ERICSSON

VoLTE Optimized Carrier Aggregation

Feature Description

399/221 04-LZA 701 6014/1 Uen J4C

Contents

1 VoLTE Optimized Carrier Aggregation Overview

The VoLTE Optimized Carrier Aggregation feature improves VoLTE retainability and introduces one new parameter and one new pmCounter for SCell handling.

Access Type:	LTE
Feature Identity:	FAJ 121 4884
Value Package Name:	VoLTE Performance
Value Package Identity:	FAJ 801 0444
Node Type:	Baseband Radio Node DU Radio Node
Licensing:	Licensed feature. One license for each node.

Summary

VoLTE Optimized Carrier Aggregation feature provides functions to improve VoLTE retainability, in extreme scenarios when there is an increased chance of VoLTE call drop while UE runs on Carrier Aggregation. The feature reduces call drop rate during VoLTE calls by the following methods:

— Volte retainability is improved by suppressing SCell configuration and deconfiguration together with deconfiguration of UL CA functions. DL CA functions and DL SCell are kept.

— VoLTE retainability is improved by deconfiguration of UL and DL SCells and measurements related to CA and SCells during VoLTE calls. The UL and DL in the SCell are reconfigured when VoLTE call ends.

— VoLTE retainability is improved by deconfiguration of only UL SCell and maintenance of DL SCells during VoLTE calls.

The new MOM attribute `sCellHandlingAtVolteCall` is introduced for SCell handling in MO classes EUtranCellFDD and EUtranCellTDD.

In addition, the new PM counter `pmCaDeconfiguredVolte` is added to MO classes EUtranCellFDD and EUtranCellTDD to monitor SCell deconfigured by setup of VOIP bearer. The PM counter `pmCaDeconfiguredVolte` is stepped when SCell is deconfigured due to the setup of VOIP bearer.

Additional Information

More information about this feature and related topics can be found in the following documentations:

- *3GPP TS 36.300; Overall description, Stage 2*
- *3GPP TS 36.331 Radio Resource Control (RRC)*
- *3GPP TS 36.413 S1 Application Protocol (S1AP)*
- *3GPP TS 36.423 X2 Application Protocol (X2AP)*
- Carrier Aggregation
- Uplink Carrier Aggregation
- Dynamic SCell Selection for Carrier Aggregation
- Configurable SCell Priority
- 3CC DL Carrier Aggregation Extension
- 4CC DL Carrier Aggregation Extension
- 5CC DL Carrier Aggregation Extension
- High Power UE

2 Dependencies of VoLTE Optimized Carrier Aggregation

This section contains a list of prerequisite and related features of VoLTE Optimized Carrier Aggregation.

Features

Table 1 Feature Dependencies

Feature	Relationship	Description
Carrier Aggregation (FAJ 121 3046)	Prerequisite	The feature VoLTE Optimized Carrier Aggregation requires the Carrier Aggregation feature to be activated. Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1: `DECONF_SCELLS`** Deconfigures DL SCells during an active voice bearer service. **Value 2: `DECONF_UL_SUPPRESS_DL_SCELLS`** Dynamic SCell Selection is suppressed during an active voice bearer service. **Value 3: `DECONF_UL_SCELLS`** Has no effect.
Dynamic SCell Selection for Carrier Aggregation (FAJ 121 3063)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1: `DECONF_SCELLS`** All SCell candidates evaluated during initial SCell selection are removed when a voice bearer is

Feature	Relationship	Description
		established and SCell selection procedure is triggered again when the voice bearer is released. **Value 2:DECONF_UL_SUPPRESS_DL_SCELLS** Deconfigures UL component carriers in SCell and suppresses Dynamic SCell selection during an active voice bearer service. **Value 3: DECONF_UL_SCELLS** Disables activities related to UL SCell selection during an active voice bearer service.
Configurable SCell Priority (FAJ 121 4701)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1: DECONF_SCELLS** All SCell candidates evaluated during Initial SCell selection are removed when a voice bearer is established and SCell selection procedure is triggered again when the voice bearer is released. **Value 2: DECONF_UL_SUPPRESS_DL_SCELLS**

Feature	Relationship	Description
		UL SCells are deconfigured and Dynamic SCell Selection is suppressed during an active voice bearer service. **Value 3: `DECONF_UL_SCELLS`** Disables activities related to UL SCell selection during an active voice bearer service.
3CC DL Carrier Aggregation Extension (FAJ 121 3084)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1: `DECONF_SCELLS`** DL SCells which have been configured for the UE are deconfigured and configuration of DL SCells is disabled during an active voice bearer service. **Value 2: `DECONF_UL_SUPPRESS_DL_SCELLS`** Dynamic SCell Selection is suppressed during an active voice bearer service. **Value 3: `DECONF_UL_SCELLS`** Has no effect.
4CC DL Carrier Aggregation Extension (FAJ 121 4466)	Related	
5CC DL Carrier Aggregation Extension (FAJ 121 4467)	Related	
Uplink Carrier Aggregation (FAJ 121 4425)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1: `DECONF_SCELLS`** Deconfigures UL SCell

Feature	Relationship	Description
		during an active voice bearer service . **Value 2:DECONF_UL_SUPPRESS_DL_SCELLS** Deconfigures UL component carriers in SCell and suppresses Dynamic SCell selection during an active voice bearer service. **Value 3: DECONF_UL_SCELLS** Deconfigures UL SCell during an active voice bearer service.
Multiple Frequency Band Indicators(FAJ 121 3054)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1: DECONF_SCELLS** Intra cell handover is disabled when Initial Context Setup, Handover or RRC Connection Reestablishment is performed with voice bearer. **Value 2: DECONF_UL_SUPPRESS_DL_SCELLS** UL SCells are deconfigured and dynamic selection of SCells is suppressed during an active voice bearer service. **Value 3: DECONF_UL_SCELLS**

Feature	Relationship	Description
		Has no effect.
High-Power UE (FAJ 121 4762)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1: DECONF_SCELLS** HPUE capability is preserved not to configure SCells according to HPUE state when the voice bearer is released and HPUE is operable. **Value 2:DECONF_UL_SUPPRESS_DL_SCELLS** UL SCells are deconfigured and dynamic selection of SCells is suppressed during an active voice bearer service. **Value 3: DECONF_UL_SCELLS** UL SCell for the UE is not configured during an active voice bearer service regardless of HPUE state.
Supplemental Downlink for Carrier Aggregation (FAJ 121 3068)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1: DECONF_SCELLS** DL SCells already configured for the UE are deconfigured and configuration of DL SCells is disabled during an active voice

Feature	Relationship	Description
		bearer service. **Value 2:** `DECONF_UL_SUPPRESS_DL_SCELLS` Dynamic selection of SCells is suppressed during an active voice bearer service. **Value 3:** `DECONF_UL_SCELLS` Has no effect.
Carrier Aggregation-Aware IFLB (FAJ 121 3068)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1:** `DECONF_SCELLS` Has no effect. **Value 2:** `DECONF_UL_SUPPRESS_DL_SCELLS` Dynamic selection of SCell is suppressed during an active voice bearer service. **Value 3:** `DECONF_UL_SCELLS` Has no effect.
Shared LTE RAN (FAJ 121 0860)	Related	Effects of the Enum values of `sCellHandlingAtVolteCall` parameter that manages SCell handling during VoLTE calls are the following: **Value 1:** `DECONF_SCELLS` Has no effect. **Value 2:** `DECONF_UL_SUPPRESS_DL_SCELLS` UL SCells are deconfigured and dynamic selection of SCells is suppressed during an active voice bearer service. **Value 3:** `DECONF_UL_SCELLS` Has no effect.

Feature	Relationship	Description
Mission-Critical Push-to-Talk (FAJ 121 4929)	Related	When the Mission-Critical Push-to-Talk feature is active, this feature treats mission-critical bearers like it treats VoLTE bearers.

Hardware

No special hardware requirement for this feature.

Limitations

No limitations for this feature.

Network Requirements

No Network Requirements for this feature.

3 Feature Operation of VoLTE Optimized Carrier Aggregation

This section describes the VoLTE Optimized Carrier Aggregation feature operation, including network configuration requirements and feature-specific functionality.

VoLTE Optimized Carrier Aggregation provides the following options to improve VoLTE retainability:

— Deconfiguration of UL and DL SCells during VoLTE Calls

— Deconfiguration of UL component carriers in SCell and suppression of DL SCells during VoLTE Calls

— Deconfiguration of UL SCell and maintenance of DL SCells during VoLTE Calls

Note: When the Mission-Critical Push-to-Talk feature is activated, all processes and criteria in this feature operation regarding VoLTE also apply to PTT.

Feature Operation Sequence Diagram

See Figure 1 for a summary of steps executed for SCell handling in the case of SCells freezing during VoLTE calls.

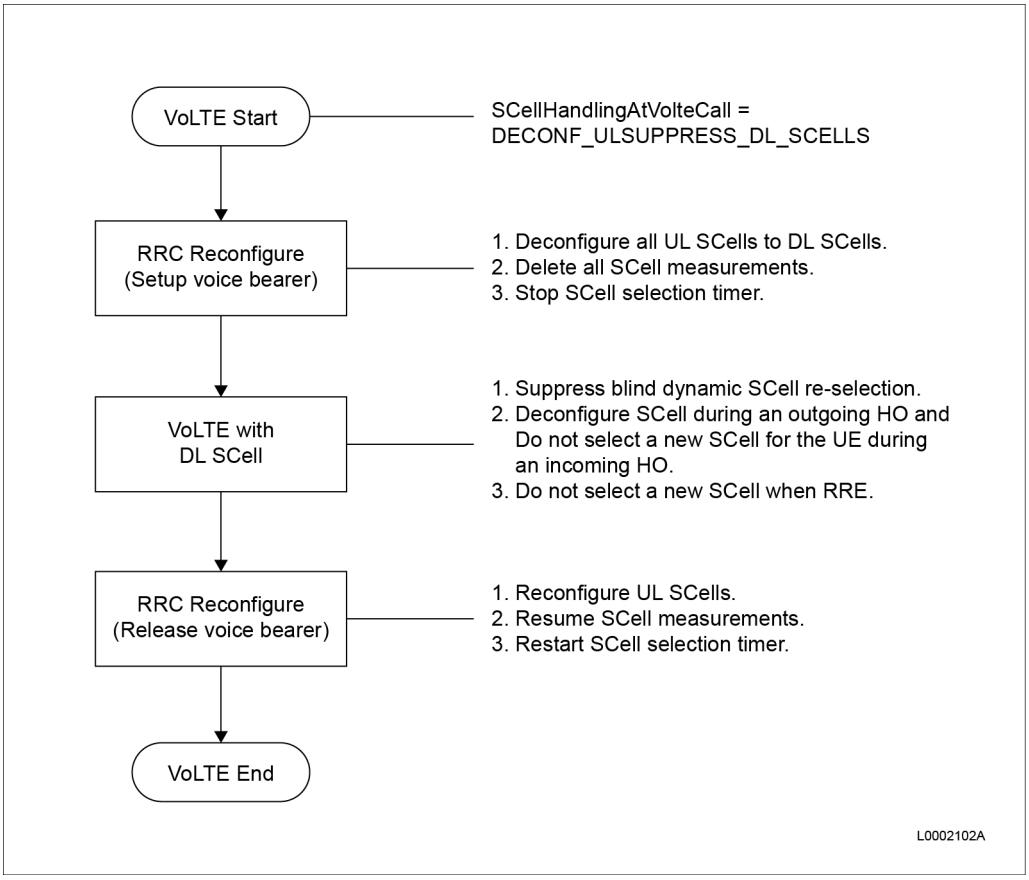

Figure 1 SCell Handling in the Case of SCells Freezing During VoLTE Calls

Process of SCell Handling

The following steps detail the process of SCell handling during VoLTE call, with an active VoLTE Optimized Carrier Aggregation feature:

1. SCells are deconfigured.
2. UL SCell is deconfigured and DL SCells are suppressed.
3. UL SCell is deconfigured. Measurement events on all SCells are deleted.
    a. The UL and DL SCells are reconfigured at Voice bearer setup.
    b. The UL component carriers in SCell are deconfigured and measurement events on DL SCell and SCell reselection timer are deleted.
    c. The dynamic SCell reselection is suppressed during the VoLTE call.
    d. The SCells are deconfigured at outgoing handover.
    e. The SCells are not configured at incoming handover.

f. No SCell is configured at RRE for UE with voice bearer.

4. UL SCell is reconfigured when VoLTE call ends:

   a. Reconfigure the DL SCells to UL and DL SCells of the UE at voice bearer release.

   b. Measurements on all SCells are resumed and SCell reselection timer is restarted.

3.1 Feature-Specific Functionalities

This section contains a list of procedures that trigger VoLTE Optimized Carrier Aggregation.

The VoLTE Optimized Carrier Aggregation feature operates when a voice bearer with `serviceType=VOIP` is established by an E-RAB setup request from the MME, an Incoming handover, or a re-establishment. The feature also supports the inclusion of VOIP bearer in the initial context setup procedure.

The VoLTE Optimized Carrier Aggregation feature can be triggered when the eNodeB receives a VOIP bearer request in the following procedures:

— E-RAB setup

— Incoming Handover

— RRC Connection Re-establishment

— Initial Context Setup

The feature can also be triggered when the voice bearer is released in the E-RAB release procedure.

3.1.1 E-RAB Setup including VOIP bearer

This section shows how VoLTE Optimized Carrier Aggregation feature interacts with E-RAB Setup including VOIP bearer.

When a bearer setup with `serviceType=VOIP` is requested in E-RAB setup request from MME, eNodeB performs the following operations based on the value of `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall`:

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_SCELLS`, the eNodeB deconfigures all UL and DL SCells configured for the UE and measurements related to the SCells.

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_UL_SCELLS`, the eNodeB

deconfigures the UL SCell and measurements related to the UL SCell while the DL SCells for the UE are kept during an active voice bearer service.

The setup of voice bearer and removal of measurements related to CA and SCell are handled with a single RRC connection reconfiguration message to reduce the number of RRC signaling.

3.1.2 Handover for UE Having VOIP Bearer

This section shows how VoLTE Optimized Carrier Aggregation feature interacts with Handover for UE Having VOIP Bearer.

When an incoming handover request is received by the eNodeB and the incoming UE has a voice bearer with `serviceType=VOIP`, eNodeB performs the following operations based on the value of `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall`:

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_SCELLS`, the eNodeB does not configure the UL and DL SCells for the UE during the initial SCell Selection procedure.

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_UL_SCELLS`, the eNodeB configures the SCells with DL only and no UL for the UE during initial SCell selection. All DL SCells for the UE are kept during an active voice bearer service.

These are applied to X2, S1, and Intra eNB handover cases as well.

Note: If the VOIP bearer is released as a result of path switch due to path switch failure, the eNodeB configures UL SCell for the UE by reconfiguring the DL SCells into UL and DL SCells.

3.1.3 RRC Connection Re-Establishment for UE Having VOIP Bearer

This section shows how VoLTE Optimized Carrier Aggregation feature interacts with RRC Connection Re-establishment for UE Having VOIP Bearer.

When the UE having voice bearer with `serviceType=VOIP` re-establishes the RRC connection, eNodeB performs the following operations based on the value of `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall`:

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_SCELLS`, the eNodeB does not configure the UL and DL SCells for the UE during the initial SCell selection procedure.

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_UL_SCELLS`, the eNodeB

configures the SCells with DL only and no UL for the UE during initial SCell selection. This means that DL SCells for the UE are kept during an active voice bearer service.

This is also applied to Inter eNB and Intra eNB RRC Connection Re-establishment cases.

Note: If the VOIP bearer is released as a result of path switch due to path switch failure, the eNodeB configures UL SCell for the UE by re-configuring the DL SCells into UL and DL SCells.

3.1.4 Initial Context Setup including VOIP bearer

This section shows how the VoLTE Optimized Carrier Aggregation feature interacts with initial the context setup including VOIP bearer.

When a bearer setup with `serviceType=VOIP` is requested in Initial Context Setup request from MME, eNodeB performs the following operations based on the value of `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall`:

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_SCELLS`, the eNodeB does not configure the UL and DL SCells for the UE during the initial SCell selection procedure.

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_UL_SCELLS`, the eNodeB configures the SCells with DL only and no UL for the UE during initial SCell selection. The DL SCells for the UE are kept during an active voice bearer service.

3.1.5 E-RAB Release including VOIP bearer

This section shows how VoLTE Optimized Carrier Aggregation feature interacts with E-RAB release including VOIP bearer.

When the release of VOIP bearer is requested in E-RAB release command from MME, eNodeB performs the following operations based on the value of `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall`:

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_SCELLS`, the eNodeB reconfigures UL and DL SCells for the UE by triggering the initial SCell selection procedure.

— If `EUtranCellFDD.sCellHandlingAtVolteCall` or `TDD.sCellHandlingAtVolteCall` is set to `DECONF_UL_SCELLS`, the eNodeB reconfigures UL and DL SCells from configured DL SCells for the UE by UL SCell priority.

Reconfiguration of UL and DL SCells and release of voice bearer are handled with a single RRC connection reconfiguration message to reduce the number of RRC signaling.

Note: If the UL cannot be removed, for example, when it is not supported by the UE capability or 3GPP standard, the UL SCell is not deconfigured to avoid unsupported UE capability or non-standard Carrier Aggregation band combination. Likewise, UL SCell can be added only when it is valid to add UL SCell.

4 Network Impact of VoLTE Optimized Carrier Aggregation

This section describes how the VoLTE Optimized Carrier Aggregation feature impacts network functions and capabilities.

Capacity and Performance

The VoLTE Optimized Carrier Aggregation improves the retainability of the VOIP bearer in the following ways:

— Deconfiguring all SCells and measurements related to CA and SCell while maintaining the voice bearer service.

— Deconfiguring only the UL SCell and measurements related to UL CA and SCell, while maintaining the voice bearer service.

These ways can affect the UL and DL throughput (or only the UL throughput) depending on the session time of the voice bearer service.

The feature provides improved KPI for retainability of VOIP bearer and the KPI *Retainability Percentage per QCI Lost* on Carrier Aggregation.

Interfaces

No impact.

Other Network Elements

No impact.

5 Parameters of VoLTE Optimized Carrier Aggregation

This section describes two parameters introduced by the VoLTE Optimized Carrier Aggregation and parameters affected by activating the feature.

Feature Configuration Parameters

The following parameters are used by the VoLTE Optimized Carrier Aggregation to configure SCell handling during VoLTE call:

— `EUtranCellFDD.sCellHandlingAtVolteCall`

— `EUtranCellTDD.sCellHandlingAtVolteCall`

Affected Parameters

The implementation of this feature affects no parameters.

Parameters Affecting the Feature

No impact.

6 Performance of VoLTE Optimized Carrier Aggregation

This section describes performance indicators, counters, and events associated with the VoLTE Optimized Carrier Aggregation feature.

KPIs

The table lists the main KPIs associated with the feature, and the expected impact.

Table 2 Key Performance Indicators

KPI	Description
E-RAB Retainability - Percentage per QCI Lost	This KPI measures the impact on the end user to reflect the percentage of established E-RAB that are lost with an abnormal release.
Average DL PDCP Cell Throughput	During voice bearer service, there is a possible decrease of DL throughput caused by deconfiguration of DL SCells.
Average UL PDCP Cell Throughput	During voice bearer service, there is a possible decrease of UL throughput caused by deconfiguration of UL Scell.
VoLTE Retainability	VoLTE retainability on Carrier Aggregation is improved by deconfiguring all UL and DL SCells or only UL SCell and measurements related to CA and SCell or UL CA and SCell during an active voice bearer service

Counters

The following counters in MO Class `EUtranCellFDD` and `EUtranCellTDD` are associated with the feature VoLTE Optimized Carrier Aggregation:

— `pmCaDeconfiguredVolte`

— `pmErabRelAbnormalEnbActQci`

— `pmErabRelAbnormalEnbActUeLostQci`

— `pmCaDeconfiguredVolte`

— `pmPdcpVolDlDrb`

— `pmSchedActivityCellDl`

— `pmPdcpVolUlDrb`

— `pmSchedActivityCellUl`

Events

Table 3 Events Related to VoLTE Optimized Carrier Aggregation

Event	Event Parameter	Description
INTERNAL_EVENT_RRC_SCELL_DECONFIGURED	EVENT_VALUE_VOIP_SETUP	SCell deconfigured due to VOIP setup.

7 Activate VoLTE Optimized Carrier Aggregation

This section describes prerequisites and steps to activate the VoLTE Optimized Carrier Aggregation.

Prerequisites

— The license key is installed in the Node

— CCTR is activated at least for a week. This ensures that troubleshooting data is available if something goes wrong.

Steps

1. Set the attribute `featureState` to `ACTIVATED` in the applicable MO instance, depending on node type:

Node Type	License Control MO
DU-based	`OptionalFeatureLicense= VoLTEOptimizedCA`
Baseband-based Node	`FeatureState= CXC4012259`

After This Task

Let the CCTR be active for one week, for continued collection of troubleshooting data.

8 Deactivate VoLTE Optimized Carrier Aggregation

This section describes steps to deactivate VoLTE Optimized Carrier Aggregation.

Prerequisites

CCTR is activated at least for a week. This ensures that troubleshooting data is available if something goes wrong.

Steps

1. Set the attribute `featureState` to `DEACTIVATED` in the applicable MO instance, depending on the following node type:

Node Type	License Control MO
DU-based	`OptionalFeatureLicense= VoLTEOptimizedCA`
Baseband-based	FeatureState= CXC4012259

After This Task

Let the CCTR be active for one week, for continued collection of troubleshooting data.

9 Engineering Guidelines

This section describes the parameter that activates the VoLTE Optimized Carrier Aggregation.

VoLTE Optimized Carrier Aggregation is a licensed feature.

The parameter `sCellHandlingAtVolteCall` is used to configure SCell handling during VoLTE call and is applicable for both EUtranCellFDD and EUtranCellTDD, see Table 4.

Table 4 Parameter for VoLTE Optimized Carrier Aggregation Feature Activation

Parameter	Description
`EUtranCellFDD.sCellHandlingAtVolteCall` `EUtranCellTDD.sCellHandlingAtVolteCall`	Manages SCell handling during VoLTE calls based on the following Enum values: **Value 0 `KEEP_SCELLS`** Default value. No changes in SCell handling. **Value 1 `DECONF_SCELLS`** Deconfigures SCells during VoLTE calls. **Value 2 `DECONF_UL_SUPPRESS_DL_SCELLS`** Deconfigures UL component carriers inSCell and suppresses DL SCell selection during VoLTE calls. **Value 3 `DECONF_UL_SCELLS`** Deconfigures UL SCells during VoLTE calls. No changes in DL SCell handling.