only the simplest method is taken into account:
  $TransportCapacity_{C\text{-}Plane}$[kbit/s] = $TransportCapacity_{U\text{-}Plane}$[kbit/s] * C-PlaneBWPercentage[%]
  Default values for C-PlaneBWPercentage:
  - LTE = 1%
  - WCDMA = 6%

Management Plane (M-Plane) bit rate:

- Mainly depends on counter and tracing configuration.
- Peaks may reach up to 30 Mbit/s. However, only a small part (0-5 Mbit/s) is needed on a permanent basis.
  Recommended bandwidth from transport dimensioning perspective:
  - LTE = 1 Mbit/s
  - WCDMA = 64 kbit/s
  - GSM = 64 kbit/s

Synchronization Plane (S-Plane) bit rate:

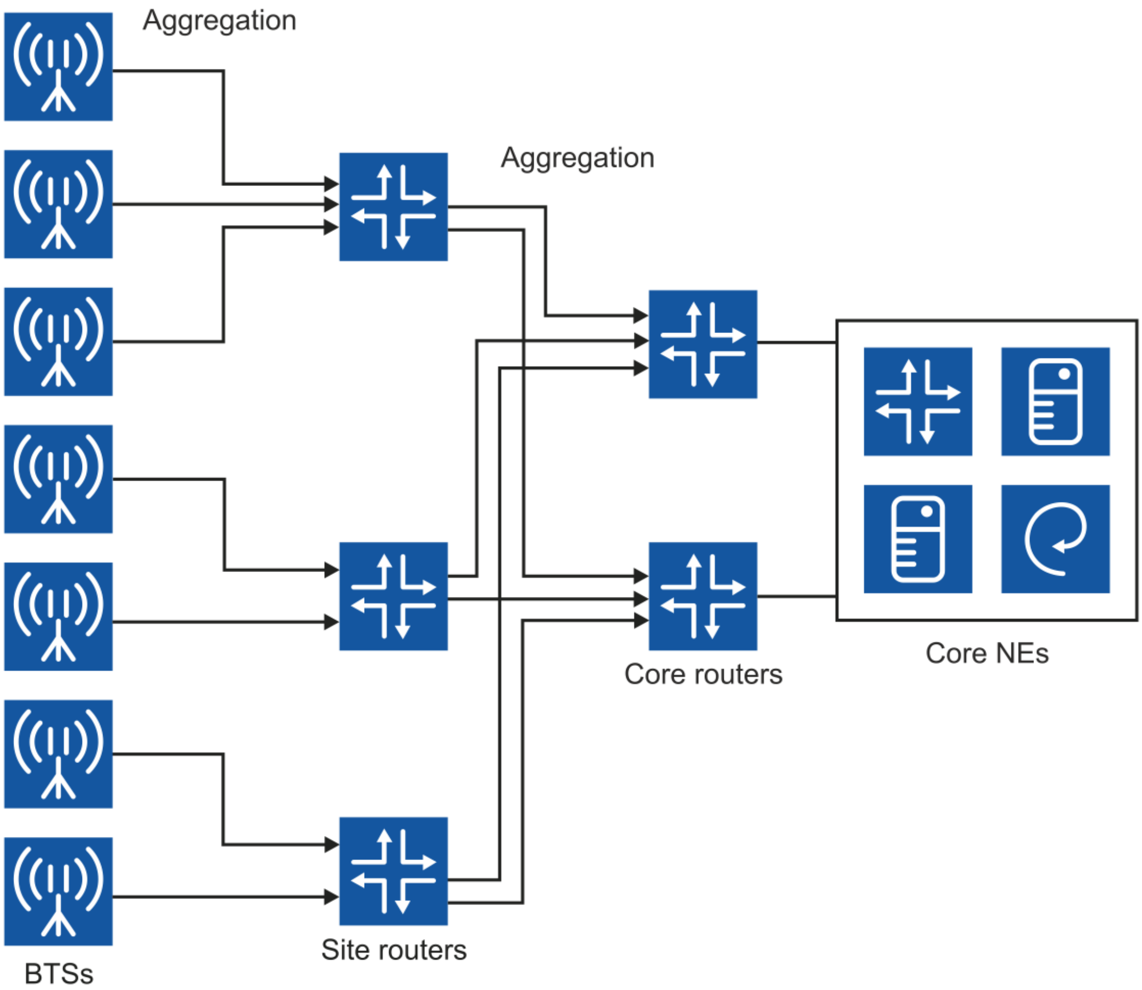
- Depends on the selected synchronization method:
  - Timing over Packet (ToP) with frequency synchronization = ~16 kbps/site (at 16 msgs/second)
  - Timing over Packet (ToP) with phase synchronization = ~239 kbps/site (at 128 msgs/second)
  - Synchronous Ethernet (SynchE) = ~8kbps/site (SSM messaging)

4.6 Mutliplexing gain

Transport link bandwidth save using multiplexing gain

Multiplexing gain is the amount of transport link bandwidth (BW) that can be saved by considering the diversity of the traffic demand, that is the variation of the traffic load in time and the available buffering space.

Figure 35: Calculation of the multiplexing gain

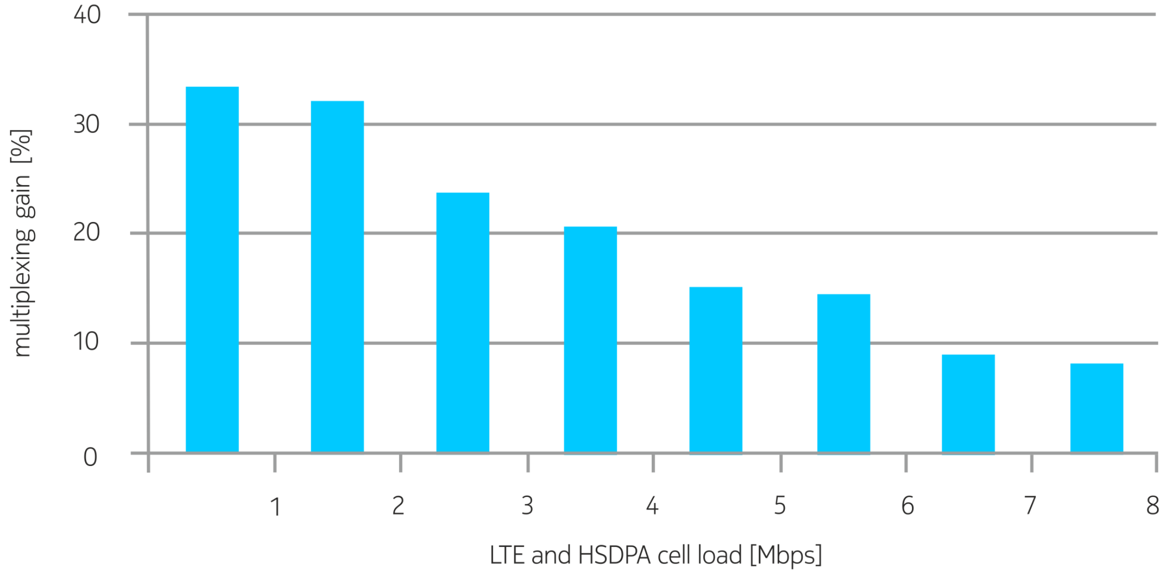


$$multiplexing\_gain = \left(1 - \frac{Aggregated\_TN\_BW}{BW\_BTS1 + BW\_BTS2}\right) \times 100\%$$

The figure below presents multiplexing gain on the transport network between two radio cells (LTE and HSDPA).

Multiplexing gain decreases as cell load increases.

Figure 36: LTE and HSDPA cell load multiplexing gain



For details on WCDMA access network dimensioning, see *Dimensioning WCDMA RAN: Access Network (Transport Interfaces)*.

For details on LTE access network dimensioning, see *Long Term Evolution Operating Documentation/ LTE Radio Access/ LTE System/ Planning LTE System/ LTE Access Dimensioning Guideline* document.

5. SRAN capacity licenses

SRAN capacity licensing is based on air interface traffic and backhaul transport traffic.

License management is a method for controlling the use of optional software applications, the capacity of network elements, and some optional hardware functionalities. For more details, see 5G and SRAN License Operation.

The air interface traffic licenses are:

- SR001004.T SBTS Data User
- RAN2123.4.T R99 CE capacity
- RAN2123.6.T CCCH Processing Set
- BSC00311 Flexi Multiradio TRX HW activation license

Backhaul transport traffic is covered by the licenses introduced by the *SR000834: IP Traffic Capacity* feature. There are three options available, the operator can choose only one at a time, and the options are mutually exclusive.

Backhaul transport traffic licenses are:

- SR000834.1.T SBTS Daily UP Data Volume
- SR000834.3.T SBTS Quarterly UP Data Volume
- SR000834.2.T SBTS Busy Hour UP Throughput

6. Dimensioning glossary

A glossary with specific terms related to dimensioning

AirScale Capacity extension plug-in unit (ABIA)	A capacity plug-in unit for the Nokia AirScale System Module Indoor/Outdoor. It provides cell-specific baseband processing and optical interfaces to radio units.
AirScale Common plug-in unit (ASIA)	A networking card within the AirScale System Module. ASIA provides transport interfaces and centralized processing.
baseband (BB) pool	Concentration of baseband resources in one place that enables signal processing resources to be shared between cells. This helps maximize the efficiency of baseband processing capacity usage.
Carrier Aggregation (CA)	In radio resource management, a method of increasing the bit rate by increasing the bandwidth. It is done by scheduling the data package transfer to more than one cell (component carriers). In CA, one cell acts as a primary cell and is changed only during the handover process, while the other component carriers are served by secondary cells and can be added or removed as required.
Centralized SW License Server (CLS)	Centralized application that provides a central control point for sharing an SW license key-based right-to-use to Nokia Networks software.
component carrier	In Carrier Aggregation (CA), the part of transmission bandwidth. Component carriers can belong to the same band (intra-band CA) or they can be part of different bands (inter-band CA).
control plane (C-plane)	The layer performing the signaling functions necessary to set up, supervise, and release calls and connections.
Internet Protocol version 6 (IPv6)	The sixth version of the Internet Protocol with the most important improvement to Internet Protocol version 4 (IPv4), namely the generation of more IP addresses.
primary cell (PCell)	In Carrier Aggregation (CA), the cell that is used to configure the connection. The PCell hosts radio resource control protocol data connection besides to providing an additional bandwidth to increase the bit rate. The PCell for the UE is changed only at handover.

quadrature amplitude modulation (QAM)
Modulation system that significantly increases the amount of information that can be carried within a given bandwidth.

secondary cell (SCell)
In Carrier Aggregation (CA), the additional cell that hosts a component carrier. The SCell provides an additional bandwidth to increase the bit rate. The SCell for the UE can be added or removed when required.

user plane (U-plane)
A layer in which user data or speech coming from the radio network controller is converted to pulse code modulation (PCM) user data and the other way round.