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LTE 19B Changes

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Summary of changes

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

Changes between Issue 01B (LTE 19B, 2020-04-07) and Issue 01A (LTE 19B, 2019-11-22)

The following sections have been added:

- LTE19 performance changes

Changes between Issue 01A (LTE 19B, 2019-11-22) and Issue 01 (LTE 19B, 2019-10-25)

The following sections have been added:

- LTE4549 changes to the LTE19B system
- LTE5510 changes to the LTE19B system
- LTE5558 changes to the LTE19B system
- Change in handling the Radio Network Layer Cause: "Release due to E-UTRAN Generated Reason"

1 Changes introduced with SRAN alignment

Following up the changes introduced in the LTE19 release, LTE and SRAN technologies are further aligned, resulting in an unified software.

The operability, maintenance, and transport areas in the LTE19 release were aligned with SRAN, due to Single Operations, Administrations and Maintenance (SOAM) architecture introduction (see Changes introduced with SOAM). In the LTE19A release, the software for LTE and SRAN is also aligned, resulting in:

- New naming convention: SBTS19A_ENB_xxxx_xxxxxx_xxxxxx.
- Easier switch from LTE-only mode to SRAN - possible by a configuration change.
- Both types of licenses, LTE and SRAN, are supported with the same software build - a migration process for licenses is not required.

For more information, see *LTE5286: Common SW Load for LTE and SRAN*.

This change impacts the documentation as well, resulting in common documents between LTE19A and SRAN19A documentation sets:

- *SBTS System Upgrade*
- all documents under *Commissioning and configuring SBTS* category
- *Troubleshooting SBTS*

1.1 Changes introduced with SOAM

The LTE19 releases introduces the Single Operations, Administrations and Maintenance (SOAM) architecture for all LTE customers using Nokia AirScale BTS and Flexi Multiradio 10 BTS.. The SOAM architecture brings various changes in legacy features content, mostly in the transport area.

As a result of SOAM introduction, there are several changes impacting the end users:

- Web Element Manager (WebEM) replaces BTS Site Manager (BTS SM)
- BTS Mediator (BTS MED) replaces iOMS
- transport features and parameters' structure are changed.

With introduction of SOAM, the LTE architecture is aligned with SRAN, and a new **SBTS** term is introduced.

SBTS A BTS working under SOAM architecture, capable of supporting one RAT (for example, LTE) or several different RATs (for example, LTE, WCDMA, and GSM) at the same time.

1.1.1 SOAM architecture overview

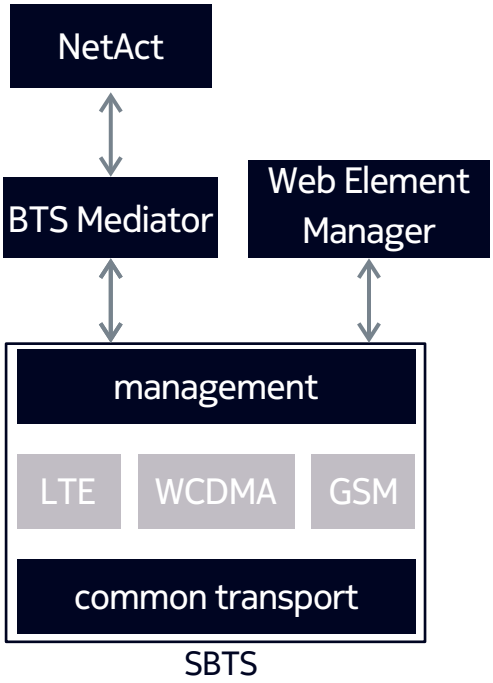
The Single Operations, Administrations and Maintenance (SOAM) architecture introduces the harmonized information model and the common management tools for all Radio Access Technologies (RAT), with BTS Mediator (BTS MED) as the interface between SBTS and NetAct.

SOAM main functionalities include:

- Network management operations between NetAct and the BTSs (using BTS MED)
- Common software and site configuration management
- Support for flexible RAT-level maintenance and recovery
- Common management tool called Web Element Manager (WebEM)

The high level SOAM architecture comprises NetAct, BTSMED, and WebEM. At the SBTS, the management level is completely decoupled from RAT applications.

Figure 1 O&M architecture for SBTS



1.1.2 Feature mapping

Mapping between legacy transport features and Common Transport features

The *LTE2113* feature is basically an umbrella feature consisting of legacy LTE transport features up to LTE18. Each of these legacy LTE transport features has a mapping to a Common Transport LTE feature. Features from LTE18A onwards will be aligned to Common Transport features. See the following mapping tables:

Table 1 Mapping legacy features to Common Transport LTE features - new feature number

LTE legacy feature number	LTE legacy feature	New LTE feature number in Common Transport	LTE feature name in Common Transport
LTE1710	Sync Hub Direct Forward	LTE3976	SHDF based RF sharing

Table 1 Mapping legacy features to Common Transport LTE features - new feature number (Cont.)

LTE legacy feature number	LTE legacy feature	New LTE feature number in Common Transport	LTE feature name in Common Transport
LTE118	Fast Ethernet (FE) / Gigabit Ethernet (GE) electrical interface	LTE1313	Electrical 100/1000-Base-T Interface
LTE119	Gigabit Ethernet (GE) optical interface	LTE1314	Small Form Factor Plugable Slot (SFP slot)
LTE119	Gigabit Ethernet (GE) optical interface	LTE1315	1000Base-SX Optical GE Interface
LTE119	Gigabit Ethernet (GE) optical interface	LTE1863	1000Base-LX Optical GE Interface
LTE119	Gigabit Ethernet (GE) optical interface	LTE1864	1000Base-ZX Optical GE Interface
LTE119	Gigabit Ethernet (GE) optical interface	LTE1865	1000Base-BX Optical GE Interface
LTE664 LTE931 LTE649	LTE transport protocol stack Ethernet Jumbo Frames QoS Aware Ethernet Switching	LTE1312	Ethernet Termination
LTE132 LTE491	VLAN based traffic differentiation, FlexiPacket Radio Connectivity	LTE1316	Multiple VLAN interfaces
LTE664 LTE125 LTE775 LTE648 LTE955 LTE1559 LTE2299	LTE transport protocol stack IPv6 for U/C plane SCTP Multihoming (MME) SCTP Multihoming IPv6 for Management Plane SCTP enhancements Dual Stack IPv4/IPv6 for S1/X2	LTE1869	IPv4/IPv6 Transport Stack
LTE871	TRS Support for Site Support Equipment	LTE3562	Basic routing for SSE traffic
LTE129 LTE131 LTE138	Traffic prioritization on Ethernet layer Traffic prioritization on IP layer (Diffserv) Traffic Shaping (UL)	LTE1317	BTS QoS Support for Terminated and Routed Traffic

Table 1 Mapping legacy features to Common Transport LTE features - new feature number (Cont.)

LTE legacy feature number	LTE legacy feature	New LTE feature number in Common Transport	LTE feature name in Common Transport
LTE1710	Sync Hub Direct Forward	LTE2330	1PPS&ToD Sync from Sync Hub Master
LTE80 LTE663 LTE1125	GPS synchronization GPS location and time retrieval GNSS receiver FYGB	LTE2328	1PPS&ToD Sync from External GNSS Receiver
LTE80 LTE911	GPS synchronization TDD Frame synchronized operation	LTE2329	BTS Synchronization Mode Support
LTE80 LTE911	GPS synchronization TDD Frame synchronised operation	LTE3459	Synchronization Holdover Support
LTE2184	Flexible Sync Input Priority	LTE3458	Common Flexible Sync Input Priority
LTE664 LTE875 LTE1401 LTE144 LTE131 LTE648	LTE transport protocol stack Different IP addresses for U/C/M/S-plane Measurement based TAC Transport Admission Control Traffic prioritization on IP layer (Diffserv) SCTP Multihoming	LTE1397	IPv4 based S1/X2
LTE1117 LTE3201 LTE3552	IPv4 based M1/M3 (part of MBMS) eMBMS in RAN sharing deployment support eMBMS capacity enhancement and support for overlapping of MBSFN Areas	LTE2227	IPv4 based M1/M3 (part of MBMS)
LTE664	LTE transport protocol stack	LTE3457	IPv4 based Management plane

Table 2 Mapping legacy to Common Transport LTE features - the same feature number

LTE legacy feature number	LTE legacy feature	LTE feature number Common Transport	LTE feature Common Transport
LTE1738	10GBase-LR Optical GE Interface	LTE1738	10GBase-LR Optical GE Interface
LTE1652	Small Form Factor Plugable (Plus) Slot	LTE1652	Small Form Factor Plugable (Plus) Slot
LTE1554	10GBase-SR Optical GE Interface	LTE1554	10GBase-SR Optical GE Interface
LTE649	QoS Aware Ethernet Switching	LTE649	QoS Aware Ethernet Switching
LTE866	Fast IP Rerouting	LTE866	Fast IP Rerouting
LTE1244	Source based Routing in BTS	LTE1244	Source based Routing in BTS
LTE2299	Dual Stack IPv4 / IPv6	LTE2299	Dual Stack IPv4 / IPv6
LTE1981	IPv6 for S-plane	LTE1981	IPv6 for S-plane
LTE1980	IPv4/IPv6 concurrent IPsec tunnel	LTE1980	IPv4/IPv6 concurrent IPsec tunnel
LTE2807	IPv6 for M1/M3	LTE2807	IPv6 for M1/M3
LTE689	IPsec for BTS	LTE689	IPsec for BTS
LTE1390	IPsec Emergency Bypass	LTE1390	IPsec Emergency Bypass
LTE1753	Backup IPsec Tunnel	LTE1753	Backup IPsec Tunnel
LTE2401	Flexible IP Addressing for PKI	LTE2401	Flexible IP Addressing for PKI
LTE2580	IPsec Expert Mode	LTE2580	IPsec Expert Mode
LTE739	IPSec for BTS (Rel.13)	LTE739	IPSec for BTS (Rel.13)
LTE692	BTS Firewall	LTE692	BTS Firewall
LTE746	IP based filtering for BTS SSE	LTE746	IP based filtering for BTS SSE
LTE1771	LTE Dual U-plane IP addresses	LTE1771	LTE Dual U-plane IP addresses
LTE505	Transport Separation for LTE RAN Sharing	LTE505	Transport Separation for LTE RAN Sharing
LTE1240	LTE User Layer TCP MSS clamping	LTE1240	LTE User Layer TCP MSS clamping
LTE592	Link Supervision with BFD	LTE592	Link Supervision with BFD
LTE140	Ethernet OAM	LTE140	Ethernet OAM
LTE574	IP Transport Network Measurements	LTE574	IP Transport Network Measurements

Table 2 Mapping legacy to Common Transport LTE features - the same feature number (Cont.)

LTE legacy feature number	LTE legacy feature	LTE feature number Common Transport	LTE feature Common Transport
LTE1460	Local and Remote IP Traffic Capturing	LTE1460	Local and Remote IP Traffic Capturing
LTE2417	IP Traffic Capacity	LTE2417	IP Traffic Capacity
LTE2788	Stateful Reflector for TWAMP	LTE2788	Stateful Reflector for TWAMP
LTE711	Synchronization from 2.048MHz signal	LTE711	Synchronization from 2.048MHz signal
LTE710	Synchronization from PDH interface	LTE710	Synchronization from PDH interface
LTE713	Synchronous Ethernet	LTE713	Synchronous Ethernet
LTE134	Timing over Packet with Frequency Synchronization	LTE134	Timing over Packet with Frequency Synchronization
LTE610	Timing over Packet Resilience	LTE610	Timing over Packet Resilience
LTE891	Timing over Packet with Phase Synchronization	LTE891	Timing over Packet with Phase Synchronization
LTE942	Hybrid Synchronization	LTE942	Hybrid Synchronization
LTE612	Synchronization Hub	LTE612	Synchronization Hub
LTE1710	Sync Hub Direct Forward	LTE1710	Sync Hub Direct Forward
LTE2645	GNSS Manual Location Entry	LTE2645	GNSS Manual Location Entry
LTE563	Synchronous Ethernet Generation	LTE563	Synchronous Ethernet Generation
LTE3046	ToP with Phase Sync Resiliency	LTE3046	ToP with Phase Sync Resiliency
LTE2438	GNSS - Operation Mode and Tracking	LTE2438	GNSS - Operation Mode and Tracking
LTE1068	S1/X2 satellite connection	LTE1068	S1/X2 satellite connection
LTE2414	Transport Overload Protection	LTE2414	Transport Overload Protection
LTE2841	Transport Overload Protection (AirScale)	LTE2841	Transport Overload Protection (AirScale)
LTE2763	Fronthaul Passive WDM	LTE2763	Fronthaul Passive WDM
LTE2855	Fronthaul Active WDM	LTE2855	Fronthaul Active WDM
LTE1710	Sync Hub Direct Forward	LTE3976	SHDF based RF sharing
LTE3456	7750-SR as Security Gateway	LTE3456	7750-SR as Security Gateway

Table 2 Mapping legacy to Common Transport LTE features - the same feature number (Cont.)

LTE legacy feature number	LTE legacy feature	LTE feature number Common Transport	LTE feature Common Transport
LTE3449	Fronthaul SFPs for fAlu site adaptation for LTE FDD and TDD	LTE3449	Fronthaul SFPs for fAlu site adaptation for LTE FDD and TDD
LTE1048	X2 mesh connectivity with IPsec	LTE1048	X2 mesh connectivity with IPsec
LTE3480	Loose Phase and Time Synchronization	LTE3480	Loose Phase and Time Synchronization

Note: Details about feature-licensing are available in the document LTE BTS Licenses. See BTS Reference Data/ LTE BTS Licenses.

1.1.3 New features

Summary of new transport features that replace legacy transport features

The following new transport features that are harmonized with SRAN are introduced in the *LTE Dedicated Mode* and replace legacy LTE transport features (reference to legacy features is in the FDD/TD-LTE18 release) summarized in the next paragraph:

Physical interfaces

- *LTE1313: Electrical 100/1000-Base-T Interface*
- *LTE1314: Small Form Factor Plugable Slot (SFP slot)*
- *LTE1315: 1000Base-SX Optical GE Interface*
- *LTE1863: 1000Base-LX Optical GE Interface*
- *LTE1864: 1000Base-ZX Optical GE Interface*
- *LTE1865: 1000Base-BX Optical GE Interface*

Ethernet transport

- *LTE1312: Ethernet Termination*
- *LTE1316: Multiple VLAN interfaces*

IP transport

- *LTE1869: IPv4/IPv6 Transport Stack*
- *LTE3562: Basic Routing for SSE Traffic*

Quality of Service

- *LTE1317: BTS QoS Support for Terminated and Routed Traffic*

Synchronization

- *LTE2330: 1PPS&ToD Sync from Sync Hub Master*

- *LTE2328: 1PPS&ToD Sync from external GNSS receiver*
- *LTE2329: BTS Synchronization Mode Support*
- *LTE3458: Common Flexible Sync Input Priority*
- *LTE3459: Synchronization Holdover Support*

TRS adapters

- *LTE1397: IPv4 based S1/X2*
- *LTE2227: IPv4 based M1/M3*
- *LTE3457: IPv4 based Management Plane*

Site solution

- *LTE3976: SHDF based RF sharing*

1.1.4 Replaced features

Summary of transport legacy features that are replaced by new transport features

The following legacy LTE transport features (reference to legacy features is in the FDD/TD-LTE18 release) are in LTE dedicated mode and replaced by the new transport features:

Originating from RL09

- *LTE118: Fast Ethernet (FE)/Gigabit Ethernet (GE) electrical interface*
- *LTE119: Gigabit Ethernet (GE) optical interface*
- *LTE664: LTE transport protocol stack*

Originating from RL05TD

- *LTE911: TDD Frame synchronized operation*

Originating from RL10

- *LTE129: Traffic prioritization on Ethernet layer*
- *LTE131: Traffic prioritization on IP layer (Diffserv)*
- *LTE132: VLAN based traffic differentiation*
- *LTE138: Traffic Shaping (UL)*
- *LTE871: TRS Support for Site Support Equipment*
- *LTE875: Different IP addresses for U/C/M/S-plane*
- *LTE663: GPS location and time retrieval*
- *LTE80: GPS synchronization*

Originating from RL20

- *LTE775: SCTP Multihoming (MME)*
- *LTE491: FlexiPacket Radio Connectivity*

Originating from RL30

- *LTE931: Ethernet Jumbo Frames*

- *LTE144: Transport Admission Control*

Originating from RL60

- *LTE1401: Measurement based TAC*

Originating from RL70

- *LTE648: SCTP Multihoming*

Originating from FDD/TD-LTE 15A

- *LTE1559: SCTP enhancements*

Originating from FDD/TD-LTE16

- *LTE2184: Flexible Sync Input Priority*
- *LTE955: IPv6 for Management Plane*

1.1.5 Summary of the changes in legacy transport features

Changes in features from the area of physical interfaces, Ethernet/IP transport, TRS security/adapters/Operations, Administrations, and Maintenance (OAM), and synchronization

The following legacy LTE transport features remain valid. However, the features are partially modified, for example the update of an object model:

Physical interfaces

- *LTE1738: 10GBase-LR Optical GE Interface*
- *LTE1652: Small Form Factor Pluggable (Plus) Slot*
- *LTE1554: 10GBase-SR Optical GE Interface*

Ethernet transport

- *LTE649: QoS Aware Ethernet Switching*

IP transport

- *LTE866: Fast IP Rerouting*
- *LTE1244: Source based Routing in BTS*
- *LTE2299: Dual Stack IPv4/IPv6*
- *LTE1981: IPv6 for S-plane*
- *LTE1980: IPv4/IPv6 concurrent IPsec Tunnel*
- *LTE2807: IPv6 for M1/M3*

TRS security

- *LTE1390: IPsec Emergency Bypass*

- *LTE1753: Backup IPsec Tunnel*
- *LTE689: IPsec for BTS*
- *LTE2401: Flexible IP Addressing for PKI*
- *LTE2580: IPsec Expert Mode*
- *LTE739: IPsec for BTS (Rel.13)*
- *LTE692: BTS Firewall*
- *LTE746: IP based filtering for BTS SSE*
- *LTE2580: IPsec Expert Mode*
- *LTE1048: X2 mesh connectivity with IPsec*

TRS adapters LTE

- *LTE1771: LTE Dual U-plane IP addresses*
- *LTE505: Transport Separation for LTE RAN Sharing*
- *LTE1240: LTE User Layer TCP MSS clamping*

TRS OAM

- *LTE592: Link Supervision with BFD*
- *LTE140: Ethernet OAM*
- *LTE574: IP Transport Network Measurements*
- *LTE1460: Local and Remote IP Traffic Capturing*
- *LTE2417: IP Traffic Capacity*
- *LTE2788: Stateful Reflector for TWAMP*

Synchronization

- *LTE711: Synchronization from 2.048MHz signal*
- *LTE710: Synchronization from PDH interface*
- *LTE713: Synchronous Ethernet*
- *LTE134: Timing over Packet with Frequency Synchronization*
- *LTE610: Timing over Packet Resilience*
- *LTE891: Timing over Packet with Phase Synchronization*
- *LTE942: Hybrid Synchronization*
- *LTE612: Synchronization Hub*
- *LTE1710: Sync Hub Direct Forward*
- *LTE2645: GNSS Manual Location Entry*
- *LTE563: Synchronous Ethernet Generation*
- *LTE3046: ToP with Phase Sync Resiliency*
- *LTE2438: GNSS - Operation Mode and Tracking*
- *LTE3480: Loose Phase and Time Synchronization*

Other

- *LTE1068: S1/X2 satellite communication*
- *LTE2414: Transport Overload Protection*

- *LTE2841: Transport Overload Protection (AirScale)*
- *LTE2763: Fronthaul Passive WDM*
- *LTE2855: Fronthaul Active WDM*
- *LTE3456: 7750-SR as Security Gateway*
- *LTE3449: Fronthaul SFPs for fAlu site adaptation for LTE FDD and TDD*

On LTE sites, where both IPv4 and IPv6 traffic is present simultaneously, user may be monitoring the PHB counters for IPv4 and IPv6 traffic separately both in the Tx and Rx directions at the IP interfaces. In such deployments, once the site is upgraded to Common Transport, these IP family specific PHB counters will be missing. This restriction will be removed in a future release.

LTE2113 impact on sales items and licensing

High-level summary of impacts to sales items and licensing

With the evolution to Common Transport, all licensed features in Legacy are expected to continue to work seamlessly. In the following tables, the changes are listed. Also, interface based pricing has been introduced i.e. first 1 Gigabit port is free, additional 1 Gigabit ethernet or optical ports are charged. Transport features and/or Transport sales items that are not listed in the following tables are either not impacted by Common Transport evolution or is basic software (BSW). Refer to FDD-LTE or TD-LTE Sales Guides for more details.

Table 3 Features/Sales Items merging to Single Feature/Sales Item for alignment

Merged features/sales items	New features/sales item in Common Transport
LTE119: Gigabit Ethernet (GE) optical interface LTE1771: LTE Dual U-Plane IP addresses LTE649: QoS Aware Ethernet Switching	LTE1314: Small Form Factor Pluggable Slot
LTE1771: LTE Dual U-Plane IP addresses LTE649: QoS Aware Ethernet Switching LTE118: Fast Ethernet (FE) / Gigabit Ethernet (GE) electrical interface	LTE1313: Electrical 100/1000-Base-T interface

Table 4 Sales Item's features to be replaced by new feature for alignment

Replaced feature	New feature in Common Transport
LTE664: LTE transport protocol stack	LTE1397: IPv4 based S1/X2
LTE80: GPS synchronization	LTE2328: 1PPS&ToD Sync from External GNSS Receiver

Interface based pricing impacts

- Interfaced based pricing is introduced through the *LTE1313* feature and *LTE1314* feature.

- For new customer contracts, the license for *LTE1314, LTE1313* need to be purchased.
- No impacts for existing customer contracts.

1.1.6 Updated object model

The introduced object models are designed to be future-proof, and takes into account possible additional hardware.

The introduction of the common transport solution between LTE and SRAN requires an update to the object model structure for all areas. The updated object model provides a simple and easy way for operators to use the unified object model.

The *LTE3442* feature introduces a unified object model through changes in the following areas:

- Management Network Layer (`MNL`)
- Transport Network Layer (`TNL`)
- Radio Network Layer (`RNL`)
- Equipment Management (`EQM`)

Note: Hardware Inventory data available at the NetAct northbound interface (NBI) are not modified.

Table 5 Managed Object mapping

Legacy Managed Object	New Managed Object	Affects NetAct FM, PM
MRBTS/LNBTS/FTM	MRBTS/TNLSVC/TNL	Yes
MRBTS/LNBTS/FTM/AMGR	MRBTS/MNL/AMGR	No
MRBTS/LNBTS/FTM/AMGR/LUAC	MRBTS/MNL/AMGR/LUAC	No
	MRBTS/MNL/AMGR/LUAC_R	No
MRBTS/LNBTS/FTM/CBRSCERTH	Not Supported	-
MRBTS/LNBTS/FTM/CBRSCERTH/CACERT	Not Supported	-
MRBTS/LNBTS/FTM/CBRSCERTH/CRLINFO	Not Supported	-
MRBTS/LNBTS/FTM/CBRSCERTH/VENDORCERT	Not Supported	-
MRBTS/LNBTS/FTM/CERTH	MRBTS/MNL/CERTH/CMP	No
	MRBTS/MNL/CERTH	Yes
	MRBTS/MNL/CERTH/CRLH	No
	MRBTS/MNL/CERTH/CRLH/CRLDPCONFIG	No
	MRBTS/MNL/MNLENT	No
	MRBTS/MNL/MNLENT/CERTHENT	No

Table 5 Managed Object mapping (Cont.)

Legacy Managed Object	New Managed Object	Affects NetAct FM, PM
	MRBTS/MNL/MNLENT/CERTHENT/CACERT_R	No
	MRBTS/MNL/MNLENT/CERTHENT/CMP_R	No
	MRBTS/MNL/MNLENT/CERTHENT/CRLH_R	No
	MRBTS/MNL/MNLENT/CERTHENT/CRLINFO_R	No
	MRBTS/MNL/MNLENT/CERTHENT/NECERT_R	No
MRBTS/LNBTS/FTM/ETHLK	MRBTS/TNLSVC/TNL/ETHSVC/ETHLK	Yes
	MRBTS/TNLSVC/TNL/ETHSVC/L2SWI/BRGPRT	Yes
	MRBTS/TNLSVC/TNL/ETHSVC/ETHLK/ETHLK_R	No
MRBTS/LNBTS/FTM/IPNO	MRBTS/MNL/MNLENT/SYNC/CLOCK/TOP (sPlaneIpAddressDN)	No
	MRBTS/TNLSVC/TNL/IPAPP	No
	MRBTS/TNLSVC/TNL/IPNO	Yes
	MRBTS/TNLSVC/TNL/IPAPP/TWAMPREFLECT	No
	MRBTS/MNL/MNLENT/FEATCADM/FEATLADM	No
	MRBTS/LNBTS/TRSNW (cPlane and uPlane)	No
	MRBTS/MNL/MNLENT/MPLANENW	No
	MRBTS/MNL/MNLENT/CERTH	No
	MRBTS/TNLSVC/TNL_R	No
	MRBTS/MNL/MNLENT/MPLANENW/MPLANENW_R	No
MRBTS/LNBTS/FTM/IPNO/BFD	MRBTS/TNLSVC/TNL/IPAPP/BFD	Yes
MRBTS/LNBTS/FTM/IPNO/BFD/BFDGRP	MRBTS/TNLSVC/TNL/IPAPP/BFDGRP	Yes
MRBTS/LNBTS/FTM/IPNO/IDNS	MRBTS/MNL/MNLENT/DNS	No
MRBTS/LNBTS/FTM/IPNO/IEIF	MRBTS/TNLSVC/TNL/IPNO/QOS/FSTSCH	Yes
	MRBTS/TNLSVC/TNL/ETHSVC/ETHIF	Yes

Table 5 Managed Object mapping (Cont.)

Legacy Managed Object	New Managed Object	Affects NetAct FM, PM
	MRBTS/TNLSVC/TNL/IPNO/IPIF/IPADDRESSV6	Yes
	MRBTS/TNLSVC/TNL/IPNO/IPIF	Yes
	MRBTS/TNLSVC/TNL/IPNO/IPIF/IPADDRESSV4	Yes
MRBTS/LNBTS/FTM/IPNO/IEIF/IVIF	MRBTS/TNLSVC/TNL/ETHSVC/ETHIF/VLANIF	Yes
	MRBTS/TNLSVC/TNL/ETHSVC/ETHIF	No
	MRBTS/TNLSVC/TNL/IPNO/IPIF/IPADDRESSV4	Yes
	MRBTS/TNLSVC/TNL/IPNO/IPIF/IPADDRESSV6	Yes
	MRBTS/TNLSVC/TNL/IPNO/QOS/FSTSCH	Yes
MRBTS/LNBTS/FTM/IPNO/IHCP	Not Supported	-
MRBTS/LNBTS/FTM/IPNO/INTP	MRBTS/MNL/MNLENT/SYNC/CLOCK/NTP	Yes
	MRBTS/MNL/MNLENT/SYNC/CLOCK/SYNCE/NTP_R	No
MRBTS/LNBTS/FTM/IPNO/IPRM	MRBTS/TNLSVC/TNL/IPAPP/FIREWALL/PKTFLTR	No
	MRBTS/TNLSVC/TNL/IPAPP/FIREWALL	No
MRBTS/LNBTS/FTM/IPNO/IPRT	MRBTS/TNLSVC/TNL/IPNO/IPRT	No
	MRBTS/TNLSVC/TNL/IPNO/IPRT/IPRT_R	No
MRBTS/LNBTS/FTM/IPNO/IPRTV6	MRBTS/TNLSVC/TNL/IPNO/IPRTV6	No
	MRBTS/TNLSVC/TNL/IPNO/IPRTV6/IPRTV6_R	No
MRBTS/LNBTS/FTM/IPNO/MCAPP	MRBTS/TNLSVC/TNL/IPNO/MCAPP	No
MRBTS/LNBTS/FTM/IPNO/MCAPP/MCGROUP	MRBTS/TNLSVC/TNL/IPNO/MCAPP/MCGROUP	No
	MRBTS/TNLSVC/TNL/IPNO/MCAPP/MCGROUP/MCGROUP_R	No
MRBTS/LNBTS/FTM/IPNO/QOS	MRBTS/MNL/MNLENT/SYNC/CLOCK/TOP	No
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC	Yes

Table 5 Managed Object mapping (Cont.)

Legacy Managed Object	New Managed Object	Affects NetAct FM, PM
	MRBTS/TNLSVC/TNL/IPNO	No
	MRBTS/TNLSVC/TNL/IPNO/QOS	Yes
	MRBTS/TNLSVC/TNL/IPNO/QOS/FSTSCH	Yes
	MRBTS/TNLSVC/TNL/IPAPP/BFD	No
	MRBTS/TNLSVC/TNL/IPNO/QOS/DSCP2PCPMAP	No
	MRBTS/TNLSVC/TNL/IPNO/QOS/DSCP2QMAP	No
	MRBTS/TNLSVC/TNL/IPNO/QOS/FLOWCL	No
MRBTS/LNBTS/FTM/IPNO/RTPOL	MRBTS/TNLSVC/TNL/IPNO/RTPOL	No
MRBTS/LNBTS/FTM/IPNO/TWAMP	MRBTS/TNLSVC/TNL/IPAPP/TWAMP	Yes
MRBTS/LNBTS/FTM/IPSECC	MRBTS/TNLSVC/TNL/IPAPP/IPSECC	No
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/SECPOL	Yes
	MRBTS/TNLSVC/IPSECTEMPLATE	No
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/IKEP	Yes
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/IKEPROTGRP	Yes
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/IPSECP	No
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/EMBYPASSREQ	No
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/EMBYPASSREQ/EMBYPASSRES	No
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/IKEPROTGRP/IKEPSWITCHREQ	Yes
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/IKEPROTGRP/IKEPSWITCHREQ/IKEPSWITCHRES	Yes
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/IPSECC_R	No
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/IKEP/IKEP_R	No

Table 5 Managed Object mapping (Cont.)

Legacy Managed Object	New Managed Object	Affects NetAct FM, PM
	MRBTS/TNLSVC/TNL/IPAPP/IPSECC/IKEPROTGRP/IKEPROTGRP_R	No
MRBTS/LNBTS/FTM/L2SWI	MRBTS/TNLSVC/TNL/ETHSVC/L2SWI	Yes
	MRBTS/TNLSVC/TNL/ETHSVC/L2SWI/DSCPTOQMAP	No
	MRBTS/TNLSVC/TNL/ETHSVC/L2SWI/IBRGPRT	No
	MRBTS/TNLSVC/TNL/ETHSVC/L2SWI/PCP2QMAP	No
	MRBTS/TNLSVC/TNL/ETHSVC/L2SWI/VLANID2QMAP	No
MRBTS/LNBTS/FTM/OAMMD	Not Supported	-
MRBTS/LNBTS/FTM/OAMMD/OAMMA	Not Supported	-
MRBTS/LNBTS/FTM/OAMMD/OAMMA/OAMMEP	Not Supported	-
MRBTS/LNBTS/FTM/OAMPRF	Not Supported	-
MRBTS/LNBTS/FTM/PMTNL	MRBTS/TNLSVC/TNL/PMTNL	No
	MRBTS/MNL/MNLENT/PMMNL	No
MRBTS/LNBTS/FTM/PPTTMRBTS/LNBTS/FTM/PPTT	MRBTS/TNLSVC/TNL/PPTT	No
	MRBTS/TNLSVC/TNL/PPTT/PPTT_R	No
	MRBTS/TNLSVC/TNL/PPTT/LOOPBACKREQ	No
	MRBTS/TNLSVC/TNL/PPTT/LOOPBACKRES	No
MRBTS/LNBTS/FTM/SECPRM	MRBTS/MNL/MNLENT/SECADM	No
	MRBTS/MNL/MNLENT/SECADM	No
MRBTS/LNBTS/FTM/SYNC	MRBTS/MNL/MNLENT/SYNC/CLOCK/SYNCE	Yes
MRBTS/	MRBTS/MNL/MNLENT/SYNC/CLOCK/SYNCE/SYNCE_R	No
MRBTS/LNBTS/FTM/SYNC/STPG	MRBTS/MNL/MNLENT/SYNC/CLOCK/PDH	No
	MRBTS/MNL/MNLENT/SYNC/CLOCK/SYNCE	No
	MRBTS/MNL/MNLENT/SYNC/CLOCK	Yes

Table 5 Managed Object mapping (Cont.)

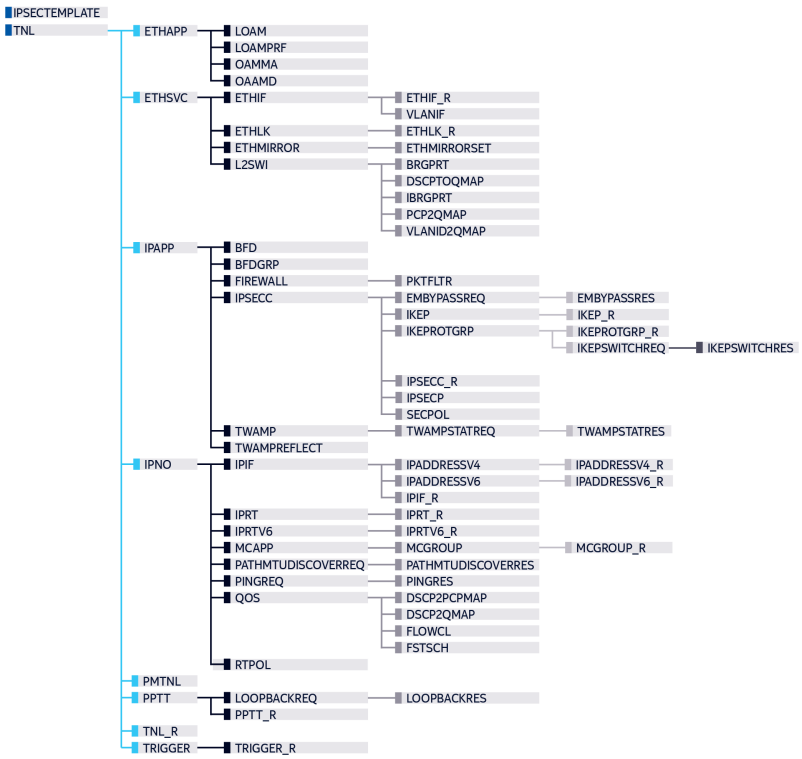
Legacy Managed Object	New Managed Object	Affects NetAct FM, PM
MRBTS/LNBTS/FTM/TAC	MRBTS/MNL/MNLENT/TAC	Yes
MRBTS/LNBTS/FTM/TAC/LTAC	MRBTS/MNL/MNLENT/TAC/LTAC	No
MRBTS/LNBTS/FTM/TOPB/TOPF	MRBTS/MNL/MNLENT/SYNC/CLOCK/TOP	Yes
	MRBTS/MNL/MNLENT/SYNC/CLOCK/TOP/TOPF	Yes
	MRBTS/MNL/MNLENT/SYNC/CLOCK/TOP/TOPF/TOPF_R	No
MRBTS/LNBTS/FTM/TOPB/TOPP	MRBTS/MNL/MNLENT/SYNC/CLOCK/TOP/TOPP	Yes
	MRBTS/MNL/MNLENT/SYNC/CLOCK/TOP/TOPP/TOPP_R	No
MRBTS/LNBTS/FTM/UNIT	EQM/APEQM/CABINET/SMOD	No
	EQM/APEQM/CABINET/TRMOD	No

1.1.6.1 Transport Network Layer

The LTE3442 feature introduced some changes to Transport Network Layer (TNL) objects.

The new `Transport Network Layer (TNL)` object model structure is based on the SRAN16 `TNL` object model, with a few key modifications. The following are the notable differences between the old and new `Transport Network Layer (TNL)` object model structure:

- The `TNL` object is moved under the Transport Network Layer Service `TNLSVC` object.
- The `*_R` objects are introduced; the separation of read-only parameters in the dedicated managed object classes is introduced.
- A number of parameters were changed from optional to mandatory, in order to assure consistency with BTS definitions.
- The `-DN` parameters are used to define pointers between MOCs. For example, the parameter `ETHLKmodDN` under the `TNLSVC/TNL/ETHSVC` MOC.

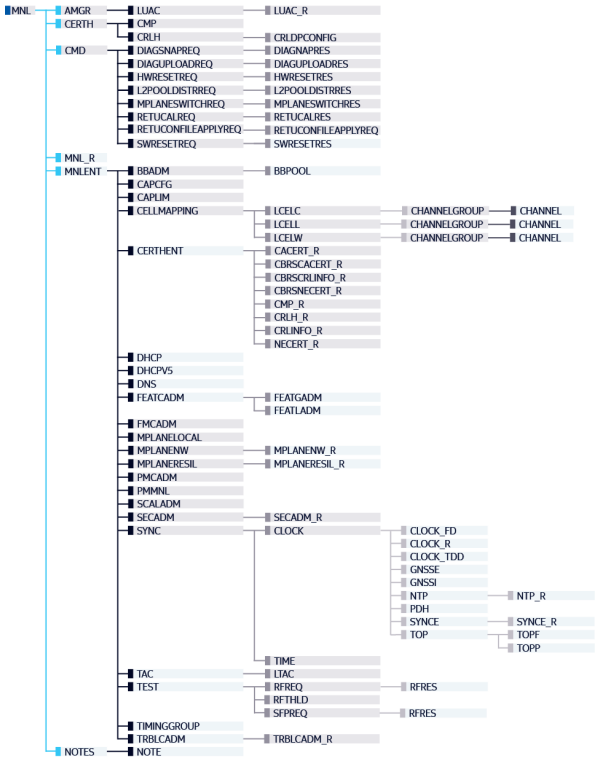


1.1.6.2 Management Network Layer

The LTE3442 feature introduced some changes to Management Network Layer (MNL) objects.

The new `Management Network Layer (MNL)` object model structure covers all generic functionality related to the management of a BTS, such as software resets or calibration and testing. Some notable changes are:

- The configuration of the Management Plane-related parameters, such as the M-Plane IP address, are moved to a dedicated object.
- The `MNL` also now includes Certificate and Feature Management-related parameters.
- Configuration for LTE Transport Admission Control (TAC) are moved under `MNL`.
- Operability functions such as DHCP and DNS are now under `MNL`.
- Synchronization functions are moved under `MNL`.



1.1.6.3 Other Managed Objects

The LTE3442 feature introduced changes to other LTE-related objects.

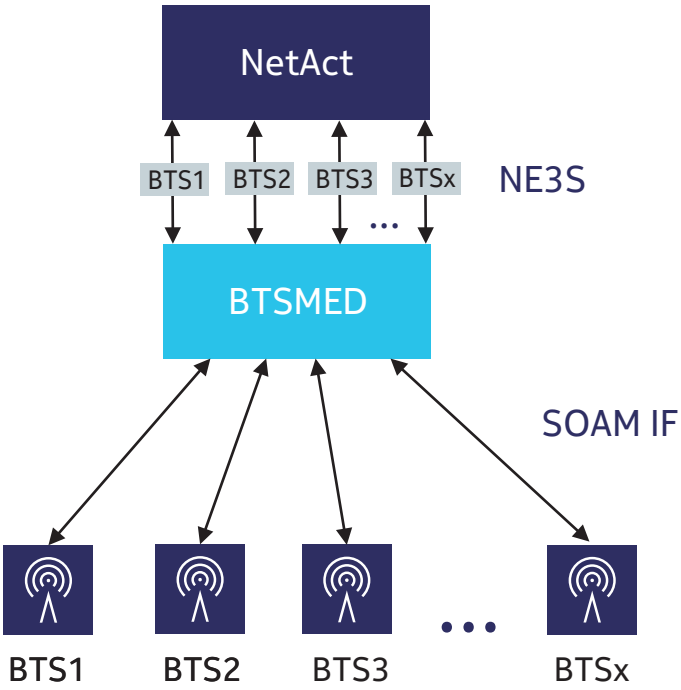
With the *LTE3442* feature, some changes were implemented for the following managed object classes (MOCs):

- Under the Radio Network Layer (`RNL`) object, the `FTM` object is removed and a new object, `LNBTS/TRSNW`, is added.
- Enhancements were made to the Equipment Management (`EQM`) object. Some parameters are moved under the `SMOD` object, and a new MOC, `TRMOD`, is added.

1.1.7 BTS Mediator introduction

BTS Mediator (BTS MED) is a network element responsible for the management of a site configuration file (SCF) and a management plane (M-plane) termination for the BTS. It allows unified integration and management of radio technologies including FDD-LTE, TD-LTE, WCDMA, GSM, Cloud, and 5G.

Figure 2 BTSMED in OAM architecture



BTS MED can be deployed as a virtual machine or as a bare-metal. When deployed as a virtual machine, it performs scalable services, and operates as a virtual network function (VNF) that can run together with NetAct on cloud-based vSphere in NetAct data center. The software packages for BTS MED are independent from NetAct software packages, and are linked to radio system releases.

For more information about BTS MED, see *BTS Mediator Operating Documentation*.

1.1.8 WebEM introduction

Web Element Manager (WebEM) is a web-based application for maintaining and commissioning a BTS. WebEM can be used in both online (direct connection to the BTS) and offline mode (saved WebEM application) for configuration creation, modification, and troubleshooting purposes. Using WebEM does not interfere with the usage of other element managers, although it is not recommended to have more than one type of element manager connected to the site at the same time.

Requirements

In order to connect to the BTS, type in the BTS management plane IP address (or local management port (LMP) IP address in case of a local connection), using one of the supported internet browsers:

- Chrome (recommended), three latest major versions compared to the release date
- Mozilla Firefox, three latest major versions compared to the release date

WebEM can be launched from any PC that is able to run a Chrome or Firefox browser, but for better performance, the following specification is required:

- The minimum screen resolution: 1366x768 pixels (1920x1080 is recommended)

- CPU: 2 GHz 32-bit (x86) or 64-bit (x64)
- RAM: 4 GB

Note: Depending on the browser's type or version, it might happen that loading a WebEM from a browser's cache will cause the application not to load successfully, and in such case it is required to either clear the browser's cache or refresh the page using `Ctrl+F5`.

Functionality

As long as the WebEM remains launched and connected to the BTS, the updates are collected constantly with a WebEM defined period.

WebEM introduces a new type of file, the Info Model Snapshot (IMS2) file. The IMS2 contains full BTS runtime data for some period of time. IMS2 files can be saved manually from the WebEM or can be automatically retrieved by WebEM when a BTS snapshot is collected.

The save location of files downloaded from WebEM (for example SCF, IMS2, or snapshot files) depends on your browser settings.

For more information, see *WebEM User Guide*.

2 Features introduced in the latest release

Where to find all features grouped per release and functional area

The list of all features introduced in the latest release, along with all features introduced in previous releases is available in the *List of Features* excel document under the *LTE Features* category. The document allows the user to filter out features per release, functional area, or hardware support.

3 BTS hardware and reference information changes

Changes in BTS hardware, alarms and faults, counters, and parameters

3.1 BTS alarm and fault changes

Changes in BTS alarms and faults are described in excel reference documents.

For information on changes in BTS alarms and faults between releases, see the following Excel documents in the **BTS Reference Data ► Alarms and Faults** category:

- *LTE BTS Alarms and Faults*
- *LTE FZ Alarms and Faults*

3.2 BTS counters changes

Changes in BTS counters are described in the excel reference document.

For information on changes in measurements and counters between releases, refer to **BTS Reference Data ► Counters and Key Performance Indicators ► LTE Performance Measurements and Key Performance Indicators** Excel document in LTE Radio Access Operating Documentation.

Overview of the Performance Measurements and Key Performance Indicators excel reference document

The Excel report provides complete information on counters and key performance indicators (KPIs). It shows the full set of counter and KPI attributes, including information about introduced changes.

The Excel report consists of three main sections:

- Measurement List
- Counter List
- KPI List

The measurements, counters, and KPIs are listed in an alphanumeric ascending order. In the KPI List there are links to be followed in the Measurement column. The links move to a tab with the Counter List and filter out the counters that take part in the KPI formula.

NOTICE: Macros need to be enabled to use the links.

Note: It is recommended to clear the filter from the Counter ID column of the Counter List before the reading is continued.

3.3 BTS parameters changes

Changes in BTS parameters are described in excel reference documents.

For information on changes in BTS parameters between releases, see the following Excel documents in the **BTS Reference Data ► Parameters** category:

- *LTE BTS Parameters*
- *LTE FZ BTS Parameters*

4 LTE RAN key performance indicator changes

Changes in KPIs are described in the excel reference document.

For information on changes in key performance indicators between releases, see **Reference ► Counters and Key Performance Indicators ► LTE Performance Measurements and Key Performance Indicators** Excel document in LTE Radio Access Operating Documentation.

Overview of the LTE Performance Measurements and Key Performance Indicators excel reference document

The Excel report provides complete information on counters and key performance indicators (KPIs). It shows the full set of counter and KPI attributes, including information about introduced changes.

The Excel report consists of three main sections:

- Measurement List
- Counter List
- KPI List

The measurements, counters, and KPIs are listed in an alphanumeric ascending order. In the KPI List there are links to be followed in the Measurement column. The links move to a tab with the Counter List and filter out the counters that take part in the KPI formula.

NOTICE: Macros need to be enabled to use the links.

Note: It is recommended to clear the filter from the Counter ID column of the Counter List before the reading is continued.

5 Changes introduced with LTE 19B features

Impact of new features on existing parameters (changed values, managed objects, or consistency checks), counters, or existing functionalities and algorithms

LTE1118 changes to the system

Modified counter description

The counter M8011C51 has been modified to include PRBs allocated with RAT1.

LTE2971 changes to the system

The DRX profile 6 (drxProfile6) and DRX smart profile 6 (drxSmartProfile6) profiles are now configured for QCI1, QCI2, QCI3, QCI4, QCI65, QCI66, QCI69, and operator specific QCIs (in the range from 128 to 254).

5.1 LTE4549 changes to the LTE19B system

Additional value added for the LNBTS Activation of CA in LTE-NR Dual Connectivity (actCAggrLteNrDualConnectivity) parameter.

The enhanced_CA_LTE_NR value is added to the LNBTS Activation of CA in LTE-NR Dual Connectivity (actCAggrLteNrDualConnectivity) parameter choice. This value is used to activate the *Flexible LTE CA with EN-DC* functionality.

LTE5266 changes to the system

Parameter location changes.

The following parameters have been moved to another location:

- The Inter Freq Load Balance A4 active limit (iFLBA4ActLim) parameter has been moved from LNBTS to LNCEL.
- The Activate active mode load equalization (actAmle) parameter has been moved from LNBTS to LNCEL.
- The Activation of inter-frequency load balancing (iFLB) (actInterFreqLB) parameter has been moved from LNBTS to LNCEL.

Note: The location change is part of the release software.

5.2 LTE5510 changes to the LTE19B system

Extension for the X2AP SgNB Modification Request message.

The X2 interface SgNB Modification Request processed message is enhanced with the E-RABs To Be Added information element (IE) related to the additional multiple bearers for already existing EN-DC connection.

5.3 LTE5558 changes to the LTE19B system

The LTE5558: S1 Handover for LTE-NR DC Option 3x feature introduces the intra-LTE S1 handover for UEs with SN-terminated split bearer established.

5.4 LTE-M mobility changes to the system in LTE19B

Changes to the system introduced by LTE-M mobility features in release LTE19B

The *LTE5303:Cat-M1: Separate HO Measurement Thresholds for VoLTE and Data* feature, introduces the following changes to the parameters:

Deleted parameters

- A3 report interval for Cat-M (a3ReportIntervalCatM)
- A3 report interval RSRP inter frequency for Cat-M (a3ReportIntervalRsrpInterFreqCatM)

Replaced parameters

- The A2 threshold for Cat-M intra and inter frequency handover measurement (threshold2CatM) parameter replaces:
  - A2 threshold for Cat-M intra frequency handover measurement (threshold2IntraFreqCatM) and
  - Threshold th2 RSRP inter frequency for Cat-M (threshold2InterFreqCatM).

  It takes the values from threshold2IntraFreqCatM and threshold2InterFreqCatM is no longer used.

- The Hysteresis of A2 threshold for Cat-M intra and inter frequency handover measurement (hysThreshold2CatM) parameter replaces:
  - Hysteresis of A2 threshold for Cat-M intra frequency handover measurement (hysThreshold2IntraFreqCatM) and

  - Related hysteresis of threshold th2 interFreq for Cat-M (hysThreshold2InterFreqCatM)

    It takes the values from hysThreshold2IntraFreqCatM and hysThreshold2InterFreqCatM is no longer used.

- The Time to trigger for A1 measurement for Cat-M (a1TimeToTriggerCatM) parameter replaces the Time to trigger for A1 inter frequency measurement for Cat-M (a1TimeToTriggerRsrpInterFreqCatM) parameter.

- The Time to trigger for A2 event to activate Cat-M intra and inter frequency handover measurement (a2TimeToTriggerCatM) parameter replaces:

  - Time to trigger for A2 event to activate Cat-M intra frequency handover measurement (a2TimeToTriggerIntraFreqCatM) and
  - Time to trigger for A2 inter frequency measurement for Cat-M (a2TimeToTriggerRsrpInterFreqCatM)

    it takes the values from a2TimeToTriggerIntraFreqCatM and a2TimeToTriggerRsrpInterFreqCatM is no longer used.

6 Changes introduced with LTE19A features

Impact of new features on existing parameters (changed values, managed objects, or consistency checks), counters, or existing functionalities and algorithms

LTE652 changes to the system

Description of alarm/parameter changes that are introduced with the LTE652: Intelligent Flexi BTS Shutdown feature.

In case the main power outage takes place, and the battery backup is present, the intelligent shutdown alarm starts. The BTS informs the operator about the fault (4395 Cells shutdown due to mains break).

The fault is also reported when the BTS power supply is available again, but not all cells are enabled yet. When all previously shutdown cells are enabled again, the alarm resulting from this fault is cleared.

See

Parameter:

Following parameters are introduced with this feature:

- `Intelligent shutdown in use (intShutdownInUse)`
  The `Intelligent shutdown in use` parameter denotes if the intelligent shutdown feature is enabled or disabled.
- `Intelligent shutdown timeout (intShutdownTimeout)`
  The `Intelligent shutdown timeout` parameter denotes the timeout for the intelligent shutdown in minutes. The zero value means that the cell is immediately shutdown with high priority. If the parameter is not present in the `LNCELL` object, it means that the cell remains operational until the batteries run out.

See

LTE1709 changes to the system

*Starting with the LTE19A release, the LTE1709: Liquid Cell feature is disabled and cannot be activated anymore. The `Activate liquid cell configuration (actLiquidCell)` LNCEL_FDD parameter must be set to **false**.*

LTE4034/SR001670 changes to the system

The introduction of the LTE4034 feature replaces legacy Plug and Play features.

The *LTE4034/SR001670: BTS support for new Plug and Play Services* feature substitutes the following features:

- *LTE154: SON LTE BTS Auto Connectivity*
- *LTE720: SON LTE BTS Auto Configuration*

6.1 LTE4531 changes to the LTE19A system

Logical channel identity (LCID) change procedure upgrade and QCI translation table enlargement

With the *LTE4531: LTE-NR DC Option 3X: Multiple non-GBR SCG Split Bearers* feature released in the LTE19A, the following changes are introduced:

- The LCID change procedure works without data radio bearer identifier (DRB ID) release during bearer change. Upgraded procedure uses Packet Data Convergence Protocol (PDCP) and Radio Link Control (RLC) reestablishment procedures.
- The `QCI translation table QCI 5` (`qciTab5`), and `QCI translation table QCI 70` (`qciTab70`) parameters are available. For more information, see Additional QCI values as EN-DC eligible bearers.

LTE4701 changes to the system

The feature introduces the `Activate improvements to CA architecture enhancements` (`actCaArchEnhImp`) parameter replacing the `Enable carr. aggr. architecture enhancements` (`actCaArchEnh`) parameter.

LTE4875 changes to the system

For Licensed Assisted Access (LAA), the `Maximum output power, LAA mode` (`pMaxLaa`) parameter is introduced.

It replaces the `Maximum output power` (`pMax`) parameter that enables the operator to set the maximum output power of the cell per antenna carrier.

The `Maximum output power, LAA mode` (`pMaxLaa`) parameter allows eNB to automatically calculate maximum output power of the LAA cell per antenna carrier.

The value of calculated output power depends on:

- used hardware
- the country of operation
- the number of configured LAA cells
- which specific unlicensed sub-bands are enabled

LTE5063 changes to the system

Impact on physical uplink control channel (PUCCH) resources, and changes to the system.

LTE5063 inherits the below restrictions with the same consideration as *LTE3230: UL Interference Offsets* and *LTE3242: A-MPR*:

Most of the restrictions, found in **TS36.101**, affect the borders of a cell's radio spectrum. Usually this is where the cell's PUCCH resources are configured. To keep PUCCH unaffected by restrictions, *LTE3230*/*LTE3242* configures PUCCH resources so that they are relocated towards the center of the cell's bandwidth. This means that there are two outer physical uplink shared channel (PUSCH) regions with maximum UE power restriction in at least one of them, and one central region between PUCCH resources.

Overall, the fragmentation of PUSCH reduces the peak throughput because:

- The maximum allocation size is reduced to the number of physical resource blocks (PRB) left between PUCCH resources, and
- UEs can be scheduled in only one region (one of the outer PUSCH regions or the central PUSCH region)
  Multicluster UL scheduling for legacy/wideband LTE is not supported because it adds high complexity, and the power backoff that is to be considered in multicluster allocations restricts the gain that can be expected.

LTE5135 changes to the system

The LTE5135: Geofencing Information in CMAS Notification feature adds the `Warning area coordinates allowed` (`warnAreaCoAllowed`) parameter and uses an optional segment in the `WRITE-REPLACE WARNING REQUEST` message.

The *LTE5135: Geofencing Information in CMAS Notification* feature introduces a new parameter, `Warning area coordinates allowed` (`warnAreaCoAllowed`), which is used to activate and deactivate the feature.

When the *LTE5135* feature is enabled, the optional segment `warningAreaCoordinatesSegment-r15` (which contains geofencing information) is used in the `WRITE-REPLACE WARNING REQUEST` message.

6.2 LTE5335 changes to the LTE19A system

Mobility scenarios improved and inter-site Carrier Aggregation (CA) support with EN-DC added.

With the *LTE5335* feature, functions of the *LTE4088: LTE-NR Dual Connectivity Option 3x* feature listed below are improved:

- The error handling and safeguarding from contrary messaging on layer 2 (L2) /control plane (C-plane) interface during the Secondary Node (SN)-terminated split bearer takeback was added.
- The resources management improvement in case of immediate *UE Context Release* when the EN-DC release is initiated by the Mobility Management Entity (MME) or the eNB.
- The UE context preemption for UEs with EN-DC established was added.

With the *LTE5335* feature, functions of the *LTE4193: Dynamic Trigger for LTE-NR DC Option 3x* feature listed below are improved:

- The *Initial Context Setup* (ICS) with EN-DC and coverage-based trigger update improves the reconfiguration of physical uplink control channel (PUCCH) resources to position compatible with EN-DC measurement gap offset. This update affects FDD cell only.
- The bearer preemption of last eligible bearer was added.
- Release of the last EN-DC eligible bearer when B1-NR measurements are activated improves better resource management.
- The sounding reference signal (SRS) resource handling and coverage-based trigger improves allocation of the SRS to avoid collision with the measurement gap set up during ICS procedure by the coverage-based trigger B1 NR measurements. This update affects TDD cell only.

With the *LTE5335* feature, functions of the *LTE4575: Blind Carrier Aggregation with LTE-NR DC Option 3x* feature listed below are improved:

- The support for inter-eNB and inter-site Carrier Aggregation (CA) were added. With this functionality, the EN-DC partner gNB can be on different site.
- The following per call measurement data (PCMD) is added:

Table 6 Additional PCMD field

Measurement data	Description
Carrier Aggregation Deconfiguration Cause 5	This filed indicates the number of times CA de-configuration involving this secondary cell (SCell) (SCell release) is attempted for the following cause: – SCell de-configuration due to EN-DC setup or Secondary Node (SN) change (LS byte 1) – Not applicable (byte 2) – Not applicable (byte 3) – Not applicable (byte 4) Other causes are defined in PCMD fields `Carrier Aggregation Deconfiguration Cause 1`, `Carrier Aggregation Deconfiguration Cause 2`, `Carrier Aggregation Deconfiguration Cause 3` and `Carrier Aggregation Deconfiguration Cause 4`.

- The following PCMD are modified:

The list of other causes defined in PCMD fields for the Carrier Aggregation Deconfiguration Cause 1, Carrier Aggregation Deconfiguration Cause 2,Carrier Aggregation Deconfiguration Cause 3 and Carrier Aggregation Deconfiguration Cause 4 were extended by the Carrier Aggregation Deconfiguration Cause 5.

- The *LTE4575* feature Activation of CA in LTE-NR Dual Connectivity (actCAggrLteNrDualConnectivity) activation flag is online modifiable.

7 Changes introduced with LTE 19 features

Impact of new features on existing parameters (changed values, managed objects, or consistency checks), counters, or existing functionalities and algorithms

7.1 LTE3435 changes to the system

The LTE3435: BTS Mediator introduction to LTE feature introduces BTS Mediator into use in LTE. The Open Fault Standard version 3.0.5 is adapted with the formatting changes replacing separator ***<name> : <value>*** *with* ***<name> = <value>****.*

7.2 LTE4575 changes to the LTE19 system

Decrease of counters related to Carrier Aggregation (CA) secondary cell (SCell)

After the *LTE4575: Blind Carrier Aggregation with LTE-NR DC Option 3x* feature is activated, and the UE enters the EN-DC mode, the SCell addition is not allowed anymore. The values of counters related to the number of CA SCells will decrease in the event of EN-DC induced or regular SCell release.

Table 7 List of counters impacted by the LTE4575 related to the SCell in CA

Type	Counter ID	Counter name	Measurement
Existing	M8011C67	Number of SCell configuration attempts	LTE Cell Resource
Existing	M8011C68	Number of successful SCell configurations	LTE Cell Resource
Existing	M8011C165	Number of event A6 triggered SCell swaps	LTE Cell Resource
Existing	M8012C151	PCell RLC data volume in DL via SCell	LTE Cell Resource
Existing	M8051C116	Average number of UEs with one activated SCell	LTE UE Quantity
Existing	M8051C117	Average number of UEs with two activated SCells	LTE UE Quantity
Existing	M8051C121	Average number of DL carrier aggregated capable UEs for 2 CCs	LTE UE Quantity

Table 7 List of counters impacted by the LTE4575 related to the SCell in CA (Cont.)

Type	Counter ID	Counter name	Measurement
Existing	M8051C122	Average number of DL carrier aggregated capable UEs for 3 CCs	LTE UE Quantity
Existing	M8051C123	Average number of UEs with one configured SCell	LTE UE Quantity
Existing	M8051C124	Average number of UEs with two configured SCells	LTE UE Quantity
Existing	M8011C213	Downlink CA Deconfiguration Attemps	LTE Cell Resource
Existing	M8011C214	Downlink CA Deconfiguration Successes	LTE Cell Resource

LTE4788 changes to the system

Description of parameter changes that are introduced with the LTE4788: ETSI and IC DFS Support for LAA feature.

The following parameters are changed by the *LTE4788: ETSI and IC DFS Support for LAA* feature:

- `Wi-Fi Channel Selection List (uCellChannelSList)`, `Transmit Power per LAA cell (pMaxLaa)` and `ITU Region (lteUItuRegion)` parameters
  These parameters are configured and updated by the eNB software. Previously configured by the operator.
- `lteuContiguousChannelPriority` parameter
  Changed default setting to `contiguousChannelsOnly`

See

LTE4504 changes to the system

The LTE4504: BTS Rx-Sniffing feature replaces the LTE1434: Flexi Multiradio BTS antenna Rx RF-sniffing and LTE2556: Flexi Multiradio BTS Rx-Sniffing enhancements features.

LTE5268 changes to the system

With the LTE5268: NB-IoT: Coexistence with UL CoMP feature, the `ulCoMpCellList` parameter is modified, to allow the coexistence of UL CoMP and NB-IoT technologies on the same hosting LTE cell.

7.3 LTE4088 changes to the LTE19 system

Description of changes that are introduced to the data model with the LTE4088: LTE-NR Dual Connectivity Option 3x feature.

The following changes are introduced by the *LTE4088: LTE-NR Dual Connectivity Option 3x* feature:

In LNBTS:

- The existing `QCI translation table QCI [6-9] (qciTab[6-9])` parameters are extended by three new structure members:
  - `LTE-NR Dual connectivity support (qciTab[6-9]/lteNrDualConnectSupport)` which allows to set the support for EN-DC. The next new member in the same `qciTab[6-9]` must be configured.
  - `NR PDCP profile index (qciTab[6-9]/nrPdcpProfId[6-9])` which is a pointer to the NR-PDCP profile.
  - `Starting ARP for EN-DC eligible bearer (startArpEnDc)` and `Stop ARP for EN-DC eligible bearer (stopArpEnDc)` are defined to configure EN-DC allowed Allocation and Retention Priority (ARP) range. An ARP value has to be added to such `QCI` with the following range: `Starting ARP for EN-DC eligible bearer (startArpEnDc)` parameter is smaller or equal than ARP and `Stop ARP for EN-DC eligible bearer (stopArpEnDc)` parameter is larger or equal than ARP.
- The existing `QCI translation table operator specific QCIs (qciTabOperator)` parameter is extended by two new structure members:
  - `LTE-NR Dual connectivity support (qciTabOperator/lteNrDualConnectSupport)` which allows to set the support for EN-DC. The next new member in the same `QCI translation table (qciTab)` must be configured.
  - `NR PDCP profile index (qciTabOperator/nrPdcpProfIdx)` which is a pointer to the NR-PDCP profile.
- In LTE-NR Dual Connectivity, the `Status report required (statusRepReq)` parameter has only one supported value.
- The existing `Sequence number size DL (snSizeDl)` is split into UL (`Sequence number size UL (pdcpProf1001/snSizeUl)`) and DL (`Sequence number size DL (pdcpProf1001/snSizeDl)`) where the limitation to 18-bit is included.

- New managed object classes (MOCs) are added: **LNRELGNBCELL**, **NRDCDPR**, and **NRDCPR** (dedicated profiles).

8 Changes introduced with LTE 18A features

Impact of new features on existing parameters (changed values, managed objects, or consistency checks), counters, or existing functionalities and algorithms

LTE3571 changes to the system

List of modified parameters

The following existing parameters are modified by the *LTE3571: NB-IoT co-existence with eICIC* feature:

Table 8 Parameters modified by the LTE3571 feature

Full name	Abbreviated name	Change description
`Activate enhanced inter-cell interference coordination`	`actEicic`	Parameter modified to allow the co-existence of eICIC and inband NB-IoT technologies on the same hosting LTE cell.
`Nb-IoT operation mode`	`nbIoTMode`	Parameter modified to allow the support of eICIC together with inband NB-IoT on the same hosting LTE cell.

LTE2774 changes to the system

The SID packet sizes, that are constant values for the relevant audio codecs (AMR, AMR-WB and EVS) have been reduced to make UL allocations more adapted to the real packet sizes.

LTE2617 changes to the system

The LTE2617: Increased carrier monitoring in idle mode feature introduces the following changes.

Configuration Management

Introduced parameters, such as the `incMonExSel` and `reducedMeasPerformance` parameters, are mandatory when SIB5 is configured, whereas the `eutCelResSubPrio` and `cellReSelSubPrio` parameters are optional.

Note: These new parameters are valid for both FDD and TDD cells. In case of NB-IoT FDD cells, the value of these parameters is ignored by the eNB.

The following parameters are updated:

- The multiplicity of the Inter frequency Idle Mode parameters (IRFIM) managed object class (MOC) is extended from 8 to 16.
- The multiplicity of the EUTRA carrier list for idle mode load balancing (dlCarFrqEutL) structure under the Mobility Idle Mode Default Profile (MODIMP) and Mobility Idle Mode Profile (MOIMP) MOCs is extended from 8 to 16.

When extendedFreqPriorities-r13 is supported by the UE, cellReselectionSubPriority which includes fraction numbers is also supported. As a result, the following parameter values are extended to support fraction numbers:

- idleLBCellReSelPrio
- idleLBCellReSelPrio2CC
- idleLBCellReSelPrio3CC
- idleLBCellReSelPrio4CC
- idleLBCellReSelPrio5CC
- idleLBEutCelResPrio
- idleLBEutCelResPrio2CC
- idleLBEutCelResPrio3CC
- idleLBEutCelResPrio4CC
- idleLBEutCelResPrio5CC

For more information, see *BTS reference data/Parameters/LTE BTS Parameters*.

Consistency Checks

A new SIB5 message cutting rule is introduced which changes the SIB5 consistency check. When the configured content is larger than expected, some SIB5 content will be cut out as a result. A warning will be raised and sent to operators when this occurs.

LTE4259 changes to the system

The LTE4259 feature changes the range of values for two parameters

The range of values for the following parameters is extended:

- IFGPR Group Size in dedicated group profile (groupSize)
- IFGDPR Group Size in default group profile (groupSize)

The new range is from 0 to 16.

LTE2179 changes to the system

List of modified parameters

The following existing parameters are modified by the *LTE2179: TDD downlink carrier aggregation 4CC - 80 MHz* feature:

Table 9 Parameters modified by the LTE2179 feature

Full name	Abbreviated name	Change description
Max. DL CA configuration for UL CA	maxDlCaConfigForUlCa	Added TDD applicability.
Max number of secondary cells for DL carrier aggr	maxNumScells	Parameter setting **2** changed into **3** in the consistency check.
Max number carrier aggr configured UEs 3 carriers	maxNumCaConfUe3c	Modification attribute changed from **On-line** to **Requires object locking**. Parameter name amended to accommodate for increased number of SCells. Setting extended to **50**.
Activate flexible SCell selection	actFlexScellSelect	Parameters consistency check amended to allow inter-operability with Cell Resource Groups for 4 CC CA.
Activation of downlink carrier aggregation	actDLCAggr	Parameters consistency check amended to allow inter-operability with Cell Resource Groups for 4 CC CA.
Cell resource sharing mode	cellResourceSharingMode	Parameters consistency check amended to allow inter-operability with Cell Resource Groups for 4 CC CA.
Activation of automatic PUCCH allocation	actAutoPucchAlloc	Parameters consistency check amended to allow inter-operability with Cell Resource Groups for 4 CC CA.

LTE4096 changes to the system

At least one QCI translation table, that is the QCI translation table operator specific (QCIsqciTabOperator) structure must be configured with the value of the QCI (qci) parameter in the 98 to 100 range to activate the LTE4096 feature.

LTE4117 changes to the system

The LTE4117: NB-IoT: Inter-frequency Idle mode Mobility feature introduces support of SIB4-NB for intra-frequency enhancement and SIB5-NB allowing NB-IoT UEs for inter-frequency cell reselection.

The *LTE4117: NB-IoT: Inter-frequency Idle mode Mobility* feature brings the following changes:

- The *LTE4117* feature support system information blocks (SIBs) for Narrowband Internet of Things (NB-IoT) devices with SIB4-NB and SIB5-NB. The SIB4-NB enhances intra-frequency cell reselection with neighbouring and blacklist cell list. Usage of SIB5-NB with addition of SIB3-NB allows the NB-IoT UE in RRC_IDLE mode to perform inter-frequency reselection where neighbouring NB-IoT cells are set with different frequencies than the active NB-IoT cell.
- This feature allows encapsulation of system information (SI) messages to simplify and reduce the traffic.
- The *LTE4117* feature changes the existing parameters listed in *#unique_64/unique_64_Connect_42_table_k32_zj4_bn* from object locking to online modification.

LTE4739 changes to the system

The LTE4739 feature changes the preemption algorithms and adds conditions to two existing parameters.

Preemption algorithms

The *LTE4739* feature changes the preemption algorithms to include Cat-M devices and bearers and NB-IoT devices, providing the operator a configurable time limit for the preemption duration.

Parameters

New conditions were added to existing parameters as follows:

- LNBTS `Activate RRC connection and SCell context preemption (actContextPreemption)`
  If the LNBTS `Supported LTE cell technology (supportedCellTechnology)` parameter is configured to **FDD** and if at least one LNCEL `Cell technology (cellTechnology)` parameter is set to **NB-IoT-FDD**, the following condition must be fulfilled:
  - The value of the LNBTS `Preemption priority of pure NB-IoT RRC connections (pureRrcPreempPrioNB)` parameter is allowed to be configured to **true** only if the LNBTS `Activate RRC connection and SCell context preemption (actContextPreemption)` parameter value is set to **true**.
- LNBTS `Activate enhanced AC and GBR services (actEnhAcAndGbrServices)`
  If the LNBTS `Supported LTE cell technology (supportedCellTechnology)` is configured to **FDD** and if at least one LNCEL_FDD `Activate LTE-M feature (actCatM)` is set to **true**, the following condition must be fulfilled:
  - The value of the LNBTS `Indicates if Cat-M preemption vulnerability for DRB bearers and UE Contexts is disabled or not (actPreempVulCatM)` parameter is allowed to be configured to **true** only if the LNBTS `Activate enhanced AC and GBR services (actEnhAcAndGbrServices)` parameter value is set to **true**.

LTE3974 changes to the system

The LTE3974: AirScale CBRS: Support Enhanced Measurement feature introduces a new parameter to the system.

Because the Received Signal Strength Indicator (RSSI) measurement with grant affects service (throughput, link reputation/repetition, modulation and coding scheme (MCS)), a parameter is introduced to allow online modification in order to perform the measurement while an inquiry event occurs. If this parameter is enabled, at the end of one RSSI measurement, including pre-TX, of a Citizens Broadband Radio Service Device (CBSD), the BTS Operations and Maintenance (BTSOM) opens a timer. Before the timer expires, the BTSOM does not perform the enhanced RSSI measurement on the CBSD, instead it uses the latest measurement results if the CBSD needs to apply for a new grant.

The feature is activated using the newly introduced `Activate the support for CBRS Enhanced Measurement` (`actCbrsEnhMeas`) parameter.

LTE3796 changes to the system

LTE3796 introduces new counters to calculate the degraded RRC success rate and to check usage statistics of a particular recovery phase for each cell.

LTE3796 introduces the `Number of Signaling Connection Establishment Requests rejected due to OAM Intervention (M8013C122)` counter to calculate the degraded radio resource control (RRC) success rate.

LTE3796 introduces the following counters to check usage statistics of a particular recovery phase for each cell:

- `Degraded RRC success rate recovery phase I (M8020C13)` to determine how many times the recovery action in Phase 1 is initiated.
- `Degraded RRC success rate recovery phase II (M8020C14)` to determine how many times the recovery action in Phase 2 is initiated.
- `Degraded RRC success rate recovery phase III (M8020C15)` to determine how many times the recovery action in Phase 3 is initiated.

LTE4066 changes to the system

Possible KPI changes due to the LTE4066: Low Latency Fast UL Grants feature functionality

Enabling of R14 functionality, provided by the `Activate low latency fast UL grants`(`actUlTxSkip`) parameter, may lead to change in UL/DL Discontinuous Transmission (DTX) detection rate.

When Activate low latency fast UL grants(actUlTxSkip) parameter is configured, the R14 UE may skip UL transmissions for an UL grant if no data is available for transmission in the UE buffer. This functionality introduces some ambiguity where the eNB shall detect the hybrid automatic repeat request (HARQ) response (acknowledgment/negative acknowledgment(ACK/NACK)) from the UE (physical uplink shared channel or physical uplink control channel (PUSCH or PUCCH)).

Since eNB scheduling is done with some advance, there might be cases when the evaluated buffer state at an eNB differs from the actual buffer status report (BSR) sent over the air. As a result, the eNB may decide to decode the signal on a different physical channel (for example, PUSCH instead of PUCCH). The eNB housekeeping function has to deal with a possible change in UL/DL DTX in case the eNB was not able to detect the HARQ response (ACK/NACK) from the UE, or a PUSCH transmission was not detected.

Any lack of response for a proactive UL grant for R14 UE will have to be still treated as “skippable” (since eNB is not aware of the real state of UE’s data buffer in a given subframe), or it simply has an issue with a proper decoding of physical downlink control channel (PDCCH).

The impact can be observed mainly on PDCCH allocations for PDSCH transmissions with HARQ reporting for which eNB received no HARQ response from UE (M8010C62) counter (PDCCH allocations for physical downlink shared channel (PDSCH) transmissions with HARQ reporting for which eNB received no HARQ response from the UE) and related counters.

List of impacted KPIs that might increase with the feature activated:

- E-UTRAN MAC PDU Re-transmission Ratio Downlink LTE_5216a
- Perc UL_SCH TB RTRANS LTE_140b
- Block error ratio (BLER) in UL LTE_1553a
- E-UTRAN Percentage of PUSCH transmissions using Low MCS Codes (MCS<=9) LTE_6260a
- E-UTRAN Percentage of PDSCH transmissions using Low MCS Codes (MCS<=9) LTE_6262a
- E-UTRAN Average RSSI for PUCCH LTE_5441b
- E-UTRAN Average SINR for PUCCH LTE_5541b
- E-UTRAN Average PRB usage per TTI UL LTE_5273b
- Avg AGG PDCCH sched LTE_1084a
- E-UTRAN average PRB usage per TTI DL LTE_5276b

List of impacted KPIs that might decrease with the feature activated:

- Avg MCS PUSCH trans LTE_1075a
- E-UTRAN Percentage of PUSCH transmissions using High MCS Codes (MCS>=20) LTE_6261a
- E-UTRAN Average SINR per Cell for PUCCH LTE_5370a
- E-UTRAN Average SINR per Cell for PUSCH LTE_5371a
- Average RSSI for PUSCH LTE_5444b
- E-UTRAN Average SINR for PUSCH LTE_5544b
- E-UTRAN Average RSSI per Cell for PUSCH LTE_5369a
- E-UTRAN Average RSSI per Cell for PUCCH LTE_5368a

9 Changes introduced with LTE 18SP features

Impact of new features on existing parameters (changed values, managed objects, or consistency checks), counters, or existing functionalities and algorithms

LTE3687 changes to the system

Modification of UL and DL CA parameters

The following parameters are modified by the *LTE3687: FDD carrier aggregation 2CC UL with 4CC/5CC DL* feature:

- `Activation of uplink carrier aggregation` (`actULCAggr`) LNBTS
- `Max number of secondary cells for DL carrier aggr` (`maxNumScells`) LNCEL

Parameters have been modified by the change in a consistency checks to allow the support of 4CC/5CC DL CA with 2CC UL CA.

LTE3870 changes to the system

LTE3870 modified several existing parameters.

LTE3870 introduces the possibility to modify several Cat-M1 related parameters online, eliminating the need to lock/unlock the cell.

Note: For a complete list of the parameters related to LTE3870, see .

LTE4494 changes to the system

Description of parameters changed or introduced with the LTE4494: Cat-M1 Dynamic Repetitions Support

Changes to existing parameters introduced with LTE4494

The existing parameter listed below is extended to a new value range **n32**:

- CATMPR - `numRepPerPreambAttemptCECatM`
  This parameter defines the number of PRACH repetitions per preamble attempts for Cat-M UEs in Coverage Enhancement (CE) Level 0.

The existing parameter listed below is also extended to the new value of **n32** if CATMPR parameter `numCELevelCatM` is set to **2**:

- CATMPR - `catMCELevel1`/`numRepPerPreambAttemptCECatM`

This parameter defines the number of PRACH repetitions per preamble attempts for Cat-M UEs in CE Level 1.

The number of MPUSCH repetitions can be configured to maximum 32 by setting the `puschMaxNumRepModeACatM` parameter to **r32** and the `puschRepLevModeACatM` paramater to **4**.

The number of MPUSCH repetitions for CE Level 1 can be configured to a maximum of 32 if CATMPR the `numCELevelCatM` parameter is set to **2**, by setting `puschMaxNumRepModeACatM` to **r32** and `catMCELevel1`/`puschRepLevModeACatM` to **n4**.

Note: If the dynamic repetition is activated on PUSCH, only the first PUSCH grant is set to 32 repetitions. The number of repetitions can vary to up to 32, depending on the BLER or RF conditions.

LTE2647/SR001070 changes to the system

The LTE2647/SR001070 feature blocks the direct login access to the service account called toor4nsn, provides a new service account called serviceuser (which is by default visible instead), and changes the parameters used for storing the SSH keys for service accounts. As a result, when upgrading to LTE/SRAN 18SP release, the operator must reconfigure all credentials for service accounts, and configure a new service account password.

Before the LTE/SRAN 18SP release, the credentials for a service account were configured using the `Service User Public Keys (serviceUserPublicKeys)` parameter. The SSH keys were applicable for the `toor4nsn` account. With LTE/SRAN 18SP, a new parameter is introduced for `toor4nsn`: `rootUserPublicKeys`, while `serviceUserPublicKeys` parameter is used for a new service account `serviceuser`. During the system upgrade, all configured SSH keys are deleted (not migrated to a new parameter). After the upgrade, the operator must reconfigure them manually. This can be done either using the Network Element Manager for a particular BTS or NetAct Configurator plan file for more BTSs.

After upgrade to LTE/SRAN 18SP release, there is no default SSH key pre-configured by Nokia. It means there is no possibility to escalate to root by default. In case Nokia Service personnel needs to get root access for diagnosis tasks then the operator must first configure at least one public SSH key (the access to the privileged account is possible only if at least one key has been provisioned). The operator will not be notified by a warning of the missing provisioning.

Additionally, after upgrade to LTE/SRAN 18SP, a new password for the `serviceuser` account is added. Assuming that before the upgrade the credentials for service account were configured as:

```
Login: toor4nsn
Password: operator_configured_password
```

then after the upgrade the credentials are changed as follows:

```
Login: toor4nsn
Password: operator_configured_password
(credentials configured at BTS, but not working)
```



```
Login: serviceuser
Password: default_Nokia_password
(new set of credentials)
```

Note: It is an essential part of BTS hardening that the operator configures a new password for the `serviceuser` account (after software upgrade or during BTS commissioning).

New parameter for Coordinated Multipoint and CRAN features

In LTE18SP, a new parameter is introduced that is used to activate all Coordinated Multipoint and CRAN features.

In releases up to LTE18SP, the Coordinated Multipoint features, that is

- *LTE1402: Uplink Intra-eNB CoMP*
- *LTE1691: Uplink intra-eNB CoMP 4Rx*
- *LTE2104: Uplink Intra eNodeB CoMP 4 RX with Softbit Combination*
- *LTE2128: Uplink Intra eNodeB CoMP 8 RX with Softbit Combination*

were activated with `Active Uplink CoMP` (`actUlCoMp`) parameter. Since release LTE18SP, those features are activated with the new `Activate CoMP` (`actCoMp`) parameter, which needs to be set to **fixedULCoMp**.

The same parameter is used with CRAN features. In CRAN deployment scenario, the `actCoMp` parameter needs to be configured **measBasedCoMp**.

If Coordinated Multipoint and CRAN needs to be deactivated, the `actCoMp` parameter needs to be configured to **disabled**.

10 Changes introduced with LTE 18 features

Impact of new features on existing parameters (changed values, managed objects, or consistency checks), counters, or existing functionalities and algorithms

10.1 LTE2839 changes to the system

LTE2839 modifies existing parameters and improves capacity and QoS

Modified parameters

Multicast channel info

`mchInfo` MBSFN_FDD

- Multicast channel configuration per GBR QCI
- Multiplicity is extended from **4** to **6**
- One list item for each `qci` value
- `mchInfo` is a structure with multiplicity n comprising
  - `dataMCS` (**0**,**25**)
  - `mchSchedulingPeriod`
    - Multicast channel Scheduling period
    - Possible values (radioframes): 4:**rf4**; 8:**rf8**; 16:**rf16**; 32:**rf32**; 64:**rf64**; 128:**rf128**; 256:**rf256**; 512:**rf512**; 1024:**rf1024**
    - All configured `mchSchedulingPeriod` values must be less than or equal to `mcchRepetitionPeriod` MBSFN_FDD
    - `mbmsSyncPeriod` M1SYNC must be at least twice the value of the longest amongst all instances of `mchInfo/mchSchedulingPeriod` MBSFN_FDD
    - If `mchInfo/qci` is **1** or **2** or **3** or **4**, the `mchSchedulingPeriod` cannot be set to **rf4**
  - `qci`
    - QCI
    - Values added with *LTE2839*: **65** and **66**
    - The `qci` value must be unique within all list items
    - Only following values are valid for `qci`: **1**, **2**, **3**, **4**, **65**, **66**

Capacity improvements

- With *LTE2839*, the maximum number of MBMS sessions per MBSFN is increased to **32** in order to support multiple Mission Critical Push to Talk (MCPTT) group calls (using QCIs 65/66)
- Maximum number of pmchs is increased to **7**. In order to meet the capacity demands of Public safety scenarios with different media, support of multiple pmchs carrying the similar QCI type is required

– Number of similar bearers of the same QCI type can be greater than **16** (current pmch maximum), requiring additional pmch to be created to support similar bearers

Note: Public Safety MBMS bearers and normal MBMS bearers such as QCI 1 are not multiplexed within the same pmch

QoS improvements

- Mission-Critical Push To Talk (MCPTT) Group Communication (using QCI 65/66) is characterized by low packet delay budgets. Shorter MCH scheduling period values (<**80** ms) have to be supported to ensure more frequent scheduling of related MBMS sessions
- *LTE2839* provides reduced minimum MCH scheduling period to **rf4** (**40** ms) in order to meet the end-to-end delay and BLER for media transport for QCIs 65/66

10.2 LTE2927 changes to the system

The LTE2927: Changed Feature Restriction Policy for 1.4 and 3 MHz feature impacts parameters, including their managed objects and consistency checks.

The following changes to the system have been introduced due to the *The LTE2927: Changed Feature Restriction Policy for 1.4 and 3 MHz* feature:

Update of the `actDLCAggr` parameter consistency check

The `actDLCAggr` parameter can be configured to **true**, only if no LNCEL_FDD instance exists with `dlChBw` set to **1.4 MHz** or **3 MHz**.

The consistency check for the `actDLCAggr` parameter is updated to allow downlink carrier aggregation activation for eNBs which host the 3 MHz or 1.4 MHz bandwidth cells along with other bandwidths. This change applies to intra-eNB and inter-eNB and inter-site carrier aggregation scenarios, both for FDD-FDD and for FDD-TDD combinations.

Note: 1.4 MHz and 3 MHz cells cannot be used in DL CA combinations, neither as a PCell nor as a SCell. Thus, invalid CA combinations involving 1.4 MHz and 3 MHz cells can lead to erroneous eNB behavior

Related feature:

- *LTE1089: Downlink carrier aggregation - 20 MHz*

Change of the `actIntraFreqLoadBal` parameter managed object

The *LTE2927* feature moves the *LTE1140* feature flag `actIntraFreqLoadBal` from LNBTS to LNCEL instance. The *LTE1140* feature can be activated in cells under an eNB with mix-bandwidth (bandwidth both <5 MHz and >=5 MHz) cells. Nevertheless, it is still not supported in 1.4 MHz/3 MHz cells.

Related feature:

- *LTE1140: Intra-frequency load balancing*

Change of the `actInterFreqLB` parameter managed object

The *LTE2927* feature moves the *LTE1170* and the *LTE1387* features flag `actInterFreqLB` from LNBTS to LNCEL instance and adds support inter-frequency load balance features in l3 MHz cell. The *LTE1170* and the *LTE1387* features remain restricted in 1.4 MHz cells.

Related features:

- *LTE1170: Inter eNode B IF Load Balancing*
- *LTE1387: Intra-eNode B IF Load Balancing*

Removed restriction of the 1.4/3 MHz cells for `actDlIntShaping`

The *LTE2927* feature removes the restriction of 1.4/3 MHz cells for `actDlIntShaping`. For 1.4/3 MHz cells, the `actDlIsh` parameter must be set to **false** and the `amountBlankedRes` parameter must be set to **0**.

Related feature:

- *LTE1800: Downlink interference shaping*

Change of the `actAmle` parameter managed object

The *LTE2927* feature moves the *LTE1841* feature flag `actAmle` from LNBTS to LNCEL instance. The *LTE2927* feature causes the *LTE1841* feature not to work in LTE1.4 MHz cells.

Related feature:

- *LTE1841: Inter-Frequency Load Equalization*

Removed restriction of the 1.4/3 MHz cells for `actCsgS1Mobility`

The *LTE2927* feature removes the bandwidth consistency check on the *LTE2351* feature flag `actCsgS1Mobility`. Previously, when the `actCsgS1Mobility` was set to **true**, the `dlChBw` had to be set to: **5 MHz**, **10 MHz**, **15 MHz**, or **20 MHz** values. Now, the *LTE2351* feature can be enabled in all kinds of bandwidth, including 1.4 MHz and 3 MHz cells.

Related feature:

- *LTE2351: S1 based handover towards CSG cells*

Related parameter:

- `dlChBw`

Changed consistency check of the `act1xSrvcc` parameter

The `act1xSrvcc` parameter can be configured to **true** if a CDFIM instance with the configured `csfbRegParam1xRtt` parameter exists for all LNCEL instances. The LNCEL instances cannot operate in one of the following bandwidth: 1.4 MHz and 3 MHz. Additionally, the *LTE738* feature does not work in 1.4 MHz and 3 MHz bandwidth cells.

Related feature:

- *LTE738: SRVCC to 1xRTT/CDMA*

Related parameter:

- csfbRegParam1xRtt

10.3 LTE3225 changes to the system

For maxNumScells parameter (maximum number of secondary cells for DL carrier aggregation) the range is set from 1 to 4 with step value 1.

10.4 LTE3590 changes to the system

A new CA intra-cell handover mode (caIntraCellHoMode) parameter is introduced.

A new MRBTS/LNBTS CA intra-cell handover mode (caIntraCellHoMode) parameter is introduced by the *LTE3590: CA and MFBI Interworking Extensions* feature.

This parameter replaces, renames the MRBTS/LNBTS Activate CA steering intra-cell handover (actCaIntraCellHo) parameter, and enhances its range.

The following intra-cell handover modes to MFBI mapped or native frequency with carrier aggregation needs are supported:

- **disabled**
  Intra-cell handover to MFBI mapped or native frequency with CA needs is disabled.
- **nonCAtoCA**
  Intra-cell handover will be performed if there is no CA band combination supported both by UE and eNB for current operating band of the PCell, while there are CA band combinations supported both by UE and eNB for another operating band of the PCell.
- **moreDLCACapacity**
  This mode covers the **nonCAtoCA** mode. In addition to **nonCAtoCA** mode intra-cell handover will be also performed if there are CA band combinations which have more potential DL CA aggregation bandwidth supported both by UE and eNB for PCell on another operating band than current operating band.

10.5 UE selection algorithms modified by LTE3757

The modifications of LB UE selection algorithms brought by LTE3757

LB UE Selection algorithm modification

This is the core functionality of *LTE3757*.

When a cell is overloaded the candidate UEs for offload are selected by the common UE selection algorithm which is applied to inter frequency load balancing features. This algorithm does not provide any option that will allow operator a prioritization in how the eNodeB chooses a candidate for offload. LTE3757 covers this missing functionality.

UE selection for offload is prioritized per operator-defined SPID groups.

The mobility profiles are defined either by the SPID group or by the default profile. The operator defines a new Mobility Profile parameter (iFLBCandPrio MOPR / MODPR). This parameter indicates the selection priority for Connected Mode Load Balancing. The value of the highest offload priority is the default value: **0**.

When the already existing trigger for the Connected Mode Load Balancing offload is reached then the eNodeB evaluates SPID groups available for UE candidate selection. The UEs belonging to SPID groups with the highest offload priorities for Load Balancing are offloaded first and UEs belonging to lower offload priority SPID groups are offloaded only if UEs from higher offload priority SPID groups did not sufficiently reduce the load below the high load threshold for LB offload.

The evaluation of SPID groups priority is done at the expiry of the operator defined timer (iFLBCandSelUpdateTimer LNCEL). If the already existing threshold for the Connected Mode Load Balancing (iFLBHighLoad Threshold) + operator defined cell level high-load threshold step (iFLBHighLoadStep LNCEL) is exceeded, then the next lower offload priority SPID group is selected. The UEs with all SPID groups selected so far are considered for offload.

Additionally, if the load is reduced below the threshold mentioned above the SPID groups are step-wise excluded from offload.

Active Mode Load Equalization (AMLE) UE Selection algorithm modification

There are situations when the *LTE3757: SPID based offload UE candidate selection* and *LTE1841: Inter-Frequency Load Equalization* features are both enabled.

When a cell enters inter-frequency LB active state, the AMLE functionality is not applied.

When AMLE functionality is applied, iFLBCandPrio MOPR / MODPR of Mobility Profile assigned to this UE = iFLBCandPrioCell. For AMLE, iFLBCandPrioCell is always set to the highest priority for offload (that is **0**). The UEs from profiles with iFLBCandPrio = **0** are candidates for AMLE.

Note: For more information on iFLBCandPrioCell see .

LB UTRAN UE selection algorithm modification

There are situations when the *LTE3757: SPID based offload UE candidate selection* and *LTE1357: LTE-UTRAN load balancing* features are both enabled.

The UTRAN LB selection algorithm is affected in the same way as the one for LTE inter-frequency LB. The UE is selected if the following conditions are met:

- UE belongs to a SPID group allowed by the operator to be offloaded to UTRAN (allowLBHoToUtran MOPR / MODPR set to **true**)
  and
- iFLBCandPrioCell >= iFLBCandPrio MOPR / MODPR of Mobility Profile assigned to this UE

If a UE does not belong to a SPID group allowed by the operator to be offloaded to UTRAN (allowLBHoToUtran MOPR / MODPR set to **false**), the UE is not selected for UTRAN offload.

Note: This case is for FDD only as UTRAN LB is only for FDD.

10.6 Preemption candidate selection algorithm modified by LTE3758

The modifications of pre-emption candidate selection algorithm brought by LTE3758

The pre-emption candidate selection algorithm is modified so that the selection is done according to PLMN groups with certain selection order between each PLMN group.

The pre-emption candidate selection algorithm applies at cell level to E-RABs (if it was the last E-RAB of an UE) and UE contexts (if *LTE1898* is activated together with *LTE3758*).

This also applies at baseband level if

- configured thresholds are reached

or

- in case of AirScale hardware only, corresponding pool limits (see the *LTE2733: Baseband pooling* feature for details) are reached.

In case of AirScale hardware the pool resources available for pre-emption are partitioned so that only resources from cells with the same pre-emption profile as the request hosting cell are considered valid for pre-emption. Bearers or UE contexts belonging to the same pool, but having different cell level pre-emption profile assigned, are not subject to pre-emption candidate selection.

10.7 LTE3866 changes to the system

Withdrawn band combination

With the *LTE3866: Additional Carrier Aggregation Band Combinations 2CC – VI* feature released in LTE18, the support of band 5 + band 28 introduced by the release LTE17 in *LTE3047: Additional Carrier Aggregation Band Combinations 2CC – V* feature is removed.

10.8 New Model Object Chart (MOC) introduced by LTE4154

The modifications of Model Object Chart (MOC) brought by LTE4154

Model Object Chart (MOC) modification

The *LTE4154: CA-aware Idle Mode Load Balancing II* feature introduces two new Model Object Chart (MOC) entries:

- `Carrier Aggregation-aware Idle Mode Load Balancing PCell configuration (CAIMLBP)`

The MOC CAIMLBP is introduced as subordinate to LNBTS-CAGENB. It is introduced to hold PCell configuration with PCell EARFCN combination for the *LTE4154: CA-aware Idle Mode Load Balancing II* feature.
The maximum number of CAIMLBP instances is 12.

- `Carrier Aggregation-aware Idle Mode Load Balancing SCell configuration (CAIMLBS)`
  The MOC CAIMLBS is introduced as subordinate to LNBTS-CAGENB-CAIMLBP. It is introduced to hold SCells' configurations as a structured list per number of component carriers.
  The maximum number of CAIMLBS instances per CAPLIMBP instance is 6.

10.9 LTE4222 changes to the system

Timer setting modification as a prevention of spurious retransmissions

`Timer Reordering for DRB Cat-M (tReordDrb)` parameter recommended value was modified from **0 ms** to **200 ms**. This timer is used by the receiving side for data reordering, protocol data unit (PDU) loss detection, and delay of the PDU transmission status.

Without activation of the *LTE4222* feature, there is a single HARQ process, so there is no potential spurious retransmission issue, and T-reordering `(tReordDrb)` timer can be configured to **0 ms**. With the *LTE4222* feature activated, when the data radio bearer (DRB) is operating under multiple HARQ processes, the mentioned T-reordering timer must be set to a value other than **0 ms** to prevent the risk of spurious retransmission.

By default, radio link control (RLC) layer initiates retransmission procedure whenever a transmission detection gap occurs. Below the RLC, the HARQ also has its own retransmission mechanism and when there are multiple HARQ processes, some transmissions/retransmissions could be completed faster than the others. As a result, there is a possibility of premature retransmission request at the RLC layer, so the T-reordering timer is used to ensure all media access control (MAC) layer related HARQ processes have been completed properly.

If the timer would be too short, the RLC may prematurely request a retransmission for a PDU that is still in the HARQ retransmission process. Also the value of T-reordering timer should not be too large because it may result in longer transmission, even in single-HARQ transmission mode.

10.10 LTE4409 changes to the system

With the LTE4409: NB-IoT: Enhancements and Improved Feature Interactions (OTDOA, FDD-TDD CA) feature introduction the LNBTS_FDD `Attach without PDN connectivity support ( attachNoPDNConn)` parameter range is enhanced to include NB-IoT support.

10.11 LTE3865 changes to the system

Modified counter

A new description and meaning is introduced in the *LTE3865* feature for the M8026C284 Number of bursts in UL counter originated from the *LTE3778* feature.

- Previous *LTE3778* feature counter M8026C284 Number of burst in UL implementation provided number of UL grants after SR.
- Current *LTE3865* feature counter M8026C284 Number of burst in UL implementation provides the total number of data bursts in UL. The M8026C284 counter has been modified with triggering done from received data when no previous transmission was done for the buffered data.
  In the *LTE3865* feature a new M8026C286 Number of UL Grants after SR reception counter has been created to replace previous M8026C284 counter implementation from the *LTE3778* feature.

Starting from FDD-LTE 18SP release the counters M8012C207, M8012C208, M8012C210, M8012C211 are no longer supported. In FDD-LTE 18SP there are four new counters introduced: M8012C216, M8012C218, M8047C17, M8047C18.

For counter descriptions, see *LTE Measurements, Counters, and KPIs* reference document.

10.11.1 Counters improvement with the LTE3865

Enhancements for all counters related to the IP scheduled throughput

With the *LTE3865: Additional DL initial burst delay counters for overall traffic and CA* feature, DL and UL IP scheduled throughput related counters are improved as follows:

- Maximum 10 s duration per burst is removed. The counter updates are triggered continuously for already completed DRB data transmissions.
- The DL burst data counting is triggered from the moment of reception of the HARQ feedback for both RLC UM and RLC AM mode DRBs.
- A new DL burst measurement is started in parallel with a previous burst that is still waiting for its HARQ feedback to consider that previous burst as completed.
- UL burst is detected and counted from the moment of data reception, taking into account the HARQ retransmissions.

As a result there can be more samples which leads to a more accurate and increased value of the data volume and transmission time counters in DL. Improved UL burst detection also leads to a more accurate measurement data for the UL counter.

The DL data burst triggering from HARQ feedback can contribute to a higher throughput value compared to previous releases when radio link control (RLC) retransmissions were needed during data burst time. All RLC retransmissions which are successfully transmitted on HARQ are counted, whereas in previous releases which used RLC triggering RLC negative acknowledgement (NACK) transmissions were excluded from the data volume count. Parallel DL data burst measurement can contribute to higher throughput value compared to previous releases when more data bursts are counted in bursty data transmission for UEs in good radio frequency conditions.

Table 10 List of impacted counters and KPIs related to DL and UL IP scheduled throughput

Counter ID	Counter name	Corresponding KPI
M8001C135	Number of RLC SDUs on UL DTCH	not used in KPI calculation
M8001C142	UL RLC PDUs received	LTE_5207b
M8006C183	ERAB_IN_SESSION_TIME_QCI3	LTE_5575a LTE_5578a LTE_5581a LTE_5581b LTE_5584a LTE_5584b
M8006C184	ERAB_IN_SESSION_TIME_QCI4	LTE_5575a LTE_5579a LTE_5581a LTE_5581b LTE_5585a LTE_5585b
M8006C185	ERAB_IN_SESSION_TIME_NON_GBR	LTE_5575a LTE_5580a LTE_5581a LTE_5581b LTE_5586a LTE_5586b
M8011C231	NUM_SUCC_CA_ACT_SCELL_DL	not used in KPI calculation
M8012C16	RLC_SDU_VOL_UL_DCCH	not used in KPI calculation
M8012C17	RLC PDU volume received	LTE_5283a LTE_5283b
M8012C70	MAC SDU volume on UL-DCCH	not used in KPI calculation
M8012C71	MAC SDU volume on UL-DTCH	not used in KPI calculation
M8012C79	Volume of RLC SDUs on UL-DTCH	not used in KPI calculation
M8012C117	IP Throughput volume in DL for QCI 1	LTE_5350a LTE_5503a
M8012C118	IP Throughput time in DL for QCI 1	LTE_5350a
M8012C119	IP Throughput volume in DL for QCI 2	LTE_5351a LTE_5504a
M8012C120	IP Throughput time in DL for QCI 2	LTE_5351a
M8012C121	IP Throughput volume in DL for QCI 3	LTE_5352a LTE_5505a
M8012C122	IP Throughput time in DL for QCI 3	LTE_5352a
M8012C123	IP Throughput volume in DL for QCI 4	LTE_5353a LTE_5506a
M8012C124	IP Throughput time in DL for QCI 4	LTE_5353a

Table 10 List of impacted counters and KPIs related to DL and UL IP scheduled throughput (Cont.)

Counter ID	Counter name	Corresponding KPI
M8012C125	IP Throughput volume in DL for QCI 5	LTE_5354a LTE_5507a
M8012C126	IP Throughput time in DL for QCI 5	LTE_5354a
M8012C127	IP Throughput volume in DL for QCI 6	LTE_5355a LTE_5508a
M8012C128	IP Throughput time in DL for QCI 6	LTE_5355a
M8012C129	IP Throughput volume in DL for QCI 7	LTE_5356a LTE_5509a
M8012C130	IP Throughput time in DL for QCI 7	LTE_5356a
M8012C131	IP Throughput volume in DL for QCI 8	LTE_5357a LTE_5510a
M8012C132	IP Throughput time in DL for QCI 8	LTE_5357a
M8012C133	IP Throughput volume in DL for QCI 9	LTE_5358a LTE_5511a
M8012C134	IP Throughput time in DL for QCI 9	LTE_5358a
M8012C165	IP Throughput net time in DL for QCI 1	LTE_5503a
M8012C166	IP Throughput net time in DL for QCI 2	LTE_5504a
M8012C167	IP Throughput net time in DL for QCI 3	LTE_5505a
M8012C168	IP Throughput net time in DL for QCI 4	LTE_5506a
M8012C169	IP Throughput net time in DL for QCI 5	LTE_5507a
M8012C170	IP Throughput net time in DL for QCI 6	LTE_5508a
M8012C171	IP Throughput net time in DL for QCI 7	LTE_5509a
M8012C172	IP Throughput net time in DL for QCI 8	LTE_5510a
M8012C173	IP Throughput net time in DL for QCI 9	LTE_5511a
M8012C187	DL nonGBR IP throughput Data Volume for UEs without CA	LTE_6178a LTE_6178a
M8012C191	DL nonGBR IP throughput time for UEs without CA	LTE_6178a LTE_6178a
M8012C209	Number of bursts with CA activity in DL for nonGBR (QCIs6-9)	not used in KPI calculation
M8012C212	Number of single TTI initialbursts for nonGBR (QCIs 6-9) in DL	not used in KPI calculation
M8012C213	Single TTI Burst Data Volume in DL for nonGBR (QCIs 6-9) traffic	not used in KPI calculation

Table 10 List of impacted counters and KPIs related to DL and UL IP scheduled throughput (Cont.)

Counter ID	Counter name	Corresponding KPI
M8012C216	Initial burst waiting for scheduling applicability delay in DL PCell and one or more SCells for nonGBR (QCIs 6-9)	not used in KPI calculation
M8012C218	Initial burst scheduling applicability and scheduling delay in DL PCell and one or more SCells for nonGBR (QCIs 6-9)	not used in KPI calculation
M8026C284	Number of Bursts in UL	LTE_6285a
M8026C287	Number of Uplink Bursts for nonGBR (QCIs 6-9)	not used in KPI calculation
M8038C28	IP Throughput volume in DL for QCI1 per PLMN-ID	LTE_5847a
M8038C29	IP Throughput time in DL for QCI1 per PLMN-ID	LTE_5847a
M8038C30	IP Throughput volume in DL for QCI2 per PLMN-ID	LTE_5848a
M8038C31	IP Throughput time in DL for QCI2 per PLMN-ID	LTE_5848a
M8038C32	IP Throughput volume in DL for QCI3 per PLMN-ID	LTE_5849a
M8038C33	IP Throughput time in DL for QCI3 per PLMN-ID	LTE_5849a
M8038C34	IP Throughput volume in DL for QCI4 per PLMN-ID	LTE_5850a
M8038C35	IP Throughput time in DL for QCI4 per PLMN-ID	LTE_5850a
M8038C36	IP Throughput volume in DL for QCI5 per PLMN-ID	LTE_5851a
M8038C37	IP Throughput time in DL for QCI5 per PLMN-ID	LTE_5851a
M8038C38	IP Throughput volume in DL for QCI6 per PLMN-ID	LTE_5852a
M8038C39	IP Throughput time in DL for QCI6 per PLMN-ID	LTE_5852a
M8038C40	IP Throughput volume in DL for QCI7 per PLMN-ID	LTE_5853a
M8038C41	IP Throughput time in DL for QCI7 per PLMN-ID	LTE_5853a
M8038C42	IP Throughput volume in DL for QCI8 per PLMN-ID	LTE_5854a
M8038C43	IP Throughput time in DL for QCI8 per PLMN-ID,	LTE_5854a
M8038C44	IP Throughput volume in DL for QCI9 per PLMN-ID	LTE_5855a

Table 10 List of impacted counters and KPIs related to DL and UL IP scheduled throughput (Cont.)

Counter ID	Counter name	Corresponding KPI
M8038C45	IP Throughput time in DL for QCI9 per PLMN-ID	LTE_5855a
M8047C0	IP Throughput volume in DL for QCI/ARP dynamic profile	not used in KPI calculation
M8047C2	Throughput time in DL per Profile	not used in KPI calculation
M8012C91	IP Throughput volume in UL for QCI 1	LTE_5359a LTE_5512a
M8012C92	IP Throughput time in UL for QCI 1	LTE_5359a
M8012C93	IP Throughput volume in UL for QCI 2	LTE_5360a LTE_5513a
M8012C94	IP Throughput time in UL for QCI 2	LTE_5360a
M8012C95	IP Throughput volume in UL for QCI 3	LTE_5361a LTE_5514a
M8012C96	IP Throughput time in UL for QCI 3	LTE_5361a
M8012C97	IP Throughput volume in UL for QCI 4	LTE_5362a LTE_5515a
M8012C98	IP Throughput time in UL for QCI 4	LTE_5362a
M8012C99	IP Throughput volume in UL for QCI 5	LTE_5363a LTE_5516a
M8012C100	IP Throughput time in UL for QCI 5	LTE_5363a
M8012C101	IP Throughput volume in UL for QCI 6	LTE5364a LTE_5517a
M8012C102	IP Throughput time in UL for QCI 6	LTE_5364a
M8012C103	IP Throughput volume in UL for QCI 7	LTE_5365a LTE_5518a
M8012C104	IP Throughput time in UL for QCI 7	LTE_5365a
M8012C105	IP Throughput volume in UL for QCI 8	LTE_5366a LTE_5519a
M8012C106	IP Throughput time in UL for QCI 8	LTE_5366a
M8012C107	IP Throughput volume in UL for QCI 9	LTE_5367a LTE_5520a
M8012C108	IP Throughput time in UL for QCI 9	LTE_5367a
M8012C156	IP Throughput net time in UL for QCI 1	LTE_5512a
M8012C157	IP Throughput net time in UL for QCI 2	LTE_5513a
M8012C158	IP Throughput net time in UL for QCI 3	LTE_5514a
M8012C159	IP Throughput net time in UL for QCI 4	LTE_5515a
M8012C160	IP Throughput net time in UL for QCI 5	LTE_5516a

Table 10 List of impacted counters and KPIs related to DL and UL IP scheduled throughput (Cont.)

Counter ID	Counter name	Corresponding KPI
M8012C161	IP Throughput net time in UL for QCI 6	LTE_5517a
M8012C162	IP Throughput net time in UL for QCI 7	LTE_5518a
M8012C163	IP Throughput net time in UL for QCI 8	LTE_5519a
M8012C164	IP Throughput net time in UL for QCI 9	LTE_5520a
M8026C286	Number of UL Grants after SR reception	not used in KPI calculation
M8038C10	IP Throughput volume in UL for QCI1 per PLMN-ID	LTE_5856a
M8038C11	IP Throughput time in UL for QCI1 per PLMN-ID	LTE_5856a
M8038C12	IP Throughput volume in UL for QCI2 per PLMN-ID	LTE_5857a
M8038C13	IP Throughput time in UL for QCI2 per PLMN-ID	LTE_5857a
M8038C14	IP Throughput volume in UL for QCI3 per PLMN-ID	LTE_5858a
M8038C15	IP Throughput time in UL for QCI3 per PLMN-ID	LTE_5858a
M8038C16	IP Throughput volume in UL for QCI4 per PLMN-ID	LTE_5859a
M8038C17	IP Throughput time in UL for QCI4 per PLMN-ID	LTE_5859a
M8038C18	IP Throughput volume in UL for QCI5 per PLMN-ID	LTE_5860a
M8038C19	IP Throughput time in UL for QCI5 per PLMN-ID	LTE_5860a
M8038C20	IP Throughput volume in UL for QCI6 per PLMN-ID	LTE_5861a
M8038C21	IP Throughput time in UL for QCI6 per PLMN-ID	LTE_5861a
M8038C22	IP Throughput volume in UL for QCI7 per PLMN-ID	LTE_5862a
M8038C23	IP Throughput time in UL for QCI7 per PLMN-ID	LTE_5862a
M8038C24	IP Throughput volume in UL for QCI8 per PLMN-ID	LTE_5863a
M8038C25	IP Throughput time in UL for QCI8 per PLMN-ID	LTE_5863a
M8038C26	IP Throughput volume in UL for QCI9 per PLMN-ID	LTE_5864a

Table 10 List of impacted counters and KPIs related to DL and UL IP scheduled throughput (Cont.)

Counter ID	Counter name	Corresponding KPI
M8038C27	IP Throughput time in UL for QCI9 per PLMN-ID	LTE_5864a
M8047C1	IP Throughput data volume in UL per Profile	not used in KPI calculation
M8047C17	Number of single TTI initial bursts for in DL per Profile	not used in KPI calculation
M8047C18	Single TTI initial burst data volume in DL per Profile	not used in KPI calculation
M8047C3	IP Throughput time in UL per Profile	not used in KPI calculation

For counter descriptions, see *LTE Measurements, Counters, and KPIs* reference document.

Note: The U-Plane counters are not supported with FZM one cell deployment.

Note: Starting from FDD-LTE 18SP release the counters M8012C207, M8012C208, M8012C210, M8012C211 are no longer supported. In FDD-LTE 18SP there are four additional counters introduced: M8012C216, M8012C218, M8047C17, M8047C18.

11 LTE 19B algorithm changes

Algorithm changes for pre-LTE 19B radio resource management features

11.1 Prioritization of the optional power group over the mandatory power group for baseband pool allocation

With this change the baseband pool allocation is now prioritized on the optional group (also known as second power group PG#2) instead of the mandatory one. This allows the BTS to reserve mandatory power group for potential GSM deployment.

Related features

LTE2733: Baseband Pooling

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

11.2 Modified conditions for triggering the step-wise SCell configuration

The Resource Allocation Type (RAT) 1 is supported.

Short description

Supporting RAT 1 results in a reduced inter-cell interference and an optimized downlink Physical Resource Block (PRB) utilization for services with small transport block size allocations.

Related features

LTE1541: Advanced SCell Measurement Handling

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter values might increase:

- M8011C311: Total number of PRBs used for Resource Allocation Type 1 (RAT1) scheduling
- M8012C20: PDCP SDU data volume on eUu Interface downlink
- M8012C179: Average achievable MAC PDU Throughput in Downlink per Cell
- M8012C80: RLC SDU DL-DTCH volume
- M8012C181: Average achievable MAC PDU Throughput in Uplink per Cell
- M8012C183: Average achievable MAC PDU throughput in Downlink per User
- M8012C184: Maximum achievable MAC PDU throughput in Downlink per User

12 LTE19A algorithm changes

Algorithm changes for pre-LTE 19A radio resource management features

12.1 LTE19A common algorithm changes

12.1.1 Improved SCell handling when moving from bad to good channel conditions

This change aims at reducing the scheduling delay and the probability of unnecessary secondary cell (SCell) releases.

Short description

When the channel status equals either 'bad' or 'undetected' (during the SCell channel quality estimation), the eNB will gradually reduce (age) the delta CQI received from DL link adaptation. This aging is performed in each consecutive SCell channel quality estimation period during which the channel status is bad or undetected until a configurable target delta CQI is reached.

When the signal quality improves and if a negative delta CQI is gradually reduced during the channel quality estimation, the eNB will likely transition the SCell channel status to good faster than in the original implementation (when the original delta CQI was used for the entire period of channel quality estimation).

Related features

LTE1541 Advanced SCell measurement handling

Related parameters

- `Activate delta CQI aging in SCell channel estimation` (`actDeltaCqiAgingScellChEst`)
- `Activate advanced SCell measurement handling` (`actAdvScellMeas`)
- `Activation of downlink carrier aggregation`(`actDLCAggr`)
- `Delta CQI target value in SCell channel estimation`(`deltaCqiTargetScellChEst`)
- `Delta CQI aging window in SCell channel estimation` (`deltaCqiAgingWinScellChEst`)

Expected impact on performance counters

There are no related counters.

12.1.2 QCI-specific UL power control

This change might improve the UL throughput for specific target QCI bearers or for 64QAM UEs.

Short description

With this change enabled, the eNB creates QCI-specific UL power control settings that can be applied to a selected QCI to define modulation-specific values for PUSCH target closed loop power control settings. The selected QCI can be replaced in favor of all QCIs for modulation 64QAM or higher.

The target QCI will have separate parameters for modulation values lower than 64QAM in UL and modulation higher or equal to 64QAM.

Related features

LTE27 Open loop UL power control and DL power setting

Related parameters

- Method for UL power control (actUlpcMethod)
- Activate Differentiation for PUSCH closed loop power control (actUlpcDiffPusch)
- QCI for differentiated PUSCH closed loop power control (ulpcDiffTgtQci)
- TPC Direction for Quad 1 of differentiated PUSCH ULPC Decision Matrix (ulpcDiffTpcDirQuad1)
- TPC Direction for Quad 9 of differentiated PUSCH ULPC Decision Matrix (ulpcDiffTpcDirQuad9)
- Time interval for power command decisions with differentiated ULPC (ulpcDiffReadPeriod)
- Differentiated 64QAM ULPC settings applied for all QCIs (ulpcDiffAllQci64Qam)
- PHR Threshold for Up TPC with differentiated ULPC (ulpcDiffPhrThresh)
- MCS Delta Threshold for Up TPC with differentiated ULPC (ulpcDiffMcsThresh)
- Lower RSSI threshold for differentiated TPC decision per QCI (ulpcDiffLowLev)
- Lower SINR threshold for differentiated TPC decision per QCI (ulpcDiffLowQual)
- Lower RSSI threshold for differentiated TPC decision with 64QAM (ulpcDiffLowLev64)
- Lower SINR threshold for differentiated TPC decision with 64QAM (ulpcDiffLowQual64)
- Upper RSSI threshold for differentiated TPC decision per QCI (ulpcDiffUpLev)
- Upper SINR threshold for differentiated TPC decision per QCI (ulpcDiffUpQual)
- Upper RSSI threshold for differentiated TPC decision with 64QAM (ulpcDiffUpLev64)
- Upper SINR threshold for differentiated TPC decision with 64QAM (ulpcDiffUpQual64)
- Configuration for differentiated PUSCH closed loop power control (ulpcDiffSchConfig)
- Control for differentiated PUSCH closed loop power control (ulpcDiffSchControl)
- Configuration of PUSCH closed loop power control for differentiation with 64QAM (ulpcDiffConfig64)

- Uplink power control PUSCH configuration (ulpcPuschConfig)

Expected impact on performance counters

There are no related counters.

12.1.3 Improved UL grant efficiency for TCP boosting

New parameters are introduced to improve the grant efficiency used for Transmission Control Protocol (TCP) boosting. The PDCCH and PUSCH usage ratio is expected to be reduced. The Received Signal Strength Indicator (RSSI) noise increase should be reduced when the LTE4066 feature is activated.

Short description

This change aims at improving the efficiency of TCP boost proactive UL grants and the skippable TCP boost proactive UL grants by introducing the following enhancements:

- Grants will only be triggered when the scheduled data size at a TTI is not lower than the value of the ilMinDataTrigGrantTcpBoost parameter.
- Grant can be sent only after the configured gap (ilGrantGapTcpBoost) TTIs elapsed since the previous UL grant (regardless of the grant type).
- A grant delay timer is introduced (ilGrantDelayTcpBoost) to avoid sending grants too soon.
- The grant period expiration accuracy is improved so that no grants are sent after the grant timer expires.

Related features

LTE4066: Low Latency Fast UL Grants

Related parameters

- Activate improve UL grant efficiency for TCP Boost (actUlGrantEffTcpBoost)
- Improved latency minimum DL data to trigger TCP Boost proactive UL grants sending (ilMinDataTrigGrantTcpBoost)
- Improved latency initial delay for proactive UL grants triggered for TCP boosting (ilGrantDelayTcpBoost)
- Improved latency gap for proactive UL grants triggered for TCP boosting (ilGrantGapTcpBoost)

Expected impact on performance counters

There are no related counters.

12.2 LTE19A FDD algorithm changes

12.2.1 Correction of PUCCH RSSI and PUCCH SINR KPIs in inter-site CA

The PUCCH Received Signal Strength Indicator (RSSI) and PUCCH Signal to Interference and Noise Ratio (SINR) KPIs will show correct values in inter-site carrier aggregation (CA) scenarios.

Short description

With this change, 'DTX-to-ACK' and 'DTX-to-NACK' (discontinuous transmission acknowledgement or negative acknowledgement) errors caused by the PUCCH pre-allocation based decoding of PUCCH format 3 and PUCCH format 1bwcs will not result in fake PUCCH SINR samples and fake PUCCH RSSI samples that were taken into the calculation of the PUCCH KPIs and counters.

Related features

LTE3022/SR001419: Inter-site Carrier Aggregation

Related parameters

`Activate inter-eNB DL carrier aggregation` (`actInterEnbDLCAggr`)

Expected impact on performance counters

If the `actInterEnbDLCAggr` parameter value is set to **true** and the CA deployment is inter-site (there is an X2-connected SCell), then the following KPI values might increase:

- LTE_5441b E-UTRAN Average RSSI for PUCCH
- LTE_5541b E-UTRAN Average SINR for PUCCH

12.2.2 Modification of conditions triggering the step-wise secondary cell (SCell) configuration

The SCell configuration will be triggered only when the UE is in 'in-sync' state.

Short description

With this change, the step-wise SCell configuration will not be triggered when the UE is in 'out-of-sync' state.

Related features

LTE1541: Advanced SCell Measurement Handling

Related parameters

`PDCCH Order Configuration` (`pdcchOrderConfig`)

Expected impact on performance counters

If the DL carrier aggregation is enabled, the `numTxWithHighNonGbr` parameter value is bigger than 0, and the `pdcchOrderConfig` parameter value is either set to **enabled** or not configured at all, then the following KPI values might decrease:

- LTE_5319c E-UTRAN Average UEs with Configured one SCell in DL
- LTE_5320b E-UTRAN Average UEs with an Activated SCell in DL
- LTE_5672b E-UTRAN Average UEs with Configured two SCells in DL
- LTE_5999a E-UTRAN Average UEs with Configured three SCells in DL
- LTE_6003d E-UTRAN Average Number of CCCs in DL
- LTE_6166a E-UTRAN SCell Configuration Attempts in DL and UL
- LTE_6304a E-UTRAN Average UEs with Configured four SCells in DL
- LTE_6615a E-UTRAN Average UEs with Configured five SCells in DL
- LTE_6791a E-UTRAN Average UEs with Configured six SCells in DL
- LTE_5246a E-UTRAN Average UEs with Activated Three SCells in DL
- LTE_5674b E-UTRAN Average UEs with Activated Two SCells in DL
- LTE_6302a E-UTRAN Average UEs with Activated Four SCells in DL
- LTE_6614a E-UTRAN Average UEs with Activated Five SCells in DL
- LTE_6792a E-UTRAN Average UEs with Activated Six SCells in DL

12.2.3 RIP interference measurement correction

The cell PUSCH Received Interference Power (RIP) fetch-type reports show correct results for PRACH Physical Resource Blocks (PRBs) and PRACH subframe.

Short description

The RIP interference measurement for PRACH PRBs was calculated from both PRACH PRBs and PUSCH PRBs. With this change, the PUSCH PRBs are excluded.

Related features

LTE1914: RIP (Received Interference Power) measurement report extension/Support RIP initiated alarms

Related parameters

`Activate RIP alarming` (`actRIPAlarming`)

Expected impact on performance counters

There are no related counters.

12.2.4 Change in handling the Radio Network Layer Cause: "Release due to E-UTRAN Generated Reason"

Introduction of a 3GPP-compliant mechanism for handling Radio Network Layer Cause due to E-UTRAN Generated reason in case of receiving a E-RAB Release Command with incorrect E-RAB IDs.

Short description

In case of unknown E-RAB ID, the original procedure of handling the Radio Network Layer Cause: "Release due to E-UTRAN Generated Reason" (sent within the `S1AP: UE CONTEXT RELEASE REQUEST` message from eNB to MME) resulted in moving the

“E-RAB to be Released List” to “E-RAB Failed to Released List”. For bearers which the E-RAB ID was not known, the cause was set to “Unknown E-RAB ID”. For others, the cause was set to "Release due to E-UTRAN Generated Reason".

After the change, the UE context should not be released (the S1AP: UE CONTEXT RELEASE REQUEST message is not sent) when the MME sends an E-RAB release command with an incorrect E-RAB ID. As a result, other bearers are not released because of the "E-UTRAN Generated Reason".

Related features

There are no related features.

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter impact is expected:

- The M8013C60 eNB initiated UE Context releases with radio network layer cause "Unspecified" counter value might decrease.
- The M8006C259 eNB initiated E-RAB releases due to E-UTRAN Generated Reason counter value might increase.

12.3 LTE19A TDD algorithm changes

12.3.1 TDD mMIMO downlink PRB usage-based multiple users paring

This change improves the dynamic balancing of single user and multiple user performance in different scenarios by controlling the maximum number of layers.

Short description

In the original implementation:

- The MU set is prioritized as long as UEs fulfill the pairing criterion.
- The number of paired layers is always set by the dlMaxNumLayerPerMuRBG parameter.

With the change:

- The number of Physical Resource Blocks (PRBs) is prioritized and once the PRB fulfills the UEs requirement, single user is preferred.
- The number of paired layers is decided by dlMaxNumLayerPerMuRBG and the number of requested resource block groups (RBGs) for all the UEs

Related features

- *LTE2666: Massive MIMO*

- *LTE3463: DL MU-MIMO for massive MIMO*

Related parameters

- `The maximum multiplexing layers per MU RBG for downlink MU-MIMO of TDD mMIMO` (`dlMaxNumLayerPerMuRBG`)

Expected impact on performance counters

The cell and user throughput might be improved, thus the following counter values can be impacted:

- `M8011C232` - `M8011C238` (Number of RBGs for 2-8 paired UEs in DL MU-MIMO mode)
- `M8012C117` - `M8012C134` (IP Throughput volume/time in DL for QCI 1-9)

12.3.2 PDCCH CCE power limiting (TDD)

Performance improvement for sites in dense urban areas.

Short description

In dense urban sites the AirScale BTS is dealing with high PDCCH utilization and blocking because of UEs that are using a high number of Control Channel Elements (CCEs) and power boosting together. This is reducing data scheduling and causing RLC retransmissions, thus impacting data retainabililty. This change should prevent this behavior by setting PDCCH resource limits:

- Limit the maximum equivalent CCEs (link adaptation requests - CCEs + power boost). This will be based on Control Format Indicator (CFI) link adaptation methods.
- Limit the physical CCE aggregation level by restricting the use of aggregation level 8 with power boosting (consumes a total number of 16 CCEs when this happens). Instead, the AirScale BTS will allow power boosting only for aggregation level 1/2/4 (excluding 8). This should double the PDCCH space and reduce blocking.
- Limit the `pdcchCqiShift` range during the Open Loop Link Adaptation (range from -5 to +10 instead of -10 to +10).

Related features

- *LTE749: Link adaptation for PDCCH*
- *LTE1035: Outer loop link adaptation for PDCCH*

Related parameters

- `Max PDCCH Aggregation` (`maxPdcchAgg`)
- `Max PDCCH Aggregation During High PDCCH Load` (`maxPdcchAggHighLoad`)
- `Max PDCCH Physical CCEs` (`maxPhyCces`)
- `PDCCH LA CQI shift` (`pdcchCqiShift`)
- `Min PDCCH LA CQI shift` (`minPdcchCqiShift`)
- `Max PDCCH LA CQI shift` (`maxPdcchCqiShift`)
- `Activate outer loop link adaptation` (`actOlLaPdcch`)

Expected impact on performance counters

The following counter values can be impacted:

- M8011C39 - M8011C42 (AGG1/2/4/8 used PDCCH)
- M8011C43 - M8011C46 (AGG1/2/4/8 blocked PDCCH)

13 LTE 19 algorithm changes

Algorithm changes for pre-LTE 19 radio resource management features

13.1 QCI5 and QCI1 scheduling enhancement for CAT-M VoLTE Ues

This change aims at improving the CAT-M VoLTE UEs performance by reducing the Cat-M VoLTE voice gap and radio link failure in parallel with QCI5 SIP transmission. It improves the VoLTE performance (less voice gaps), quality (possibility of using higher codecs), and capacity.

Short description

This change consists of two parts:

- The first enhancement:
  - The common link adaptation concept for all bearers (no separate QCI1 semi-static link adaptation)
  - The Cat-M scheduler will select the MCS just to fit the data in buffer for Cat-M UEs (higher MCS for QCI5 and lower MCS for QCI1 with less data, similar as LTE4885 for Rel-14 UL). Multiple HARQs (LTE4222 and LTE4442) are also possible for VoLTE bearer.
  - The Cat-M scheduler will use the VoLTE-specific link adaptation BLER target for link adaptation, after first the DL QCI1 payload arrived.
  - The Cat-M scheduler will limit the maximum number of repetitions used for the QCI1 bearer.
  - The MPDCCH LA to follow the common concept as non-GBR.
  - The dynamic repetition must be enabled if Cat-M VoLTE is enabled.
  - New parameters are introduced for UL/DL VoLTE BLER target and UL/DL maximum repetition for VoLTE
- The second enhancement:
  - Boosting the QCI1 (re-)transmission when there are some QCI5 (re-) transmitted
  - When being boosted, the QCI1 UL/DL will still toggle as currently.
  - Initial transmission and re-transmissions are both counted as QCI1 or QCI5 transmissions.

Related features

There are no related features.

Related parameters

New parameters:

CATMPR/`amcCStepUpQci1CatM`

CATMPR/`dlTargetBlerQci1CatM`

CATMPR/ulTargetBlerQci1CatM

CATMPR/catMVoLTETab/mpdschMaxNumRepQci1CatM

CATMPR/catMVoLTETab/mpuschMaxNumRepQci1CatM

Updated existing parameters (consistency checks, value range):

CATMPR/catMVoLTETab/dlMaxHarqTxQci1CatM

CATMPR/catMVoLTETab/ulMaxHarqTxQci1CatM

CATMPR/catMVoLTETab/maxGbrDlQci1CatM

CATMPR/catMVoLTETab/maxGbrUlQci1CatM

CATMCEL/actDynamicRepVoLTECatM

Expected impact on performance counters

The following counter and KPI values might decrease:

- LTE_6381a E-UTRAN Average VoLTE PDCP SDU Delay in DL for Cat-M UEs
- LTE_6382a E-UTRAN Average VoLTE Latency Uplink for Cat-M UEs
- LTE_6383a E-UTRAN Average VoLTE Latency Downlink for Cat-M UEs
- LTE_6384a E-UTRAN VoLTE PDCP SDU Discard Ratio in DL for Cat-M UEs
- LTE_6385a E-UTRAN VoLTE PDCP SDU Loss Ratio in the DL for Cat-M UEs
- LTE_6386a E-UTRAN VoLTE PDCP SDU Loss Ratio in the UL for Cat-M UEs
- M8061C105 Mean PDCP SDU delay on DL DTCH for DRB for VoLTE (LTE-M)
- M8061C106 Average HARQ transmission time for TBs for VoLTE (LTE-M)
- M8061C107 PDCP SDU delay on UL DTCH Mean for VoLTE (LTE-M)
- M8061C110 Number of lost PDCP SDUs in UL for VoLTE UEs (LTE-M)
- M8061C111 Number of PDCP SDU UL for VoLTE (LTE-M)
- M8061C112 Number of lost PDCP SDUs in DL for VoLTE UEs (LTE-M)
- M8061C113 Number of PDCP SDU discarded in DL for VoLTE UEs (LTE-M)
- M8061C114 Number of PDCP SDU DL for VoLTE UEs (LTE-M)

13.2 Counters for micro-DTX

The M8010C93 counter will not be provided for some radio units.

Short description

The new radio units (from release 5 onwards) do not support the reporting of suppressed OFDM symbols with micro DTX ratio.

Before FL19 release, the M8010C93 Suppressed OFDM symbols with micro DTX ratio in RF module counter was reported by the system module for rel. 5 radio units. From FL19 onwards, the M8010C94 Suppressed OFDM symbols

`with micro DTX ratio in FS module` counter was added and the implementation of M8010C93 was reverted. This leads to situation that for some radio units only the M8010C94 counter is provided, while for others both M8010C93 and M8010C94 counters are available.

Related features

- *LTE3036: Micro DTX extension*
- *LTE1891: eNodeB Power Saving – Micro-DTX*

Related parameters

There are no related parameters.

Expected impact on performance counters

- `M8010C93 Suppressed OFDM symbols with micro DTX ratio in RF module`
- `M8010C94 Suppressed OFDM symbols with micro DTX ratio in FS module`
- LTE_5789a E-UTRAN Percentage of Suppressed OFDM Symbols with Micro DTX in RF Module

13.3 Average number of available PRBs when micro DTX extension is activated

The LTE3036: Micro DTX extension feature activation impacts the M8001C216 counter.

Short description

The M8001C216 counter will not discard the muted Transmission Time Intervals (TTIs) when the LTE3036 feature is activated. This is because the muted Physical Resource Blocks (PRBs) are available in a very short time (almost immediately) whenever a larger amount of data needs to be transmitted. A sudden drop of KPI values for estimation of spectral efficiency is avoided.

Related features

LTE3036: Micro DTX extension

Related parameters

There are no related parameters.

Expected impact on performance counters

The `M8001C216: Average number of available PRBs per TTI on PDSCH` counter value will increase when the LTE3036 feature is activated.

13.4 Direct reporting removal

The direct reporting of CSI/ACK/NACK from the uplink physical layer to each serving cell (PCell and SCells) is removed.

Short description

All CSI/ACK/NACK reports are delivered to the serving cells by the DL scheduler of the PCell or by the DL scheduler of the UL+DL SCell (in case of uplink control information (UCI) on the SCell's PUSCH). The new reporting solution is scalable and it is an enabler of CA features with number of CC equal or higher than 6.

Related features

LTE4753: Licensed Assisted Access 7CC

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

13.5 Changes in inter-site carrier aggregation (CA)

Changes aimed at improving the secondary cell (SCell) configuration success rate are now applicable for UEs that are candidates for inter-site CA (UEs that can get an SCell connected through the X2 interface). Before this change the improvements were applicable only for UEs that are candidates for intra-site CA.

Short description

When one of the following conditions are fulfilled:

1. condition:
   - `dlCaMinPcellCqi` is bigger than **0** and/or `ulCaMinPcellSinr` is bigger than **0** and/or `dlCaMinPcellCqiQci1` is bigger than **0** and/or `ulCaMinPcellSinrQci1` is bigger than **0**

   and

   - `actInterEnbDLCAggr` equals to **true** and the CA deployment is inter-site (there are SCells connected via the X2 interface)
2. condition
   - `actInterEnbDLCAggr` equals to **true** and the CA deployment is inter-site (there are SCells connected via the X2 interface

then this change will increase the SCell configuration success rate and decrease the SCell configuration failures.

Related features

LTE3022/SR001419: Inter-site Carrier Aggregation

Related parameters

- SCell add DL CQI threshold (dlCaMinPcellCqi)
- SCell add UL SINR threshold (ulCaMinPcellSinr)
- SCell add DL CQI threshold for QCI1 (dlCaMinPcellCqiQci1)
- SCell add UL SINR threshold for QCI1 (ulCaMinPcellSinrQci1)
- Activate inter-eNB DL carrier aggregation (actInterEnbDLCAggr)

Expected impact on performance counters

The following KPI value might increase:

- LTE_5323a E-UTRAN SCell Configuration Success Ratio

The following KPI and counter values might decrease:

- LTE_6166a E-UTRAN SCell Configuration Attempts in DL
- M8011C67 Number of SCell addition attempts

14 LTE 18A algorithm changes

Algorithm changes for pre-LTE 18A features

14.1 The number of subframes adaptation for message 2 in DL

Multiple Random Access (RA) responses can be fit into one message 2. The eNB selects the subframes for RA response Media Access Control (MAC) C-PDU based on the the transport block size (TBS) size.

Short description

Before this change, only one RA response could be fit into one message 2 with a fixed number of subframes. The change improves the scheduling efficiency for message 2 in the DL and reduces the timeout of the RA `response window size for NB-IoT (raRespWinSizeNB)` parameter.

Related features

There are no related features.

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter values might decrease:

- `M8066C15 MAC PDU volume in DL for NB-IoT UEs`
- `M8066C18 Used NB-IoT DL resources`

14.2 Legacy PUCCH region expansion steps calibrated for Cat-M

More active UEs with a smaller physical uplink control channel (PUCCH) configuration in 5 MHz cells

Short description

This change calibrates the PUCCH configuration when the cell bandwidth is 5MHz and the *LTE3128: LTE-M* feature is activated. It reduces the number of format1b with channel selection (F1bCS) resources available for 2CC Carrier Aggregation (CA) to allow more resources available for scheduling request and therefore to have more active UEs in the cell by a smaller PUCCH configuration.

This change brings better coexistence of legacy PUCCH configuration with the strong constraints of Cat-M configuration in a small bandwidth cell (5 MHz). 2CC CA-capable UEs may experience increased blocking (the UE cannot be scheduled in the secondary cell (SCell) because there are not enough 'F1bCS' resources for providing feedback).

Related features

- *LTE1130: Dynamic PUCCH Allocation*
- *LTE2664: Load-based PUCCH Region*

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

14.3 LTE2664 enhancements of minimal configuration handling

Decreasing of the radio admission control (RAC) rejection at a minimal physical uplink control channel (PUCCH) configuration

Short description

During the field trials of the *LTE2664: Load-based PUCCH Region* feature it was noticed that usage of the minimal configurations causes frequent RAC rejections. Especially for Carrier Aggregation (CA) and MIMO PUCCH configurations, the number of UEs supported in the minimal configuration is near the real minimal limit (the eNB needs to consider the pre-reservations for handover/TAU/emergency). Because the expansion includes the system information block (SIB) reconfiguration, the time needed for such procedure is significant (5~20s), and in such time the number of UEs kept for the additional connections might be quickly exhausted, causing the RAC rejections.

At expansion from the minimal PUCCH configuration, the RAC is immediately informed of the new target capacity. Therefore, the RAC will not block the incoming UEs above the threshold given for the minimal PUCCH configuration. Free scheduling request (SR) resources during the transition are allocated at 40 ms.

During the transition phase of the expansion, CA is temporary suspended. The 'F1bCS' dedicated resources are used for SR allocation during this phase. In the transient phase from the minimal PUCCH configuration, RAC does not guarantee pre-reservations for handover and non-data radio bearer (non-DRB, like tracking area update) connections.

Finally the system ignores the expansion timer. This avoids any delay when expanding from the minimal PUCCH configuration. As soon as the conditions for the expansion are fulfilled, the expansion is triggered even if the `Countdown timer SIB modification by PUCCH expansion (countdownPucchExp)` still has not expired.

At the compression to the minimal configuration, a method has been implemented to avoid too early compressions that consequently may cause blocking issues with the next consequent new expansion.

Related features

- *LTE2664: Load-based PUCCH Region*

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

14.4 Support Cat-M CE ModeA Paging Optimization

Support of a per-CE level paging for CE ModeA UEs, which determines the MPDCCH/MPDSCH paging repetition according to UE's RF conditions. This mechanism saves the MPDCCH/MPDSCH paging resources.

Short description

Before the change, the eNB would page the Cat-M UE in a CE ModeA (that is, CE0 or CE1) with common MPDCCH/MPDSCH paging repetition regardless of the "Coverage Enhancement Level" information received from the MME paging.

This change optimizes the paging for ModeA, that is:

1. The eNB optimizes the MPDCCH paging repetition according to the "Coverage Enhancement Level" information received from the MME paging. The eNB maps the *mpdcch-NumRepetition-r13* (taken from "Coverage Enhancement Level" IE from MME) up to the nearest possible higher CE level and use mapped CE level's paging repetitions for this paging record. The RRC paging message is sent with the highest CE level and with its paging repetitions derived from all paging records included in the message.
2. The eNB implements the CE level paging MPDSCH repetition according to the selected MPDCCH CE level.
3. The eNB implements the CE level ramp-up after unsuccessful paging attempts.
4. The eNB supports the CE level threshold for the first paging attempt on E-UTRAN Cell Global Identifier (ECGI) only (that is, only if the first mapped CE level is higher than the threshold, the ECGI-only paging will be supported.).

Related features

There are no related features.

Related parameters

CATMPR/catMCELevel1: `Repetition level of M-PDCCH(UE-SS) for Cat-M CE Level 1 (mpdcchRepLevPagCatM)`

CATMPR/catMCELevel1: `Repetition level of PDSCH(Paging) for Cat-M CE Level 1 (pdschRepLevPagCatM)`

CATMPR: `Maximum attempt number for paging message within current coverage level for Cat-M CE ModeA (pagAttCeIncreaseModeACatM)`

CATMCEL: `Starting Coverage Level to support first paging attempt on ECGI only for Cat-M (startingCovLevelPagingOptCatM)`

Expected impact on performance counters

There are no related counters.

14.5 SCell activation for 256 QAM-capable UEs

Transition to 256 QAM tables and configuration of the secondary cells (SCells) are modified with the introduction of LTE4064.

Short description

The algorithms for transition between 256 QAM and legacy tables and the SCell activation and modification for 256 QAM-capable UEs (addition or swap) are modified with the introduction of *LTE4064:256 QAM enhancements*. For details, refer to *LTE4064* feature description.

Before the change, the 256 QAM tables were used by default for initial admission of 256 QAM capable UEs. Many UEs which used 256 QAM tables according to the *LTE3073: 256 QAM Extensions* feature experienced throughput degradation. The degradation was caused by lower granularity of 256 QAM tables around the QPSK area which triggered Carrier Aggregation (CA) to get sufficient bandwidth to transmit data which is in the buffer.

With the introduction of *LTE4064:256 QAM enhancements*, the 256 QAM capable UEs are initially admitted with legacy tables and the transition to 256 QAM tables happens only for UEs in good radio conditions. Therefore, the total number of activated UEs in 256 QAM mode is reduced in FL18A. Since 256 QAM tables are used only for UEs in good radio conditions, there is no throughput degradation and the CA activation is used in an optimized way.

Related features

- *LTE4064:256 QAM enhancements*

Related parameters

There are no related parameters.

Expected impact on performance counters

The call drop rate of 256 QAM configured UEs might decrease:

- LTE5090f: E-UTRAN E-RAB Drop Ratio per Cause, RNL due to loss of connection to the UE, initiated by eNB

The following counter values might decrease:

- M8011C196 PDSCH transmission using QPSK of 256QAM-scheduled UE
- M8011C197 PDSCH transmission using 16QAM of 256QAM-scheduled UE
- M8012C175 MAC PDU volume PDSCH using QPSK of 256QAM-scheduled UE
- M8012C176 MAC PDU volume PDSCH using 16QAM of 256QAM-scheduled UE
- M8011C200 PDSCH transmission nacks using QPSK of 256QAM-scheduled UE
- M8011C201 PDSCH transmission nacks using 16QAM of 256QAM-scheduled UE
- M8011C202 PDSCH transmission nacks using 64QAM of 256QAM-scheduled UE
- M8011C203 PDSCH transmission nacks using 256QAM of 256QAM-scheduled UE
- M8011C204 Failed PDSCH transmission using QPSK of 256QAM-scheduled UE
- M8011C205 Failed PDSCH transmission using 16QAM of 256QAM-scheduled UE
- M8011C206 Failed PDSCH transmission using 64QAM of 256QAM-scheduled UE
- M8011C207 Failed PDSCH transmission using 256QAM of 256QAM-scheduled UE
- M8010C116 - M8010C131 (UE Reported CQI Level 00 for 256QAM-configured UEs - UE Reported CQI Level 15 for 256QAM-configured UEs)
- M8010C132 - M8010C147 (CQI Level 0 for Codeword 1 Reported by 256QAM-configured UEs - CQI Level 15 for Codeword 1 Reported by 256QAM-configured UEs)

The following counter and KPI values might decrease:

- M8051C116 Average number of UEs with one activated SCell
- M8051C117 Average number of UEs with two activated SCells
- M8051C21 Average number of UEs with three activated SCells
- M8051C22 Average number of UEs with four activated SCells
- M8012C151 PCell RLC data volume in DL via SCell
- LTE_5320b E-UTRAN Average UEs with an Activated SCell in DL
- LTE_5674b E-UTRAN Average UEs with Activated Two SCells in DL
- LTE_5246a E-UTRAN Average UEs with Activated Three SCells in DL
- LTE_6302a E-UTRAN Average UEs with Activated Four SCells in DL
- LTE_5324a E-UTRAN RLC PDU Volume DL via Scell

The following counter and KPI values might increase:

- M8010C36 - M8010C51 (UE Reported CQI Level 00 - UE Reported CQI Level 15)
- M8001C45 - M8001C73 (PDSCH transmissions using MCS0 - PDSCH transmissions using MCS28)
- M8001C236 - M8001C238 (PDSCH transmissions using MCS29 - PDSCH transmissions using MCS31)
- M8001C103 - M8001C131 (PDSCH transmission nacks using MCS0 - PDSCH transmission nacks using MCS28)
- M8001C239 - M8001C241 (PDSCH transmission nacks using MCS29 - PDSCH transmission nacks using MCS31)
- M8001C156 - M8001C209 (Failed Transmission PDSCH MCS0 - Failed Transmission PDSCH MCS28)
- M8001C242 - M8001C244 (Failed Transmission PDSCH MCS29 - Failed Transmission PDSCH MCS31)
- LTE_6119a E-UTRAN Average CQI of 256QAM configured UEs
- LTE_6263a This KPI provides the percentage of PDSCH transmissions using High MCS Codes (MCS>=20).

The following counter and KPI value changes depend on radio conditions:

- M8011C198 PDSCH transmission using 64QAM of 256QAM-scheduled UE
- M8011C199 PDSCH transmission using 256QAM of 256QAM-scheduled UE
- M8012C177 MAC PDU volume PDSCH using 64QAM of 256QAM-scheduled UE
- M8012C178 MAC PDU volume PDSCH using 256QAM of 256QAM-scheduled UE
- LTE_6262a E-UTRAN Percentage of PDSCH transmissions using Low MCS Codes (MCS<=9)

Higher numbers of CCs might be used less frequently for 256 QAM UEs (depending on the radio conditions), therefore the following counter values (with related KPIs) might be impacted:

- M8051C116 Average number of UEs with one activated SCell
- M8051C117 Average number of UEs with two activated SCells
- M8051C21 Average number of UEs with three activated SCells
- M8051C22 Average number of UEs with four activated SCells
- M8051C168 Average number of UEs with five activated Scells

14.6 Dynamic UL resource units selection

Potential throughput improvement with larger transport block size scheduled in worse radio conditions

Short description

Before this change, the maximum UL transport block size (TBS) of 1000 bits was supported for Cat-NB1 UEs using 4 resource units. From FL18A onwards, the maximum UL transport block size is supported for Cat-NB1 UEs using 5/6/8/10 resource units. The efficiency is higher when the resource units are fitting the payload. Larger TBS can be scheduled also when the radio conditions become worse, therefore the UL throughput can be improved.

Related features

- There are no related features

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter values might increase:

- `M8066C14: MAC PDU volume in UL for NB-IoT UEs`
- `M8066C16: Number of used NB-IoT UL resources`

14.7 Radio Link Failure (RLF) indication during the Initial Context Setup Procedure

When there is and RLF indication, the internal resources are released sooner which leads to better resource handling.

Short description

Before the change, when an RLF indication was received during an RRC Initial Context Setup Procedure, it was ignored. After the change, when an RLF Indication is received it stops the Initial Context Setup Procedure.

Related features

There are no related features

Related parameters

There are no related parameters.

Expected impact on performance counters

The failure counting is shifted from the `M8006C247 Failed setup attempts for initial E-RABs due to "Radio Network Layer Cause - Failure in the Radio Interface Procedure"` counter to `M8006C246: Failed setup attempts for initial E-RABs due to "Radio Network Layer Cause - Radio Connection with UE lost"`, therefore the value of `M8006C246` might increase.

Degradation of the initial context setup success rate KPIs might also occur.

14.8 The SCell will not be deactivated when the ChannelStatus value equals 'undetected'

If the monitoring feature introduced with LTE1541 detects that an secondary cell (SCell) is in 'ChannelStatus = undetected', then the SCell will not be deactivated (also this SCell will not be scheduled in this state).

Short description

When the following conditions are met:

- `actAdvScellMeas` = **true**
- `multScellReleaseTimer` = **0**

then this change helps to avoid an SCell activation-deactivation ping-pong and SCell scheduling in very bad radio conditions.

Related features

LTE1541: Advanced SCell Measurement Handling

Related parameters

- Activate advanced SCell measurement handling (actAdvScellMeas)
- Mult. factor for SCell release timer (multScellReleaseTimer)
- Threshold for a not detectable Scell (scellNotDetectableThr)

Expected impact on performance counters

The following counter and KPI values might increase:

- LTE_5320b E-UTRAN Average UEs with an Activated SCell in DL (M8051C116)
- LTE_5674b E-UTRAN Average UEs with Activated Two SCells in DL (M8051C117)
- LTE_5246a E-UTRAN Average UEs with Activated Three SCells in DL (M8051C21)
- LTE_6302a E-UTRAN Average UEs with Activated Four SCells in DL (M8051C22)

15 LTE 18SP algorithm changes

Algorithm changes for pre-LTE 18SP features

15.1 Common algorithm changes

Common FDD and TD algorithm changes for pre-LTE 18SP features

15.1.1 Downlink cat-4 UEs supported in uplink 64QAM

Less expensive UEs support 64QAM UL, which improves the network throughput.

Related features

- *LTE44: 64 QAM in UL*

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter values might increase:

- M8001C41 PUSCH transmissions using MCS25
- M8001C42 PUSCH transmissions using MCS26
- M8001C43 PUSCH transmissions using MCS27
- M8001C44 PUSCH transmissions using MCS28

15.1.2 Proactive grants for VoLTE robustness

Low priority proactive uplink grants are added for non-TTI bundling QCI1 traffic. Proactive, forced SRI uplink grants are added for TTI bundling QCI1 traffic.

Related features

There are no related features.

Related parameters

There are no related parameters.

Expected impact on performance counters

The LTE_6243a Percentage of Average Uplink VoLTE Quality Break Period Expected Time KPI value might decrease.

15.2 FDD-LTE 18SP algorithm changes

Algorithm changes for pre-LTE 18SP features

15.2.1 Support of MCS29/30/31 for retransmission

Non-256QAM-capable LTE UEs (modulation and coding scheme MCS 29/30/31) or 256QAM-capable LTE UEs (MCS28/29/30/31) are supported for hybrid automatic repeat request (HARQ) retransmission in downlink (DL).

Short description

The solution is based on 3GPP TS36.213. It is beneficial for all cases (with or without Cat-M, conflicting with legacy SIBs and Cat-M SIBs). With MCS29/30/31, the possibility of collisions is reduced and the expected throughput related to the HARQ retransmission can be scheduled in the available time frame.

With the *LTE3128: LTE-M* feature enabled, the possibility of collision between LTE scheduling and Cat-M MIB/SIB/paging/data transmission increased. The gain of legacy peak throughput with this improvement significantly increased (approximately 7%~8%).

Related features

- *LTE3128: LTE-M*
- *LTE45: Fair Scheduler (UL/DL)*

Related parameters

There are no related parameters.

Expected impact on performance counters

New counters are introduced in FDD-LTE 18SP:

- M8001C236 PDSCH transmissions using MCS29
- M8001C237 PDSCH transmissions using MCS30
- M8001C238 PDSCH transmissions using MCS31
- M8001C239 PDSCH transmission nacks using MCS29
- M8001C240 PDSCH transmission nacks using MCS30
- M8001C241 PDSCH transmission nacks using MCS31
- M8001C242 Failed Transmission PDSCH MCS29
- M8001C243 Failed Transmission PDSCH MCS30
- M8001C244 Failed Transmission PDSCH MCS31
- M8012C148 MAC PDU volume PDSCH MCS29
- M8012C149 MAC PDU volume PDSCH MCS30
- M8012C150 MAC PDU volume PDSCH MCS31

The following legacy counters and KPIs are impacted:

- M8012C25 PDCP Throughput DL Max (increase)
- M8012C175 MAC PDU volume PDSCH using QPSK of 256QAM-scheduled UE
- M8012C176 MAC PDU volume PDSCH using 16QAM of 256QAM-scheduled UE
- M8012C177 MAC PDU volume PDSCH using 64QAM of 256QAM-scheduled UE
- M8012C178 MAC PDU volume PDSCH using 256QAM of 256QAM-scheduled UE
- M8011C196 PDSCH transmission using QPSK of 256QAM-scheduled UE
- M8011C197 PDSCH transmission using 16QAM of 256QAM-scheduled UE
- M8011C198 PDSCH transmission using 64QAM of 256QAM-scheduled UE
- M8011C199 PDSCH transmission using 256QAM of 256QAM-scheduled UE
- M8011C200 PDSCH transmission nacks using QPSK of 256QAM-scheduled UE
- M8011C201 PDSCH transmission nacks using 16QAM of 256QAM-scheduled UE
- M8011C202 PDSCH transmission nacks using 64QAM of 256QAM-scheduled UE
- M8011C203 PDSCH transmission nacks using 256QAM of 256QAM-scheduled UE
- M8011C204 Failed PDSCH transmission using QPSK of 256QAM-scheduled UE
- M8011C205 Failed PDSCH transmission using 16QAM of 256QAM-scheduled UE
- M8011C206 Failed PDSCH transmission using 64QAM of 256QAM-scheduled UE
- M8011C207 Failed PDSCH transmission using 256QAM of 256QAM-scheduled UE
- LTE_5292d E-UTRAN average PDCP Layer Active Cell Throughput DL (increase)
- LTE_5354a E-UTRAN Averaged IP scheduled Throughput in DL, QCI5
- LTE_5356a E-UTRAN Averaged IP scheduled Throughput in DL, QCI7
- LTE_5357a E-UTRAN Averaged IP scheduled Throughput in DL, QCI8
- LTE_5358a E-UTRAN Averaged IP scheduled Throughput in DL, QCI9
- E-UTRAN Percentage of PDSCH transmissions using Low MCS Codes (MCS<=9) - decrease
- E-UTRAN Percentage of PDSCH transmissions using High MCS Codes (MCS>=20) - increase

15.2.2 Interference Mitigation of the NB-IoT Receiver

The number of NB-PRACH false alarms is reduced by mitigating interference from neighbouring LTE PRBs.

Short Description

The interference mitigation receiver for NB-IoT is mitigating interference from PUSCH/PUCCH to NPRACH because different subcarrier spacing is used. PUSCH is using 15 kHz while NPRACH is using 3.75 kHz subcarrier spacing.

The number of NB-PRACH false alarms is reduced by mitigating interference from neighboring LTE physical resource blocks (PRBs). Before LTE 18SP, the interference caused by different subcarrier spacing increased the probability of ghost preambles. The higher the power of the PUSCH/PUCCH PRBs next to NPRACH, the higher the probability of ghost preambles. Based on the interference mitigation receiver, the probability of ghost preamble detection is reduced. Less preambles to be processed by the receiver means less data volume in UL to be scheduled and also less MSG2 to be scheduled in DL. Thanks to the new algorithm, the number of false detections significantly decreased but a zero level of false alarms cannot be guaranteed.

Related features

- *LTE3071: NB-IoT Inband*
- *LTE3570: NB-IoT Guardband 15/20MHz*
- *LTE3509: NB-IoT: Inband on Airscale without Baseband Pooling*
- *LTE3667: NB-IoT Standalone with Baseband Pooling*

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter values might decrease because of less NB-PRACH false alarms:

- M8066C14 MAC PDU volume in UL for NB-IoT UEs
- M8066C15 MAC PDU volume in DL for NB-IoT UEs
- M8066C16 Number of used NB-IoT UL resources
- M8066C18 Used NB-IoT DL resources
- M8066C35 NB-IoT RACH Setup attempts without C-RNTI
- M8066C36 NB-IoT RACH Setup attempts with valid C-RNTI
- M8066C37 NB-IoT RACH Setup attempts with invalid C-RNTI
- M8066C38 NB-IoT RACH Setup attempts without C-RNTI for NB-Iot UEs with coverage enhancement level 1
- M8066C39 NB-IoT RACH Setup attempts without C-RNTI for NB-Iot UEs with coverage enhancement level 2
- M8066C40 NB-IoT RACH Setup attempts with valid C-RNTI for NB-Iot UEs with coverage enhancement level 1
- M8066C41 NB-IoT RACH Setup attempts with valid C-RNTI for NB-Iot UEs with coverage enhancement level 2
- M8066C42 NB-IoT RACH Setup attempts with invalid C-RNTI for NB-Iot UEs with coverage enhancement level 1
- M8066C43 NB-IoT RACH Setup attempts with invalid C-RNTI for NB-Iot UEs with coverage enhancement level 2

15.2.3 Automatic calculation of the G-factor

> *From LTE 18SP onwards, the `mpdcchStartSfCssCatM` and `mpdcchStartSfUessCatM` parameter values are set by the system.*

Short description

Before LTE 18SP the possibilities of setting up both parameters were wrongly limited by consistency checks. With the *LTE4495: Cat-M1: eMBMS Coexistence Support* feature this limitation is removed as it introduces the Localized Virtual Resource Blocks (LVRB) and eMBMS coexistence. As a result, the parameter calculation is related to an invalid subframe list (probably operator unknown) and the `mpdcchMaxNumRepRaCatM` or `mpdcchMaxNumRepCatM` parameter. Because it is not feasible to let the operator calculate the value and to avoid potentially wrong settings, an automatic calculation algorithm was introduced and the parameters are calculated by the eNB. The value set is always the smallest possible one.

Related features

- *LTE4495: Cat-M1: eMBMS Coexistence Support*

Related parameters

- `MPDCCH Start SF for MPDCCH common search space for Cat-M (mpdcchStartSfCssCatM)`
- `MPDCCH Start SF for MPDCCH UE specific search space for Cat-M CE Level 0 (mpdcchStartSfUessCatM)`

Expected impact on performance counters

There are no related counters.

15.2.4 Impact of the Cat-M and eMBMS coexistence

The LTE4495 feature might impact call drop and handover failure rates.

Short description

Before the *LTE4495: Cat-M1: eMBMS Coexistence Support* feature introduction, eMBMS and Cat-M had to be deployed on different bands. Both eMBMS and Cat-M have in common that they consume resources which are not available for the legacy LTE traffic. When LTE4495 is activated, both eMBMS and Cat-M consume resources in the same band leaving less resources for legacy LTE traffic as compared to a scenario where eMBMS and Cat-M are in different bands.

When eMBMS and Cat-M are deployed in the 10 MHz band, the total amount of consumed PRBs is 42%: 15 PRBs for eMBMS plus 6 PRBs for Cat-M gives 21 PRBs out of 50 PRBs. So the relative PRB occupancy of eMBMS and Cat-M in a 10 MHz band is significant. Therefore, high traffic caused by legacy UEs in the 10 MHz band where operator is planning to deploy eMBMS and Cat-M would have a potential KPI impact.

In a mobility scenario where individual UEs or groups of UEs (for example, multiple users travelling with a bus) may experience bad radio conditions while moving away from the base station. As a result, the number of HARQ transmissions and RRC reconfiguration messages will increase. The amount of resources available to accommodate HARQ transmissions and RRC reconfiguration messages on top of the traffic generated by the legacy UEs is much lower when LTE4495 is activated. As a result, handover procedures might be delayed and the probability of call drops might increase.

Note that in many situations the eMBMS traffic appears only at certain slots during the day. In that case, the unused eMBMS resources are available for legacy UEs. Therefore, the KPI degradation described above is observed only if the eMBMS traffic is permanently high.

Related features

- *LTE4495: Cat-M1: eMBMS Coexistence Support*

Related parameters

There are no related parameters.

Expected impact on performance counters

The E-RAB drop rate and the context drop rate KPIs might be impacted (for example, LTE_5025h E-UTRAN E-RAB Drop Ratio, RAN View). Also various handover failure rates might be impacted (depending on the mobility configuration in use).

15.2.5 Adjustment of the SIB-NB broadcast NRS power value in the 4TX mode

This update aligns the NRS power in SIB broadcasting with the actual averaged NRS power used in 4TX mode.

Short description

With this change the narrowband (NB) SIB broadcast value of the NRS (Narrowband Reference Signal) power in the 4TX mode will be 3dB higher. It reflects the actual NRS power used for the 4TX mode. The accurate NRS power value results in a better downlink path loss estimation by the UE. It might also improve the accuracy of uplink power control. The higher NRS power results in a higher and more accurate UE uplink transmit power, that might lead to an overall uplink performance improvement.

Related features

- *LTE4499: NB-IoT Guardband*
- *LTE3570: NB-IoT Guardband 15/20MHz*
- *LTE3722: NB-IoT: Additional configurations (4Rx, 4Tx or 1Tx eNB support)*
- *LTE3071: NB-IoT Inband*
- *LTE3543: NB-IoT Standalone*

Related parameters

`Downlink MIMO mode` (`dlMimoMode`)

Expected impact on performance counters

There are no related counters.

15.3 TD-LTE 18SP algorithm changes

Algorithm changes for pre-LTE 18SP features

15.3.1 Cell resource group support with TDD downlink 3CC carrier aggregation

Improved admission control for TDD 3CC carrier aggregation

Related features

- *LTE1382: Cell resource groups*

- *LTE1836: TDD downlink carrier aggregation - 60Mhz*

Related parameters

- `Activation of downlink carrier aggregation (actDLCAggr)`
- `Activation of automatic PUCCH allocation (actAutoPucchAlloc)`
- `Max number of secondary cells for DL carrier aggr (maxNumScells)`
- `Cell resource sharing mode (cellResourceSharingMode)`

Expected impact on performance counters

There are no related counters.

15.3.2 Single radio voice call continuity to GSM workaround

The GSM cell is temporary blacklisted when the SRVCC handover to this GSM cell fails for consecutive number of times (defined with an internal parameter).

Related features

- *LTE873: SRVCC to GSM*

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter values might decrease:

- M8016C55 Failed Inter-System Handover preparations to GERAN with SRVCC due to timer
- M8016C56 Failed Inter-System Handover preparations to GERAN with SRVCC due to target eNB admission control
- M8016C57 Failed Inter-System Handover preparations to GERAN with SRVCC caused by other reasons
- M8016C64 Failed Inter-System Handover preparations to GERAN with VoLTE Quality triggered SRVCC due to timer
- M8016C65 Failed Inter-System Handover preparations to GERAN with VoLTE Quality triggered SRVCC due to target eNB admission control
- M8016C66 Failed Inter-System Handover preparations to GERAN with VoLTE Quality triggered SRVCC caused by other reasons

15.3.3 Extended timer ranges

Certain timer parameters have extended value ranges for accurate KPI calculation.

Related features

There are no related features.

Related parameters

- `RRC guard timer radio bearer management (rrcGuardTimer)`
- `T HO overall delta (tHoOverallD)`
- `TX2 RELOC overall delta (tx2RelODelta)`

Expected impact on performance counters

There are no related counters.

15.3.4 SCell combination selection mechanism by MIMO throughput check

The existing carrier aggregation (CA) secondary cell (SCell) combination selection is modified by performing a throughput check per each available SCell combination until the eNB finds one that passes the check.

Short description

Before the *LTE3879: TDD downlink carrier aggregation with MIMO – 12 layers* feature introduction, the radio admission control (RAC) did not consider any transmission gain when selecting CA SCells. Now with LTE3879, the RAC admits only the SCell combinations where:

- a MIMO transmission gain has been checked
- the advantage of using these particular SCells combinations has been checked.

Related features

- *LTE3879: TDD downlink carrier aggregation with MIMO – 12 layers*

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

16 LTE 18 algorithm changes

Algorithm changes for pre-LTE 18 features

16.1 Common algorithm changes

Common FDD and TD algorithm changes for pre-LTE 18 features

16.1.1 PUCCH format '1bwsc' to use cyclic PUCCH allocation

Fair resource allocation of PUCCH format 1b with channel selection for 2CC UEs

Short description

With this change, the PUCCH format 1b with channel selection '1bwsc' will use cyclic PUCCH allocation (semi-static allocation) when the *LTE2006: Flexible Scell selection* feature is enabled (the `actFlexScellSelect` parameter value is set to **true**). The change should reduce blocking of SCell activation for 2CC UEs.

Related features

- *LTE3022: Inter-site Carrier Aggregation*
- *LTE2006: Flexible Scell selection*

Related parameters

`Activate flexible SCell selection (actFlexScellSelect)`

Expected impact on performance counters

The following counter and KPI values might increase:

- `LTE_5320b E-UTRAN Average UEs with an Activated SCell in DL`
- `M8051C116 Average number of UEs with one activated Scell`
- `M8011C166 SCell scheduling blocking rate due to conflicts on PUCCH format 1bwcs resources`

16.1.2 Non-HARQ, MAC-level automatic repeat requests for inter-site carrier aggregation extension

Improvement of single UE peak rate

Short description

This concerns long X2 backhaul delays in the SCells connected over X2. To optimize the peak rate in case of small number of scheduled UEs (for long latency connection base carrier aggregation), the blocking of hybrid automatic repeat request (HARQ) process

would be pre-emptioned by the newest transmission, and the blocked HARQ process would become an RLC-level retransmission (if it is eventually committed as negative acknowledgement).

Related features

LTE3022: Inter-site Carrier Aggregation

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

16.2 FDD-LTE 18 algorithm changes

Algorithm changes for pre-LTE 18 features

16.2.1 ACK/NACK DTX detection on PUSCH

Improvement of PUSCH link level performance (block error ratio against signal-to-interference-plus-noise ratio)

Short description

When the acknowledgement or negative acknowledgement (ACK/NACK) message is expected on PUSCH (before the PUSCH decoding), the uplink receiver is initiating ACK/NACK transmission/discontinuous transmission (TX/DTX) detection. Depending on the outcome of such detection, the UL receiver will decode PUSCH assuming that ACK/NACK bits are either punctured into PUSCH respectively or not. This change applies to inter-site carrier aggregation (CA), inter-eNB CA, intra-eNB CA, and to single-carrier operation.

This change aims at improving the PUSCH link level performance. Especially in the inter-site CA scenarios when ACK/NACK is expected on PUSCH not based on actual SCell downlink transmission, but it is based on semi-static PUCCH resource allocation due to long X2 delay. It might also impact scenarios when the eNB falsely assumes ACK/NACK on PUSCH due to PDCCH miss-detection at the UE.

Related features

LTE3022: Inter-site Carrier Aggregation

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

16.2.2 SCell activation threshold based on average expected UE throughput

More accurate UE throughput prediction to trigger the SCell activation

Short description

With this change, the SCell activation buffer threshold is based on the average expected UE throughput. In the legacy implementation it was based on average UE throughput. The change applies to inter-site carrier aggregation (CA), inter-eNB CA, and intra-eNB CA.

The expected UE throughput predicts the UE throughput more accurately compared to the legacy calculation. Especially for transmission time intervals (TTIs) when all the UE data in a buffer is drained. The SCell activation threshold calculated based on expected average throughput might result in a more conservative SCell activation. If needed, this effect can be compensated by setting the `scellActivationLevel` parameter to a lower value.

Related features

LTE3022: Inter-site Carrier Aggregation

Related parameters

`Conservativeness level of SCell activation (scellActivationLevel)`

Expected impact on performance counters

The following counter and KPI values might decrease:

- `LTE_5320b E-UTRAN Average UEs with an Activated SCell in DL`
- `M8051C116 Average number of UEs with one activated SCell`
- `LTE_5674b E-UTRAN Average UEs with Activated Two SCells in DL`
- `M8051C117 Average number of UEs with two activated SCells`
- `M8051C21 Average number of UEs with three activated SCells`
- `LTE_5246a E-UTRAN Average UEs with Activated Three SCells in DL`
- `M8051C22 Average number of UEs with four activated SCells`
- `LTE_6302a E-UTRAN Average UEs with Activated Four SCells in DL`
- `M8051C123 Average number of UEs with one configured SCell`
- `LTE_5319c E-UTRAN Average UEs with Configured one SCell in DL`
- `M8051C124 Average number of UEs with two configured SCells`
- `LTE_5672b E-UTRAN Average UEs with Configured two SCells in DL`
- `M8051C19 Average number of UEs with three configured SCells`
- `LTE_5999a E-UTRAN Average UEs with Configured three SCells in DL`

- M8051C20 Average number of UEs with four configured SCells
- LTE_6304a E-UTRAN Average UEs with Configured four SCells in DL

Note: The change might be negligible.

16.2.3 Modified LTE-M scheduling priorities

Introduction of Cat-M VoLTE support is causing a change of priorities in scheduling.

Short description

From LTE 18 onwards, along with the support of Cat-M VoLTE, the scheduling priorities are changed. It results in slightly different scheduling order in case of multiple UEs with pending data and different traffic classes and/or pending HARQ retransmissions. The signaling radio bearers (SRBs) are sent prior to the pending retransmissions (ReTx). There is also a bigger differentiation of SRBs.

Related features

- *LTE4056: Cat-M1: VoLTE Support (Phase-I)*
- *LTE3653: Cat-M1: TA Management for Improved Mobility Support*

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

16.2.4 Increased value range for sFreqPrio

The sFreqPrio parameter's maximum value is extended to 10000.

Short description

The carriers for SCell addition are selected with a metric that considers both the downlink load and the frequency priority. The previous implementation assumed that all frequencies are in the licensed spectrum, with no further discrimination required. To add further discrimination capability between licensed and unlicensed frequencies, the value range has been extended to allow up to ~1000-fold (reached by using a new maximum value of sFreqPrio parameter that is 10000) biasing between candidates.

Related features

LTE2233: N-out-of-M downlink carrier aggregation

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

16.2.5 Modified NB-IoT scheduling priorities

The priority for proactive UL scheduling is higher than for UL and DL retransmission.

Short description

The change aims at reducing the probability of NB-IoT UEs having to use RACH procedure in order to get resources for UL data transmission assigned.

Related features

LTE4475: NB-IoT: Multiple Coverage Levels

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

16.2.6 Improvement of L2 HARQ ACK based NB-IoT RRC connection release.

A new configurable timer is introduced.

Short description

This change enhances the layer 2 hybrid automatic repeat request (HARQ) acknowledgement-based NB-IoT RRC connection release procedure. A new configurable timer (`tL2AckRrcRelNB`) is introduced to control this function. This timer was fixed to 70s with the introduction of the *LTE3668: NB-IoT: Coverage enhancements* feature. It can reduce the release time when there are multiple UEs in coverage enhancement area.

Related features

LTE4475: NB-IoT: Multiple Coverage Levels

Related parameters

`Timer missing L2 ack for NB-IoT RRC connection release (tL2AckRrcRelNB)`

Expected impact on performance counters

There are no related counters.

16.2.7 Improvement of NB-IoT cell deletion

A new guard timer is introduced.

Short description

A new guard timer (`tCellDelNB`) is introduced to force the release of UE context for the NB-IoT cell deletion. The change aims at reducing the cell deletion time when there are multiple UEs in a coverage enhancement area.

Related features

LTE4475: NB-IoT: Multiple Coverage Levels

Related parameters

`Guard time to force the release of UE context(s) when NB-IoT cell deletion (tCellDelNB)`

Expected impact on performance counters

There are no related counters.

16.2.8 Subframe adaptation over NPDSCH in a NB-IoT cell

The subframe number is adapted based on the transport block size (TBS).

Short description

In the previous implementation, the subframe number over NPDSCH was fixed to 4. From LTE 18 onwards (with *LTE4475: NB-IoT: Multiple Coverage Levels* introduction), it can be adapted based on the TBS size. The change improves the scheduling efficiency and reduces the packet delay.

Related features

LTE4475: NB-IoT: Multiple Coverage Levels

Related parameters

There are no related parameters.

Expected impact on performance counters

The `M8066C15 MAC PDU volume in DL for NB-IoT Ues` counter value might be impacted.

16.2.9 No preamble group B for 5MHz system with Cat-M

Additional configuration consistency check is introduced.

Short description

The configuration of random access preamble group B is prevented for systems with a 5MHz system bandwidth and the Cat-M feature activated through an additional explicit check. This configuration check should prevent increasing the volume of RRC re-establishments being caused by random access failures. The failures were caused by the size of random access response message being too large to fit in the available resources of a 5MHz system with Cat-M feature activated.

Related features

LTE3128: LTE-M

Related parameters

- `Random access preambles group A size (raPreGrASize)`
- `Activate LTE-M feature (actCatM)`

Expected impact on performance counters

There are no related counters.

16.2.10 Throughput-check procedure enhancement

A throughput-check failure of any SCell candidate will not cause an SCell addition failure as long as other SCell candidates for SCell addition remain.

Short description

With this change, the throughput-check procedure is now applied not only to the first proposed SCell candidate but it is continued until there is any SCell candidate which can pass the check, or there are no SCells remaining. This enhanced throughput procedure is applicable also for one-step SCell addition. This functionality is available independently of the feature activation status.

Related features

LTE3605: DL 4x4 MIMO with Carrier Aggregation - 12 layers

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter and KPI values might increase:

- `M8011C67 Number of SCell addition attempts`
- `M8011C68 Number of successful SCell additions`
- `LTE_6166a E-UTRAN SCell Configuration Attempts in DL`
- `M8012C151 PCell RLC data volume in DL via SCell`
- `LTE_5324a E-UTRAN RLC PDU Volume DL via Scell`
- `M8011C224 PRBs used for SCell UEs' DL DRB traffic`
- `M8011C54 PRB used PDSCH`
- `LTE_6351a E-UTRAN PRB usage ratio for CA related traffic of SCell UEs in DL`
- `M8051C123 Average number of UEs with one configured SCell`
- `LTE_5319c E-UTRAN Average UEs with Configured one SCell in DL`
- `M8051C124 Average number of UEs with two configured SCells`
- `LTE_5672b E-UTRAN Average UEs with Configured two SCells in DL`

- M8051C19 Average number of UEs with three configured SCells
- LTE_5999a E-UTRAN Average UEs with Configured three SCells in DL
- M8051C20 Average number of UEs with four configured SCells
- LTE_6304a E-UTRAN Average UEs with Configured four SCells in DL
- M8051C116 Average number of UEs with one activated SCell
- LTE_5320b E-UTRAN Average UEs with an Activated SCell in DL
- M8051C117 Average number of UEs with two activated SCells
- LTE_5674b E-UTRAN Average UEs with Activated Two SCells in DL
- M8051C21 Average number of UEs with three activated SCells
- LTE_5246a E-UTRAN Average UEs with Activated Three SCells in DL
- M8051C22 Average number of UEs with four activated SCells
- LTE_6302a E-UTRAN Average UEs with Activated Four SCells in DL

16.2.10.1 LTE3605 changes to the system

Overview of the throughput check enhancement

The throughput check is based on the twoLayerMimoAvSpectralEff and fourLayerMimoAvSpectralEff parameters which were introduced with the *LTE2582: DL 4x4 MIMO with Carrier Aggregation* feature, and the channel bandwidths of particular component carriers (CCs). In the context of the *LTE2582* feature, the throughput check is performed for step-wise secondary cell (SCell) addition (numTxWithHighNonGBR > 0).

Starting with *LTE3605*, the throughput check is performed also for one-step SCell addition (numTxWithHighNonGBR = 0). Moreover, it has been improved to analize more band combinations during the radio admission control (RAC) procedure, thus increasing the chances of finding a suitable Carrier Aggregation (CA) and MIMO layer configuration.

16.2.11 Enhancement of counters related to PDCP SDU

Implementation of counters related to the Packet Data Convergence Protocol (PDCP) service data unit SDU is moved to the RLC layer.

Short description

In the previous implementation, the monitoring of the eUu interface did not take into account the Robust Header Compression (ROHC). From LTE 18 onwards, it is included by moving the implementation to the RLC layer where the ROHC-compressed SDUs are handled.

Related features

LTE518: Operator specific QCI

Related parameters

There are no related parameters.

Expected impact on performance counters

The following VoLTE bearers counter values should decrease significantly (in case of activated Robust Header Compression):

- M8023C6 PDCP SDU data volume on eUu Interface DL for UEs assigned to QCI Counter Group 1
- M8023C7 PDCP SDU data volume on eUu Interface DL for UEs assigned to QCI Counter Group 2
- M8023C8 PDCP SDU data volume on eUu Interface DL for UEs assigned to QCI Counter Group 3
- M8023C9 PDCP SDU data volume on eUu Interface DL for UEs assigned to QCI Counter Group 4
- M8023C10 PDCP SDU data volume on eUu Interface DL for UEs assigned to QCI Counter Group 5
- M8023C11 PDCP SDU data volume on eUu Interface DL for UEs assigned to QCI Counter Group 6
- M8038C2 PDCP SDU user data volume on eUu interface in DL per PLMN-ID
- M8047C4 PDCP SDU data volume on eUu Interface downlink per Profile

16.2.12 Link adaptation for NB-IoT Inband

Link adaptation is dynamically optimizing data transmission to the radio conditions.

Short description

In FL17A, the transport block size was fixed, while in FL18 the transport block size is dynamically selected according to the data volume to be transmitted. This change reduces the PDU volume. This change is visible only when the *LTE4475: NB-IoT: Multiple Coverage Levels* feature is activated. The NB-IoT link adaptation is enabled for uplink and downlink by default.

Related features

LTE4475: NB-IoT: Multiple Coverage Levels

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter value might decrease:

- M8066C15 MAC PDU volume in DL for NB-IoT UEs

16.2.13 Lower MCS and PRB allocation is allowed in Cat-M uplink

The Cat-M UE uplink coverage is increased by enhancing the modulation and coding scheme (MCS) range and allowing one physical resource block (PRB) allocation.

Short description

The coverage gain is achieved with the following two methods:

- The link adaptation (LA) MCS range is increased from a fixed value (MCS 5) to lower values (in case of two PRBs). This is possible if the operator defined limit (configured with the `Minimum UL transport block size for Cat-M CE mode A (ulsMinTbsModeACatM)` parameter) is not exceeded.
- Under certain conditions, it is allowed to switch from two PRBs to one PRB. This results in higher available power (3 dB) for one PRB that is used to enhance the MCL (visible especially in flat channels). A loss in a more disperse channel can be encountered.

Using lower values for the `ulsMinTbsModeACatM` parameter results in more coverage gain, but on the other side it reduces available resources for all the other UEs in an RRC connected state.

Related features

- *LTE3128: LTE-M*
- *LTE3582: LTE-M Enhancements I*
- *LTE3597: Cat-M1: 15 & 20 MHz Support*

Related parameters

`Minimum UL transport block size for Cat-M CE mode A (ulsMinTbsModeACatM)`

Expected impact on performance counters

There are no related counters.

16.2.14 Improvement of VoLTE IP scheduled throughput

The Buffer Status Report (BSR) estimation is performed earlier in the scheduling process.

Short description

At the reception of a scheduling request, the uplink packet scheduler needs to estimate the BSR size for VoLTE UEs to avoid packet segmentation or to avoid scheduling all VoLTE packets in a buffer at once.

In the previous implementation, for a UE waiting in scheduler, the uplink VoLTE BSR was updated in the “post scheduling phase“ (every 10ms or every 40ms depending on the CPU Load) on a regular basis. In the current implementation, the BSR estimation is done within the frequency domain (FD) scheduler.

By making the BSR update in the FD scheduler (that is just before the scheduling), the estimation of VoLTE packet number in the BSR is more precise (that is higher) if the UE with pending scheduling request had to wait to get scheduled. As a result, it is expected that more VoLTE UEs have the buffer completely empty by the first UL grant that follows the scheduling request.

Related features

- *LTE496: Support of QCI 2, 3 and 4*

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter values might decrease:

- M8012C92 IP Throughput time in UL for QCI 1
- M8012C94 IP Throughput time in UL for QCI 2
- M8012C96 IP Throughput time in UL for QCI 3
- M8012C98 IP Throughput time in UL for QCI 4
- M8012C100 IP Throughput time in UL for QCI 5
- M8012C156 IP Throughput net time in UL for QCI 1
- M8012C157 IP Throughput net time in UL for QCI 2
- M8012C158 IP Throughput net time in UL for QCI 3
- M8012C159 IP Throughput net time in UL for QCI 4
- M8012C160 IP Throughput net time in UL for QCI 5
- M8018C0 Active UE per eNB average
- M8018C1 Active UE per eNB max
- M8018C8 Sum of Active UEs per eNB
- M8018C9 Denominator for Active UEs per eNB
- M8038C11 IP Throughput time in UL for QCI1 per PLMN-ID
- M8038C13 IP Throughput time in UL for QCI2 per PLMN-ID
- M8038C15 IP Throughput time in UL for QCI3 per PLMN-ID
- M8038C17 IP Throughput time in UL for QCI4 per PLMN-ID
- M8038C19 IP Throughput time in UL for QCI5 per PLMN-ID
- M8047C3 IP Throughput time in UL per Profile
- M8051C57 Active UE per Cell average
- M8051C58 Active UE per Cell max
- M8051C62 Sum of Active UEs per cell
- M8051C97 UEs with buffered UL data for DRB with QCI 1
- M8051C99 Sum of Active UEs with buffered data in UL per cell
- M8051C103 Sum of active UEs per cell, which had data scheduled in UL
- M8051C109 Average number of UEs with buffered data in UL
- M8051C110 Max number of UEs with buffered data in UL

The following counter and KPI values might increase:

- LTE_5359a E-UTRAN Averaged IP scheduled Throughput in UL, QCI1
- LTE_5363a E-UTRAN Averaged IP scheduled Throughput in UL, QCI5
- M8012C91 IP Throughput volume in UL for QCI 1
- M8012C93 IP Throughput volume in UL for QCI 2
- M8012C95 IP Throughput volume in UL for QCI 3
- M8012C97 IP Throughput volume in UL for QCI 4
- M8012C99 IP Throughput volume in UL for QCI 5
- M8038C10 IP Throughput volume in UL for QCI1 per PLMN-ID
- M8038C12 IP Throughput volume in UL for QCI2 per PLMN-ID
- M8038C14 IP Throughput volume in UL for QCI3 per PLMN-ID
- M8038C16 IP Throughput volume in UL for QCI4 per PLMN-ID
- M8038C18 IP Throughput volume in UL for QCI5 per PLMN-ID
- M8047C1 IP Throughput data volume in UL per Profile

16.2.15 Improvement of the average UL MCS

Higher UL modulation and coding scheme (MCS) to be used so that UL data can be transferred with smaller number of data transmissions.

Short description

The change concerns the Extended Uplink Link Adaptation (eULA). If the scheduling inactivity was higher than 200ms but smaller than 1s, the eULA considers an extra MCS downgrade towards the initial MCS only if the last UL data transmission resulted with negative acknowledgement. It is expected that most UEs in the field have stationary conditions and therefore only few additional hybrid automatic repeat request (HARQ) retransmissions are expected after this change.

Related features

- *LTE1034: Extended Uplink Link Adaptation*

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter and KPI values might decrease:

- UL MCS2 - MCS11 Usage (M8001C18 PUSCH transmissions using MCS2 - M8001C27 PUSCH transmissions using MCS11)
- M8012C89 Number of TTIs in UL with at least one UE scheduled to transmit user plane data
- LTE_6260a E-UTRAN Percentage of PUSCH transmissions using Low MCS Codes (MCS<=9)

The following counter and KPI values might increase:

- UL MCS13~MCS28 Usage (M8001C29 PUSCH transmissions using MCS13 - M8001C44 PUSCH transmissions using MCS28)
- LTE_6261a E-UTRAN Percentage of PUSCH transmissions using High MCS Codes (MCS>=20)
- LTE_5289d E-UTRAN average PDCP Layer Active Cell Throughput UL

Note: The impact depends on the `Initial MCS in uplink (iniMcsUl)` parameter setting.

16.2.16 Source rate based UL grant assignment for VoLTE (or any other small packet transmission)

Improved algorithm to avoid aperiodic CQI causing segmentation of the PUSCH grants

Short description

When aperiodic channel quality indicator (CQI) is in use it can cause the segmentation on PUSCH grants. It concerns small packets like VoLTE, but can impact other kind of traffic as well.

During the PUSCH code rate check (only for modulation and coding scheme (MCS) higher than 15), the MCS is decreased (but limited to MCS11) until the uplink control information (UCI) no longer violates the code rate. This can lead to segmentation because the amount of data to be received no longer fits into the grant for data (because of aperiodic CQI grant added).

The following change is proposed to deal with situation. If a grant is sufficiently large to receive all data pending at the UE, then a minimum MCS is defined which is the smallest MCS which still allows all data to be received without a segmentation. During the code rate check, the MCS is not reduced below this minimal MCS if aperiodic CQI is requested in the grant. If the code rate is still violated, the aperiodic CQI is dropped instead. With this evolution, the dynamic MCS limit is more often reached and the aperiodic CQI is more often skipped and replaced by a periodic CQI.

As a result, the average CQI decreases. For small allocations (1-3PRBs), the segmentation is relevant and typically only UEs in good radio conditions can have small UL PRB allocation. The aperiodic CQI value is skipped, thus the average CQI decreases.

It results in reduced PDCCH load and less UL PRB usage.

Related features

- *LTE2774: Source rate based UL grant assignment for VoLTE*

Related parameters

There are no related parameters.

Expected impact on performance counters

The following counter and KPI values might decrease:

- M8001C13 Correct non-duplicate UL-SCH TB with original reception
- M8001C139 RLC PDU reception
- M8001C142 UL RLC PDUs received
- M8001C137 RLC PDU first transmissions
- M8010C36-M8010C51 UE Reported CQI Level 00 - UE Reported CQI Level 15
- M8010C116-8010C131 UE Reported CQI Level 00 for 256QAM-configured UEs - UE Reported CQI Level 15 for 256QAM-configured UEs
- LTE_5427c E-UTRAN Average CQI
- LTE_6119a E-UTRAN Average CQI of 256QAM configured UEs

16.3 TD-LTE 18 algorithm changes

Algorithm changes for pre-LTE 18 features

16.3.1 PRACH format4 guard window adjustment

The guard band is increased, so the side-lobe is not considered in the detection window.

Short description

It was observed that the energy of the desired preamble (for example, preamble 8) might leak to the detection window of the neighboring preamble, so the fake preamble (for example, preamble 9) is detected. This change aims at decreasing the PRACH format4 false alarm rate and improving the handover performance.

Related features

There are no related features.

Related parameters

There are no related parameters.

Expected impact on performance counters

There are no related counters.

17 Performance changes

Changes introduced to increase the performance of existing features or particular radio network functions. Usually they introduce new parameters and might require activation.

17.1 LTE19 performance changes

17.1.1 UL TCP Power Boost

Functionality which improves data transfer in UL, by boosting transmit power of the UE. This functionality is based on TCP Service Differentiation.

Technical details

If the *TCP Service Differentiation* functionality is enabled (see TCP Service Differentiation), the UL TCP data transfer can be additionally boosted to allow UEs to reach the maximum modulation and coding scheme (MCS). The additional UL TCP boost is enabled with the **LNCEL** `Activate TCP UL Power Boost` (`actTcpUlPowerBoost`) parameter.

The *UL TCP Power Boost* can occur only if:

- the **LNCEL** `Boost guard time` (`boostGuardTime` timer is running (introduced with the *TCP Service Differentiation*),
- the UE Power Headroom Report (PHR) is higher than 6 dB,
- (LTE 19 release only) the UL MCS is lower from maximum possible MCS by at least 0.6,
- (LTE 19A release onwards) an averaged version of MCS is below a threshold controlled by the **DPCLPC** `MCS Delta Threshold for Up TPC with differentiated ULPC` (`ulpcDiffMcsThresh`) parameter,
- number of UEs already in UL Power Boost state is lower than **LNCEL** `Max Number of UEs in TCP UL Power Boost` (`maxTcpUlPowerBoostUEs`) parameter.

The number of UEs simultaneously in TCP Power Boost state is limited by the `maxTcpUlPowerBoostUEs` parameter. If the limit is reached, the oldest UE is released from TCP Power Boost state.

A new counter related with this functionality is introduced: `M8006C345` - total TCP boosting duration of all ERABs in UL with Power Boost.

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Table 11 Counters introduced by UL TCP Power Boost

Counter ID	Counter name	Measurement
`M8006C345`	TCP_BOOST_DUR_ERABS_UL_PB	8006: LTE EPS Bearer

Table 12 Parameters introduced by UL TCP Power Boost

Full name	Abbreviated name	Path
Activate TCP UL Power Boost	actTcpUlPowerBoost	MRBTS/LNBTS/LNCEL
Max Number of UEs in TCP UL Power Boost	maxTcpUlPowerBoostUEs	MRBTS/LNBTS/LNCEL

Table 13 Parameters related to UL TCP Power Boost

Full name	Abbreviated name	Path
Activate TCP Service Differentiation	actTcpServiceDiff	MRBTS/LNBTS/LNCEL
Boost guard time	boostGuardTime	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig

Related descriptions

TCP Service Differentiation on page 124

17.1.2 PDCCH CQI Shift for 4Tx

Functionality that improves network performance in 4Tx deployment by introducing new algorithm for Chanel Quality Indicator (CQI) mapping to aggregation level for physical downlink control channel (PDCCH).

Technical details

Before the *PDCCH CQI Shift for 4Tx* functionality, there was a single algorithm that maps CQI to aggregation level for PDCCH transmission. However, it was discovered that 4Tx Transmit Diversity results in up to 1 dB performance penalty compared to 2Tx Transmit Diversity. Therefore, an offset for mentioned algorithm is needed to allow a slightly more conservative choice of aggregation level with 4Tx. A new **LNCEL** PDCCH CQI shift for 4Tx (pdcchCqiShift4Tx) parameter is introduced to specify the value of the offset. Nokia recommends to set the value of PDCCH CQI shift for 4Tx to **-1.5**. Lowering the value too much can lead to too conservative aggregation levels resulting in wasted resources. Setting this parameter to **0** disables the *PDCCH CQI Shift for 4Tx*.

The **LNCEL** PDCCH CQI shift for 4Tx (pdcchCqiShift4Tx) must be configured if **LNCEL** Enable AMC for PDCCH link adaptation (enableAmcPdcch) or **LNCEL** Activate outer loop link adaptation (actOlLaPdcch) is set to **true**. It requires the **LNCEL_FDD/TDD** Downlink MIMO mode (dlMimoMode) to be set to **Closed Loop MIMO (4x2)** or **Closed Loop MIMO (4x4)**.

The LTE_5208a: E-UTRAN RLC PDU Re-transmission Ratio Downlink key performance indicator (KPI) should improve if the functionality is configured properly.

Related features

- *LTE749: Link Adaptation for PDCCH*
- *LTE1035: Outer Loop Link Adaptation for PDCCH*
- *LTE568: DL Adaptive Closed Loop MIMO (4x2)*

- *LTE569: Downlink Adaptive Closed Loop SU MIMO 4x4 - TM 4*
- *LTE1987: Downlink Adaptive Closed Loop SU MIMO (4x4)*

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Table 14 KPIs related to UL TCP Power Boost

KPI ID	KPI name
LTE_5208a	E-UTRAN RLC PDU Re-transmission Ratio Downlink

Table 15 Parameters introduced by UL TCP Power Boost

Full name	Abbreviated name	Path
PDCCH CQI shift for 4Tx	pdcchCqiShift4Tx	MRBTS/LNBTS/LNCEL

Table 16 Parameters related to UL TCP Power Boost

Full name	Abbreviated name	Path
Enable AMC for PDCCH link adaptation	enableAmcPdcch	MRBTS/LNBTS/LNCEL
Activate outer loop link adaptation	actOlLaPdcch	MRBTS/LNBTS/LNCEL
Downlink MIMO mode	dlMimoMode	MRBTS/LNBTS/LNCEL/LNCEL_FDD or LNCEL_TDD

17.1.3 Adaptive Vocoder PRB/TBS for TTIB

Functionality that improves network optimization by calculating the minimum transport block size (TBS) for time interval bundling (TTIB) UEs, instead of using the fixed value set by the operator. The minimum TBS is used by link adaptation to determine the transport block size (TBS).

Technical details

vocoder A technology of voice coding, allowing to send voice over digital medium. A vocoder also incorporates voice compression, a technique that effectively minimizes the number of bits used to represent voice. LTE uses the Adaptive Multi-Rate (AMR) vocoder, which has a variable bit-rate capability from 1.8 to 12.2 kbits/s.

Without *Adaptive Vocoder PRB/TBS for TTIB*, the BTS use the same **LNCEL** Minimum UL TBS for UEs for TTI bundled UEs (ttibUlsMinTbs) for all vocoder rate. This leads to the following inefficiencies in UL resources:

- If operator configures a value which is optimized for high data rate voice calls, then not enough segmentation can be achieved for low data rate voice calls. Thus, a lower cell edge gain due to segmentation for low data rate voice calls is seen.
- If operator configures a value which is optimized for low data rate voice calls, then too much segmentation occurs for high data rate voice calls. This can lead to 100% TTI utilization just to send the voice packet.

Adaptive Vocoder PRB/TBS for TTIB utilizes the mechanism introduced in the *LTE2774: Source Rate Based UL Grant Assignment for VoLTE*, that is measurement-based UL TBS adaptation. With this functionality enabled (the **LNCEL** `Activate adaptive UL min TBS for TTI Bundling` (`actTtibAdaptUlMinTbs`) set to **true**), the BTS calculates the minimum TBS, taking into account:

- effective bit rate (EBR), based on the measurements of the voice data
- the **LNCEL** `Maximum number of packet segmentation in TTIB` (`ttibUlsMaxPacketSeg`) value which defines maximum number of packet segmentation in TTIB mode

Note: Parameter must be carefully planned as too high value may lead to high resource utilization (that is, to send one voice packet high number of PRBs might be used).

If the **LNCEL** `Activate adaptive UL min TBS for TTI Bundling` (`actTtibAdaptUlMinTbs`) parameter is set to **true**, the following parameters must be configured:

- **LNCEL** `Activate TTI bundling` (`actTtiBundling`) must be set to **true** (the *LTE904: TTI Bundling* is activated)
- **LNCEL** `Activate VoLTE source rate based UL assignment` (`actVoLteSrcRate`) must be set to **true** (the *LTE2774: Source Rate Based UL Grant Assignment for VoLTE* is activated)
- **LNCEL** `Activation of VoIP coverage boosting in UL scheduling` (`actVoipCovBoost`) must be set to **false** (the *LTE2098: VoLTE Uplink Coverage Boosting* is deactivated)

This functionality is configured properly if the following counter and key performance indicators (KPIs) improve:

- M8011C215: Number of UL PRBs used for TTI Bundling
- LTE_5572f E-UTRAN E-RAB QCI1 Drop Ratio, RAN View
- LTE_5311b E-UTRAN PDCP SDU LossRatio in the UL, QCI1

Related features

- *LTE904: TTI Bundling*
- *LTE2774: Source Rate Based UL Grant Assignment for VoLTE*
- *LTE2098: VoLTE Uplink Coverage Boosting*

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Table 17 Counters related to Adaptive Vocoder PRB/TBS for TTIB

Counter ID	Counter name	Measurement
M8011C215	Number of UL PRBs used for TTI Bundling	8011: LTE Cell Resource

Table 18 KPIs related to Adaptive Vocoder PRB/TBS for TTIB

KPI ID	KPI name
LTE_5572f	E-UTRAN E-RAB QCI1 Drop Ratio, RAN View

Table 18 KPIs related to Adaptive Vocoder PRB/TBS for TTIB (Cont.)

KPI ID	KPI name
LTE_5311b	E-UTRAN PDCP SDU LossRatio in the UL, QCI1

Table 19 Parameters introduced by Adaptive Vocoder PRB/TBS for TTIB

Full name	Abbreviated name	Path
Activate adaptive UL min TBS for TTI Bundling	actTtibAdaptUlMinTbs	MRBTS/LNBTS/LNCEL
Maximum number of packet segmentation in TTIB	ttibUlsMaxPacketSeg	MRBTS/LNBTS/LNCEL

Table 20 Parameters related to Adaptive Vocoder PRB/TBS for TTIB

Full name	Abbreviated name	Path
Activate TTI bundling	actTtiBundling	MRBTS/LNBTS/LNCEL
Activate VoLTE source rate based UL assignment	actVoLteSrcRate	MRBTS/LNBTS/LNCEL
Activation of VoIP coverage boosting in UL scheduling	actVoipCovBoost	MRBTS/LNBTS/LNCEL
Minimum UL TBS for UEs for TTI bundled UEs	ttibUlsMinTbs	MRBTS/LNBTS/LNCEL

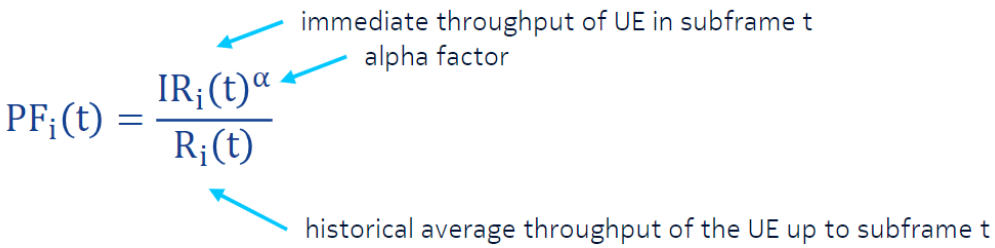
17.1.4 Load Adaptive PF Scheduling

Functionality that improves network efficiency by allowing the operator to configure adaptive (depending on the UE radio conditions) proportional fair (PF) scheduling algorithm for DL.

Technical details

PF scheduling ensures high cell throughput by favoring UEs in good radio conditions while still providing fair amount of resources to UEs in worse condition. The formula for PF scheduling is shown on the picture below.

Figure 3 PF scheduling formula



Numerator of the formula represents immediate throughput of the given UE. The UEs in good conditions will have higher possible throughput per subframe, and bigger chances of being scheduled.

Denominator of the formula represents average throughput of the given UE. The UEs in bad conditions will have lower average throughput due to UEs with better conditions being prioritized, which increases chances of UE being scheduled.

Up to release LTE19, the alpha factor in the numerator of formula was equal to 1. Since LTE19, the alpha factor can be modified, allowing to adjust the scheduling to required purposes:

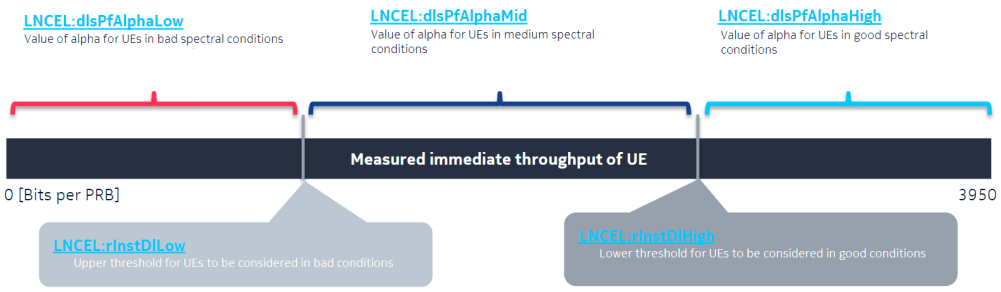
- Increasing the value will favor UEs in good conditions leading to higher cell throughput in congestion.
- Lowering the value will favor UEs in worse conditions leading to more consistent user experience.

In LTE19, *Load Adaptive PF Scheduling* can be enabled for DL using **LNCEL** `Activate DL Load adaptive PF algorithm for TD and FD scheduling steps` (`actDlsLdAdaptPf`) parameter. If it is set to **true**, the following **LNCEL** parameters must be configured:

- `Load threshold for turning on DL Adaptive PF Scheduler` (`dlAdaptPfLoadThresh`)
- `PF alpha to be used when DL instantaneous spectral efficiency is higher than rInstDlHigh` (`dlsPfAlphaHigh`)
- `PF alpha to be used when DL instantaneous spectral efficiency is lower than rInstDlLow` (`dlsPfAlphaLow`)
- `PF alpha to be used when DL instantaneous spectral efficiency is between rInstDlLow and rInstDlHigh` (`dlsPfAlphaMid`)
- `High water mark to trigger use of different PF Alpha metric in DL TD and FD scheduling steps` (`rInstDlHigh`)
- `Low water mark to trigger use of different PF Alpha metric in DL TD and FD scheduling steps` (`rInstDlLow`)

The relationship between the parameters is shown in the figure below.

Figure 4 DL PF scheduling parameters



If UEs in good conditions will be favored by alpha parameter settings, then following key performance indicators (KPIs) are expected to show improvements in high load scenario:

- LTE_5354a E-UTRAN Averaged IP scheduled Throughput in DL, QCI5
- LTE_5355a E-UTRAN Averaged IP scheduled Throughput in DL, QCI6

- LTE_5356a E-UTRAN Averaged IP scheduled Throughput in DL, QCI7
- LTE_5357a E-UTRAN Averaged IP scheduled Throughput in DL, QCI8
- LTE_5358a E-UTRAN Averaged IP scheduled Throughput in DL, QCI9
- LTE_5747a DL Spectral efficiency

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Table 21 KPIs related to Load Adaptive PF Scheduling

KPI ID	KPI name
LTE_5354a	E-UTRAN Averaged IP scheduled Throughput in DL, QCI5
LTE_5355a	E-UTRAN Averaged IP scheduled Throughput in DL, QCI6
LTE_5356a	E-UTRAN Averaged IP scheduled Throughput in DL, QCI7
LTE_5357a	E-UTRAN Averaged IP scheduled Throughput in DL, QCI8
LTE_5358a	E-UTRAN Averaged IP scheduled Throughput in DL, QCI9
LTE_5747a	DL Spectral efficiency

Table 22 Parameters introduced by Load Adaptive PF Scheduling

Full name	Abbreviated name	Path
Activate DL Load adaptive PF algorithm for TD and FD scheduling steps	actDlsLdAdaptPf	MRBTS/LNBTS/LNCEL
Load threshold for turning on DL Adaptive PF Scheduler	dlAdaptPfLoadThresh	MRBTS/LNBTS/LNCEL
PF alpha to be used when DL instantaneous spectral efficiency is higher than rInstDlHigh	dlsPfAlphaHigh	MRBTS/LNBTS/LNCEL
PF alpha to be used when DL instantaneous spectral efficiency is lower than rInstDlLow	dlsPfAlphaLow	MRBTS/LNBTS/LNCEL
PF alpha to be used when DL instantaneous spectral efficiency is between rInstDlLow and rInstDlHigh	dlsPfAlphaMid	MRBTS/LNBTS/LNCEL
High water mark to trigger use of different PF Alpha metric in DL TD and FD scheduling steps	rInstDlHigh	MRBTS/LNBTS/LNCEL
Low water mark to trigger use of different PF Alpha metric in DL TD and FD scheduling steps	rInstDlLow	MRBTS/LNBTS/LNCEL

17.1.5 Data Split CA Selection

Functionality that improves network optimization, by allowing the operator to prioritize the selected secondary cell (SCell). This way, operator can configure BTS to schedule as much non-GBR bearer traffic as possible on certain SCell (for example, Licensed Assisted Access (LAA) SCell).

Technical details

Without *Data Split CA Selection* activated, all serving cells are assigned equal non-GBR scheduler weights when the UE is in Carrier Aggregation (CA). It results in no differentiation for LAA or other frequency bands in CA scheduling fairness factor. The *Data Split CA Selection* allows the DL scheduler to favor chosen SCells (for example for LAA instances) over others if the operator wants to schedule as much non-GBR bearer traffic as possible on certain cells rather than equal balance.

The *Data Split CA Selection* is activated with the **LNCEL** `Activate carrier aggregation SCell scheduler weight factor` (`actCaScellSchedWeightFactor`) parameter set to **true**. It only needs to be activated in the LNCEL instance of the primary cell (PCell). The **CAREL** `SCell scheduler weight factor for downlink` (`scellSchedWeightFactorDl`) parameter controls SCell DL scheduler weight in relation to the PCell and other activated SCell. Only SCells with Channel Quality Indicator (CQI) that meets or exceeds the threshold set by **CAGENB** `Carrier aggregration SCell scheduler weight factor minimum CQI` (`caScellSchedWtFactMinCqi`) parameter are impacted by this scheduling factor.

Up to SRAN20A, the BTS applies the Scheduler Weight Factor updates on a periodic basis approximately every 100 ms. Since release SRAN20A, this time is configurable with the **LNCEL_FDD** `Data split CA SCell scheduler weight factor activation timer` (`caScellSchedWeightFactorTimer`) parameter. The PCell starts the timer when one of the first of following events occurs after SCell activation:

- reception of valid SCell CQI
- expiration of 33 ms timer that starts upon successful SCell activation

This functionality is configured properly if the following key performance indicators (KPIs) improve:

- LTE_5212a E-UTRAN PDCP SDU Volume DL
- LTE_5276b E-UTRAN average PRB usage per TTI DL

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Table 23 KPIs related to Adaptive Vocoder PRB/TBS for TTIB

KPI ID	KPI name
LTE_5212a	E-UTRAN PDCP SDU Volume DL
LTE_5276b	E-UTRAN average PRB usage per TTI DL

Table 24 Parameters introduced by Data Split CA Selection

Full name	Abbreviated name	Path
Activate carrier aggregation SCell scheduler weight factor	actCaScellSchedWeightFactor	MRBTS/LNBTS/LNCEL
SCell scheduler weight factor for downlink	scellSchedWeightFactorDl	MRBTS/LNBTS/LNCEL/CAREL
Carrier aggregration SCell scheduler weight factor minimum CQI	caScellSchedWtFactMinCqi	MRBTS/LNBTS/CAGENB

17.2 LTE18A performance changes

17.2.1 TCP Service Differentiation

Functionality which improves data transfer in DL and UL, by boosting the amount of resources assigned to data radio bearers (DRB) with Transmission Control Protocol (TCP) traffic.

Hardware and software requirements

Since LTE19B release, this functionality is available as the *LTE5731: TCP Service Differentiation* feature.

Table 25 LTE5731 hardware and software requirements

	FDD	TDD
Flexi Multiradio 10 BTS	FL19B	TL19B
Flexi Multiradio 10 Indoor BTS	Not supported	TL19B
Nokia AirScale BTS	FL19B	TL19B
Flexi Zone BTS	Not supported	Not supported
Flexi Zone Access Point	Not supported	Not supported
Cloud Flexi Zone Controller	Not supported	Not supported

Technical details

With the *TCP Service Differentiation* enabled (**LNCEL** Activate TCP Service Differentiation (actTcpServiceDiff) parameter set to **true**), the scheduling weight is multiplied by configured bias factor during TCP data transfer. The bias factor is applicable for:

- QCIs 5 to 9,
- QCI 70,
- operator-specific QCI,

and for each QCI is configurable separately using the **LNBTS** Boosting factor for downlink (boostFactorDl) and **LNBTS** Boosting factor for uplink (boostFactorUl) parameters.

With this functionality enabled, Packet Data Convergence Protocol (PDCP) layer is monitored for TCP traffic. From the moment it is detected, the BTS starts measuring volume of TCP data (only TCP packet with size equal or bigger than the **LNCEL** `Minimum TCP packet size` (`minTcpPacketSize`) parameter are considered for this measurement). Two thresholds are defined:

- lower threshold, which is the threshold between small and medium data transfer (**LNCEL** `Downlink minimum boosting bytes` (`dlMinBoostBytes`) or **LNCEL** `Uplink minimum boosting bytes` (`ulMinBoostBytes`) for UL)
- upper threshold, which is the threshold between medium and big data transfer (**LNCEL** `Downlink maximum boosting bytes` (`dlMaxBoostBytes`) or **LNCEL** `Uplink maximum boosting bytes` (`ulMaxBoostBytes`) for UL)

After reaching lower threshold, the scheduling bias is applied, resulting in a boost of data transfer. After reaching upper threshold, the bias application is stopped, and data transfer is not boosted anymore.

Figure 5 Algorithm of data flow boosting

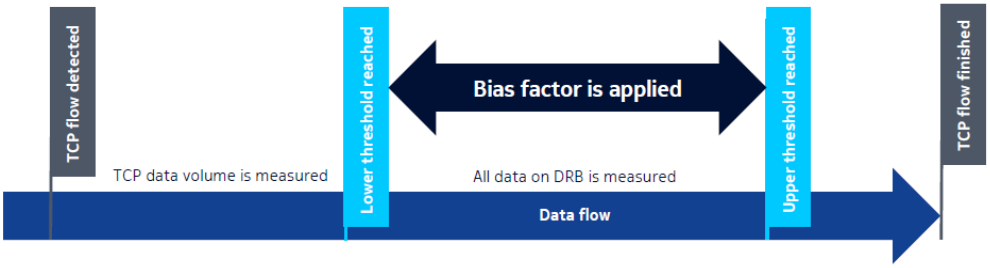
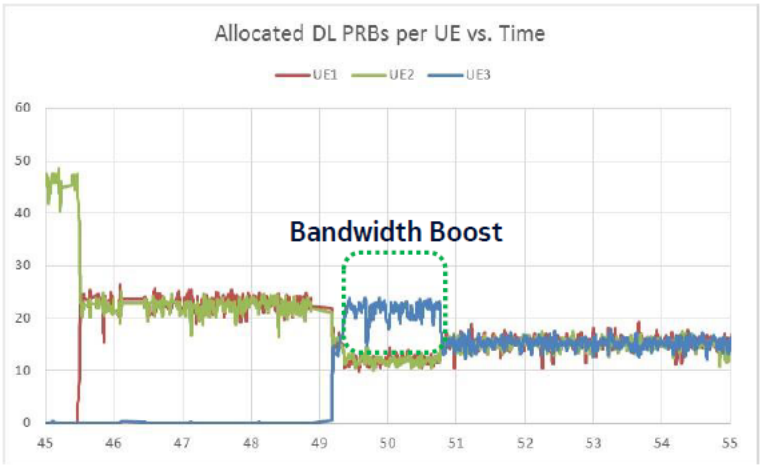


Figure 6 Exemplary result of data boosting (number of PRBs allocated vs time, for three UE)



Bias application can also be prematurely stopped if:

- Time between any two consecutive TCP packets exceeds the **LNCEL** `Time between TCP packets` (`timeBetweenTcpPackets`) parameter's value. Only TCP packet with size equal or bigger than the **LNCEL** `Minimum TCP packet size` (`minTcpPacketSize`) parameter are considered for this check.
- Handover procedure was triggered.
- Another bearer for the same UE is setup, modified, deleted or bias is applied.

- Configurable timer expires (configured with the **LNCEL** `Boost guard time` (`boostGuardTime`) parameter).

After bias application is stopped on certain DRB, it can only be started again after configurable period of time (configured with the **LNCEL** `Time until next boosting round` (`timeNextBoostingRound`) parameter).

There are two counters related with this functionality (incremented at TCP boost stop time or at the end of the measurement period):

- `M8006C337` - total TCP boosting duration of all ERABs in DL
- `M8006C338` - total TCP boosting duration of all ERABs in UL

This functionality is enhanced with UL TCP Power Boost.

Management data

Table 26 Counters introduced by TCP Service Differentiation

Counter ID	Counter name	Measurement
M8006C337	TCP_BOOSTING_DUR_ERABS_DL	8006: LTE EPS Bearer
M8006C338	TCP_BOOSTING_DUR_ERABS_UL	8006: LTE EPS Bearer

Table 27 Parameters introduced by TCP Service Differentiation

Full name	Abbreviated name	Path
Activate TCP Service Differentiation	actTcpServiceDiff	MRBTS/LNBTS/LNCEL
Boosting factor for downlink	boostFactorDl	MRBTS/LNBTS/qciTab[x]
Boosting factor for uplink	boostFactorUl	MRBTS/LNBTS/qciTab[x]
TCP Service Differentiation Configuration	tcpServiceDiffConfig	MRBTS/LNBTS/LNCEL
Downlink minimum boosting bytes	dlMinBoostBytes	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig
Uplink minimum boosting bytes	ulMinBoostBytes	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig
Downlink maximum boosting bytes	dlMaxBoostBytes	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig
Uplink maximum boosting bytes	ulMaxBoostBytes	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig
Time between TCP packets	timeBetweenTcpPackets	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig
Minimum TCP packet size	minTcpPacketSize	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig
Boost guard time	boostGuardTime	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig
Time until next boosting round	timeNextBoostingRound	MRBTS/LNBTS/LNCEL/tcpServiceDiffConfig

Related descriptions

UL TCP Power Boost on page 116

17.2.2 Advanced Step-wise SCell Addition for CA: Initial SCellAddition in One Step

Functionality that improves network optimization by more efficient use of the secondary cell (SCell) resources, and minimization of signaling messages. It is achieved by combining two methods of SCell addition: one-step and step-wise.

Technical details

When *Advanced Step-wise SCell Addition for CA* is not activated, there are two independent ways of SCell addition: one-step and step-wise.

If BTS is configured for one-step SCell addition, then all possible SCells are added when the UE enters the cell. However, buffer measurement is not started, and if SCells are dropped, then they cannot be added back.

If BTS is configured for step-wise SCell addition, then SCells are added only after measurement criteria are fulfilled (for example, buffer based or UE measurements) and only one SCell can be added at a time. It is performed depending on demand, using separate RRC Connection Reconfiguration messages (this can lead to signaling message overload).

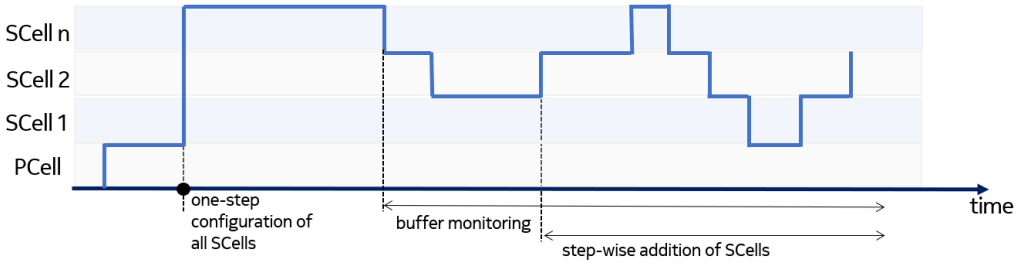
When the *Advanced Step-wise SCell Addition for CA* is activated, all SCells are configured in one-step manner, but the BTS also starts inactivity monitoring to allow SCells to be de-configured and added back as needed (based on UE throughput demand).

This functionality can be enabled with the **LNBTS** `Activate advanced step-wise SCell addition` (`actAdvStepwiseScellAdd`) parameter, and requires the **LNBTS_FDD/TDD** `Number of sampled subframes with High Non-GBR traffic` (`numTxWithHighNonGbr`) to be configured to value higher than **0**. The `actAdvStepwiseScellAdd` parameter can be configured to either **one-step advanced** or **buffer-based**.

With the `actAdvStepwiseScellAdd` parameter set to **one-step advanced**, upon the UE entering the cell, the BTS selects all eligible candidate SCells (based on configuration and UE capabilities), and then adds the SCells in one-step (a single RRC Connection Reconfiguration message is sent). If the *LTE2276: Measurement-based SCell Selection* is activated, SCells are filtered according to *LTE2276* rules. After the initial one-step addition, the BTS follows the step-wise behavior:

- Channel quality and SCells activity are monitored (channel quality is monitored if *LTE1541: Advanced SCell Measurement Handling* is activated).
- Inactive SCells are de-configured if the *LTE1541* is activated and the `multScellReleaseTimer` parameter is higher than 0.
- Non-GBR user data buffer measurements are performed, and released SCells are added again in a step-wise manner (if the *LTE2276* is activated, SCells are filtered according to *LTE2276* rules).
- SCells unavailable due to channel quality measurements are de-configured and cannot be added again unless the *LTE2276* is activated.

Figure 7 One-step advanced solution



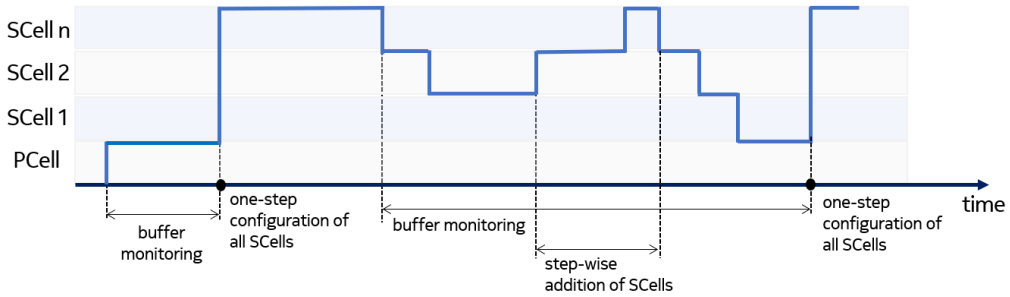
With the `actAdvStepwiseScellAdd` parameter set to **buffer-based**, upon the UE entering the cell, the BTS starts non-GBR user data buffer measurements. If no SCells are configured when an SCell addition trigger occurs, the BTS selects all eligible candidate SCells (based on configuration and UE capabilities), and then adds the SCells in one-step (a single RRC Connection Reconfiguration message is sent). If the *LTE2276: Measurement-based SCell Selection* is activated, SCells are filtered according to *LTE2276* rules. After the initial one-step addition, the BTS follows the step-wise behavior:

- Channel quality and SCells activity are monitored (channel quality is monitored if the *LTE1541: Advanced SCell Measurement Handling* is activated).
- Inactive SCells are de-configured if the *LTE1541* is activated and the `multScellReleaseTimer` parameter is higher than 0.
- Non-GBR user data buffer measurements are performed, and, if the SCell addition trigger occurs, the SCells are added again:
  - In step-wise manner if at least one SCell is configured.
  - In one-step manner if all SCells are released.

  If the *LTE2276* is activated, SCells are filtered according to *LTE2276* rules.
- SCells unavailable due to channel quality measurements are de-configured and can't be added again unless the *LTE2276* is activated.

If Carrier Aggregation (CA) Steering intra-cell handover is triggered, and the functionality is set to **buffer-based**, then upon the trigger for CA Steering intra-cell handover, the BTS selects all eligible candidate SCells based on configuration and UE capabilities. If the *LTE2276* is activated, SCells are filtered according to *LTE2276* rules.

Figure 8 Buffer-based solution



Related features

- *LTE1541: Advanced SCell Measurement Handling*
- *LTE2276: Measurement-based SCell Selection*

Management data

Table 28 Parameters introduced by Advanced Step-wise SCell Addition for CA: Initial SCell Addition in One Step

Full name	Abbreviated name	Path
Activate advanced step-wise SCell addition	actAdvStepwiseScellAdd	MRBTS/LNBTS

Table 29 Parameters related to Advanced Step-wise SCell Addition for CA: Initial SCell Addition in One Step

Full name	Abbreviated name	Path
Number of sampled subframes with High Non-GBR traffic	numTxWithHighNonGbr	MRBTS/LNBTS/LNBTS_FDD MRBTS/LNBTS/LNBTS_TDD

17.2.3 Fast Scheduling Flexible CA

Functionality which can reduce the amount of time before DL data transmission on a newly added secondary cell (SCell) begins.

Technical details

The BTS sends DL data on SCell only if it has an indication that the UE is already monitoring physical downlink control channel (PDCCH) on that SCell. Without activation of the *Fast Scheduling Flexible CA* functionality, the BTS gets that indication in one of two ways:

- Valid Channel Quality Indicator (CQI) report (different than **0/out of range**) was received for particular SCell.
- At least 33 ms passed since particular SCell was activated (BTS waits enough time to increase the chances that UE is already monitoring PDCCH on newly added SCell).

When the *Fast Scheduling Flexible CA* is activated (the **LNCEL** SCcell fast downlink scheduling selection (scellFastSchedulingSelect) parameter set to **true**), the BTS proactively requests aperiodic CQI (A-CQI) for the newly activated SCell, rather than wait for a periodic CQI. The BTS makes a maximum of four such requests, in order to receive a valid CQI for the SCell. In the case that no valid CQI is received, then the 33 ms wait criteria is applied to trigger the start of scheduling on the SCell. Averagely, with this functionality activated, the delay for the start of DL scheduling on newly activated SCells should be shorter.

Management data

Table 30 Parameters introduced by Fast Scheduling Flexible CA

Full name	Abbreviated name	Path
SCcell fast downlink scheduling selection	scellFastSchedulingSelect	MRBTS/LNBTS/LNCEL

17.2.4 UL Dynamic BLER Adaptation

Functionality that improves UL throughput, due to dynamically adapted block error rate (BLER) value for UL non-GBR traffic.

Technical details

Without the *UL Dynamic BLER Adaptation* functionality, the target BLER for UL Adaptive Modulation and Coding (AMC) is configurable statically by **LNCEL** `UL AMC target BLER` (`ulTargetBler`) parameter, in range 1% to 50% (default 10%). If the *UL Dynamic BLER Adaptation* functionality is enabled (**LNCEL** `Activate uplink dynamic target BLER` (`actUlDynamicTargetBler`) set to **true**), the target BLER depends on UE channel conditions (signal-to-interference-plus-noise-ratio (SINR), Power Headroom Report (PHR)). The goal of dynamic target BLER change is to use a higher target BLER as SINR degrades (for example 30% near cell edge). For very good SINR, the target BLER remains at 10%.

When this functionality is activated, the UL throughput for UEs nearing cell edge improves compared to a fixed target BLER of 10%. This improvement can be visible at cell level key performance indicators (KPIs) such as LTE5289d - E-UTRAN average PDCP Layer Active Cell Throughput UL.

Management data

Table 31 Parameters introduced by UL Dynamic BLER Adaptation

Full name	Abbreviated name	Path
`Activate uplink dynamic target BLER`	`actUlDynamicTargetBler`	MRBTS/LNBTS/LNCEL

Table 32 Parameters related by UL Dynamic BLER Adaptation

Full name	Abbreviated name	Path
`UL AMC target BLER`	`ulTargetBler`	MRBTS/LNBTS/LNCEL

Table 33 Key performance indicators related to UL Dynamic BLER Adaptation

KPI ID	KPI name
LTE5289d	E-UTRAN average PDCP Layer Active Cell Throughput UL

