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Carrier Aggregation

Commercial Product Description

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Contents

1 Carrier Aggregation Identity

Value Package Identity:	FAJ 801 0405
Introduced In:	L17.Q4
Standards:	36.331, 36.321, 36.101 - Release 10 and onwards

2 Benefits of Carrier Aggregation

Carrier Aggregation increases user bandwidth by combining carriers, resulting in higher speed for users across the network. Carriers on the same or different frequency bands can be combined, allowing operators with fragmented, non-contiguous spectrum to compete against those with larger contiguous allocation.

Higher peak bit rates: combining two component carriers of 20 MHz each allows to reach bit rates up to 300 Mbps.

Improved app coverage: Carrier Aggregation improves bit rates for all users with Carrier Aggregation capable device, even in poor radio conditions.

Increased network capacity: an aggregated carrier provides 5-30% higher capacity compared to that of two individual carriers.

3 Carrier Aggregation Business Values

Revenue Growth: Reduced Churn

Improved customer satisfaction.

Increased app coverage increases customer satisfaction and thus reduces churn.

Revenue Growth: Greater Usage

Increased revenues.

Increased user speeds drive data consumption and therefore can increase wireless data revenues.

OPEX Reduction: Improved Spectrum Efficiency

Increased sector capacity.

A Carrier Aggregation enabled sector provides higher aggregate capacity than separate carriers.

4 Included Functions

4.1 3CC DL Carrier Aggregation Extension Overview

The 3CC DL Carrier Aggregation Extension feature can transmit data to a single UE on three carriers simultaneously. This leads to increased downlink speed and improved end-user experience.

Access type:	LTE
Feature Identity:	FAJ 121 3084
Value Package Name:	Carrier Aggregation
Value Package Identity:	FAJ 801 0405
Node Type:	Baseband Radio Node
	DU Radio Node
Licensing:	Licensed feature. One license per radio.

Summary

The benefit of the 3CC DL Carrier Aggregation Extension feature is the capability to transmit data to a single UE on three carriers simultaneously.

In addition, support is added for the new band combination signaling according to 3GPP TS 36.331. The new band combination signaling enables UEs supporting more than 128 band combinations to provide all relevant band combinations to the eNodeB. The UE only reports carrier aggregation band combinations for specific bands requested by the eNodeB. This is instead of reporting all the supported carrier aggregation band combinations.

By supporting a higher number of MIMO layers, a higher spectrum efficiency with higher peak downlink throughput can be achieved.

The maximum number of MIMO layers can be configured for the UE up to the following:

— Corresponding capacity and peak rate limitations of the eNodeB DU platform.

— Corresponding capacity and peak rate limitations of the UE capabilities.

Note: To reach peak rate limitations, the UE has to support the system configurations shown in Table 1.

The main benefits of the feature are the following:

— Increased downlink speed across the coverage area.

— More efficient use of scattered spectrum, making it possible to combine three chunks of bandwidth instead of only two.

— Improved end-user experience by achieving peak throughput based on system configurations, number of component carriers and TX layers in unit of Mbps at the physical layer. See details in Table 1.

— For TDD only: Provides clearer information for HARQ-ACK feedback information which leads to lower BLER and more stable and higher downlink throughput.

— A higher number of MIMO layers is also supported on both DUS31 and DUS41. The peak throughput depends on the existing DUS41 capabilities.

Table 1 Peak Throughput Based on System Configurations

	Number of TX Layers	64-QAM			256-QAM		
Number of Component Carriers		1CC	2CC	3CC	1CC	2CC	3CC
FDD	2	150	300	450	195	391	587
	4	300	600	899	391	783	1174
TDD UL/DL Configuration 2 (SSF7)	2	110	220	330	143	285	428
	4	213	426	N/A	286	560	700
TDD UL/DL Configuration 2 (SSF6)	2	108	216	324	139	279	418
	4	208	416	N/A	279	546	700

Additional Information

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

— *3GPP TS 36.331*

— *3GPP TS 36.211*

— *3GPP TS 36.212*

— *3GPP TS 36.213*

— *3GPP TS 36.101*

— Dynamic SCell Selection for Carrier Aggregation

— 4x4 Quad Antenna Downlink Performance Package

— 256-QAM Downlink

4.2 4CC DL Carrier Aggregation Extension Overview

The 4CC DL Carrier Aggregation Extension feature adds the capability to transmit downlink data to a UE on four carriers simultaneously

Access Type:	LTE
Feature Identity:	FAJ 121 4466
Value Package Name:	Carrier Aggregation
Value Package Identity:	FAJ 801 0405
Node Type:	Baseband Radio Node
	DU Radio Node
Licensing:	Licensed feature. One license required for each node.

Summary

The main benefits of the feature are the following:

— Increased downlink speed across the coverage area

— More efficient use of scattered spectrum, making possible to combine four chunks of bandwidth for one UE

— Improved end-user experience by achieving peak throughput based on system configurations, number of component carriers and TX layers

The feature provides support for the new band combination signaling according to 3GPP TS 36.331 and TS 36.101. The new band combination signaling enables UEs supporting more than 128 band combinations to provide all relevant band combinations to the eNodeB. The UE only reports carrier aggregation band combinations for specific bands requested by the eNodeB, instead of reporting all the supported carrier aggregation band combinations.

By supporting higher number of MIMO layers, a higher spectrum efficiency with higher peak downlink throughput can be achieved.

The maximum number of MIMO layers that can be configured for the UE depends upon the following:

— Corresponding capacity and peak rate limitations of the eNodeB DU or Baseband platform.

— Corresponding capacity and peak rate limitations of the UE capabilities.

For FDD, the maximum number of supported MIMO layers is 16.

Note: To reach peak rate limitations, the UE has to support the system configurations.

Table 2 Peak Throughput Based on System Configurations (in Mbps at the Physical Layer)

	Number of TX Layers	64-QAM				256-QAM			
Number of Component Carriers		1CC	2CC	3CC	4CC	1CC	2CC	3CC	4CC
FDD	2	150	300	450	600	201	403	605	807
	4	300	600	899	1198(1)	403	807	1211	1615(1)
TDD UL/DL Configuration 2 (specialSubframe Pattern = 7)	2	110	224	337	449	143	285	428	1145
	4	213	426	639	852(1)	286	572	859	859(1)
TDD UL/DL Configuration 2 (specialSubframe Pattern = 6)	2	108	216	324	432	139	279	418	556
	4	208	416	631	842(1)	279	558	837	1116(1)

(1) Based on 16 layers configuration, with 4CC, 20-MHz bandwidth.

Additional Information

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

— *3GPP TS 36.331*

— *3GPP TS 36.211*

— *3GPP TS 36.212*

— *3GPP TS 36.213*

— *3GPP TS 36.101*

— Carrier Aggregation

— Dynamic SCell Selection for Carrier Aggregation

— 3CC DL Carrier Aggregation Extension

— 4x4 Quad Antenna Downlink Performance Package

— 256-QAM Downlink

— Configurable SCell Priority

— Carrier Aggregation FDD-TDD

— Carrier Aggregation-Aware IFLB

— Supplemental Downlink for Carrier Aggregation

— 3CC DL Carrier Aggregation Extension

— Uplink Carrier Aggregation

— Cross-DU Carrier Aggregation Support

— Multiple Frequency Band Indicators

— Elastic RAN

4.3 5CC DL Carrier Aggregation Extension Overview

Access Type:	LTE
Feature Identity:	FAJ 121 4467 R3
Value Package Name:	Carrier Aggregation
Value Package Identity:	FAJ 801 0405
Node Type:	Baseband Radio Node
Licensing:	Licensed feature. One license per node.

Summary

The 5CC DL Carrier Aggregation Extension feature adds the capability to transmit downlink data to a UE on five carriers simultaneously.

The maximum number of MIMO layers can be configured for a UE up to the corresponding capacity and peak rate limitations of the eNodeB DU platform and UE capabilities. By supporting a higher number of MIMO layers, a higher spectrum efficiency with higher peak downlink throughput can be achieved.

Note: To reach peak rate limitations, the UE has to support the system configurations as shown in Table 3.

The 5CC DL Carrier Aggregation Extension feature supports duplex mode FDD , TDD , mix of FDD and TDD (FDD as PCell) with a maximum of 12 MIMO layers.

The peak DL throughput depends on the 5CC duplex mode configuration and type of carrier aggregation deployment (Intra, Inter-eNB or Elastic RAN).

The main benefits of this feature are the following:

— Provides the capability to transmit data to a single UE on five carriers simultaneously, up to a total bandwidth of 100 MHz.

— Facilitates a more efficient use of scattered spectrum by making it possible to combine up to five components of LTE spectrum.

— Higher maximum UE downlink throughput due to an additional component carrier (subject to UE Category limits).

— A given maximum UE downlink throughput can be reached with narrower bandwidth carriers than with 3CC or 4CC.

— Higher average UE downlink by supporting a higher number of MIMO layers, a higher spectrum efficiency with throughput because of an additional component carrier.

— The radio channel requirements for realizing peak UE downlink throughput near 1.2 Gbps are less stringent. With 4CC, peak UE downlink throughput near 1.2 Gbps requires one carrier supporting 4-layer transmission, and the others supporting only 2-layer transmissions. An approximately 1.2 Gbps peak UE downlink throughput can be achieved with 5CC, if 20 MHz carriers are used. This enables the peak to be maintained over a greater range of channel conditions.

— With the Supplemental Downlink with License-Assisted Access feature, the mixed combination of licensed FDD and LAA SCells is supported on 5 CC DL Carrier Aggregation. This combination enables the use of mixed licensed and unlicensed spectrums in Carrier Aggregation.

— Provides more carrier aggregation candidates.

Table 3 Peak Throughput Based on System Configurations

	Number of TX Layers	64-QAM					256-QAM				
Number of Component Carriers		1CC	2CC	3CC	4CC	5CC	1CC	2CC	3CC	4CC	5CC
FDD	2	150	300	450	600	750	195	391	587	783	979
	4	300	600	899	900 (1)	900 (1)	391	783	1174	1174 (1)	1174 (1)
TDD UL/DL Config 2 (SSF 7)	2	110	220	330	440	550	143	285	428	580	720
	4	213	426	639	639 (1)	639 (1)	286	572	859	859 (1)	859 (1)

(1) Based on 12 layers configuration, 20 MHz bandwidth.

4.4 Carrier Aggregation FDD-TDD Overview

Access Type:	LTE
Feature Identity:	FAJ 121 4252
Value Package Name:	Carrier Aggregation
Value Package Identity:	FAJ 801 0405
Node Type:	Baseband Radio Node DU Radio Node

Licensing:	Licensed feature. One license for each node.

Summary

The Carrier Aggregation FDD-TDD feature allows downlink traffic to be offloaded on the TDD spectrum without being constrained by the limited uplink application coverage of a TDD carrier. Instead, a UE can be served by the larger range FDD uplink while still enjoying the substantial downlink performance boost provided by the TDD carrier.

Figure 1 shows an over-the-air drive measurement and illustrates the coverage extension of the TDD spectrum when combined with FDD in carrier aggregation.

Note: The TDD spectrum provides a substantial DL performance improvement, well beyond the traditional coverage point of a TDD carrier not used in carrier aggregation with FDD.

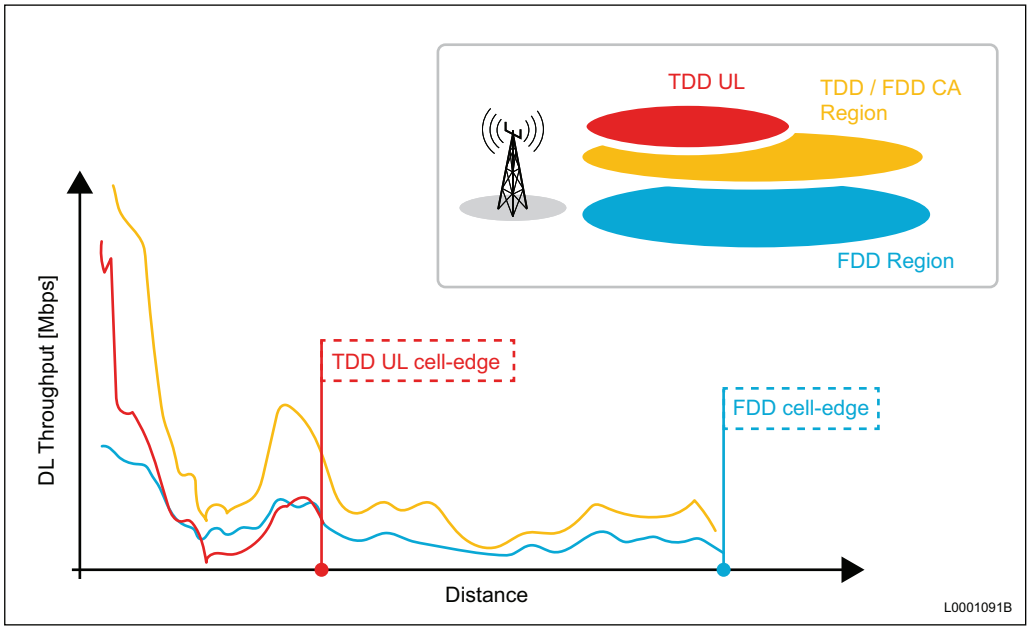

Figure 1 Extending TDD Coverage

In sites where operators have access to both FDD and TDD spectra, the Carrier Aggregation FDD-TDD feature enables both spectrum resources to be used. The use of both spectrum resources improves system performance and end-user experience.

For more information about benefits of carrier aggregation in general, see Carrier Aggregation.

Carrier Aggregation FDD-TDD provides the following benefits:

— Extends TDD downlink coverage and provides user data rate gains by using the uplink of FDD carriers. As uplink HARQ feedback is sent on FDD carriers, TDD HARQ bundling is not required.

— Increases user peak throughput by combining FDD and TDD data rates.

— Supports asymmetric traffic.

The Carrier Aggregation FDD-TDD feature supports the following characteristics:

— 2CC DL CA, where the PCell is FDD and the SCell can be FDD or TDD.

— 3CC DL CA, where the PCell is FDD and the SCells can be FDD, TDD, or a mix of FDD and TDD.

— 4CC DL CA, where the PCell is FDD and the SCells can be FDD, TDD, or a mix of FDD and TDD.Dynamic SCell Selection for Carrier Aggregation

— 5CC DL CA, where the PCell is FDD and the SCells can be FDD, TDD, or a mix of FDD and TDD.

— FDD-TDD CA is not available for Category 5 UEs with DL 4x4 MIMO feature active on the ENodeB, regardless of the actual number of layers used in the transmission.

— TDD cells configured with Transmission Modes (TM) 7, 8, and 9 are overridden to TM3 when used as SCells.

— Dynamic switching between TM3 and TM4 is not available for SCells.

Additional Information

— *3GPP TS 36.101*

— *3GPP TS 36.211*

— *3GPP TS 36.212*

— *3GPP TS 36.213*

— *3GPP TS 36.321*

— *3GPP TS 36.331*

— Carrier Aggregation

— 3CC DL Carrier Aggregation Extension

— 4CC DL Carrier Aggregation Extension

— 5CC DL Carrier Aggregation Extension

— Dynamic SCell Selection for Carrier Aggregation

— Multiple Frequency Band Indicators

— Inter-eNodeB Carrier Aggregation

— Elastic RAN

4.5 Carrier Aggregation Overview

Access Type:	LTE
Feature Identity:	FAJ 121 3046
Value Package Name:	Carrier Aggregation
Value Package Identity:	FAJ 801 0405
Node Type:	Baseband Radio Node DU Radio Node
Licensing:	Licensed feature. One license per node.

Summary

The benefit of the Carrier Aggregation feature is that it enables data to be simultaneously transmitted on two bands to a single UE. The main benefits of Carrier Aggregation are the following:

— Increased downlink speed across the coverage area

— More efficient use of scattered spectrum

— Higher capacity

The Carrier Aggregation feature supports the following characteristics:

— Up to four downlink component carriers

— For 3 MHz, up to two downlink component carriers

— Statically configured secondary component carrier

— Up to two uplink component carriers

— Mixed Transmission Mode supported between carriers

— Same downlink and uplink subframe configuration for two aggregated TDD carriers

Note: If the Cross-DU Carrier Aggregation Support feature is enabled, then different special subframe patterns are allowed for a PCell and SCell that are spread over two DUs.

— Dynamic activation or deactivation of secondary component carrier

— No cross-carrier scheduling

— Inter-band aggregation

— Contiguous intra-band carrier aggregation between TDD carriers

— Non-contiguous intra-band carrier aggregation

— Intra- and Inter-LTE Mobility

— FDD only: for 3 MHz carrier bandwidth

Note: Carrier Aggregation is not supported in 3 MHz for Elastic RAN, or Inter-eNodeB CA features.

Figure 2 shows the UE configuration supported by Carrier Aggregation. For a UE that supports 3GPP release 8, 9, or both, each carrier configuration appears as an LTE release 8 carrier, whereas a UE capable of Carrier Aggregation can exploit the total aggregated bandwidth for up to two downlink carrier configurations. For more details about Carrier Aggregation configuration and setup of secondary carriers, refer to *3GPP TS 36.331*.

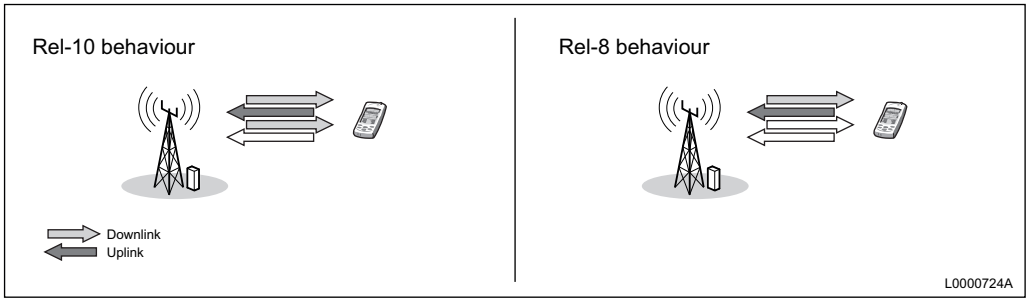

Figure 2 UE Configurations Supported by Carrier Aggregation. The Left-Hand Figure Shows the Asymmetric Two-Downlink and One-Uplink Case. The Right-Hand Figure Shows the Legacy Case.

A UE configured for carrier aggregation has one PCell and one SCell. The PCell is the cell where the UE is connected, has established the RRC connection, and is operating on the primary frequency. The SCell operates on a secondary frequency and can be configured once the RRC connection is established.

Note: If Cell Sleep Mode feature is active, it can affect the Carrier Aggregation feature. If, for example, all SCell candidates are capacity cells that have sleep mode enabled, the carrier aggregation capability is disabled when all capacity cells enter sleep mode. Also, if the PCell is a capacity cell with sleep mode enabled, the CA capability of a UE ends as the UE moves out of the cell when the cell enters sleep mode.

Intra-Cell Handover to Additional Band is an enhancement to the Multiple Frequency Band Indicators feature. When activated it increases the availability of Carrier Aggregation for UEs not supporting Carrier Aggregation on the primary band, but on the MFBI additional band. More information can be found in Multiple Frequency Band Indicators.

Frequency Band Indicator Priority Rel-12 is another enhancement to the Multiple Frequency Band Indicators feature. When activated, it increases the availability of Carrier Aggregation for UEs supporting band prioritization in two cases. One case is when there are possible CA combinations on the additional band, but not on the primary band, and the other is when there are more possible CA combinations on the additional band. More information can be found in Multiple Frequency Band Indicators.

Additional Information

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

— *3GPP TS 36.331*

— *3GPP TS 36.321*

— *3GPP TS 36.213*

— *3GPP TS 36.101*

— FDD only: Supplemental Downlink for Carrier Aggregation

— Dynamic SCell Selection for Carrier Aggregation

— 3CC DL Carrier Aggregation Extension

— 4CC DL Carrier Aggregation Extension

— 5CC DL Carrier Aggregation Extension

— Cross-DU Carrier Aggregation Support

— Carrier Aggregation FDD-TDD

— FDD only: Enhanced PDCCH Link Adaptation

- Multiple Frequency Band Indicators
- Uplink Carrier Aggregation
- Elastic RAN
- Configurable SCell Priority

4.6 Dynamic SCell Selection for Carrier Aggregation Overview

Access Type:	LTE
Feature Identity:	FAJ 121 3063
Value Package Name:	Advanced Carrier Aggregation, Carrier Aggregation
Value Package Identity:	FAJ 801 0564, FAJ 801 0405
Node Type:	Baseband Radio Node DU Radio Node
Licensing:	Licensed feature. Once license per radio.

Summary

The Dynamic SCell Selection for Carrier Aggregation feature is based on the Carrier Aggregation feature and offers the following functions:

- A cell used as a PCell can have more than one SCell candidate.
- An SCell candidate of a cell can be added or deleted without the need to lock and unlock the cell for the change to take effect.
- Based on L3 measurements and by the SCell selection algorithm, the SCell of a UE is dynamically configured or deconfigured.
- When the number of component carriers is decided, it is not considered whether the UE can support lower subset band combinations. Hence, there is more opportunity for a configuration with higher number of component carriers.
- After successful SCell configuration, any SCell deconfiguration attempt is prevented if it leads to an unsupported UE capability or non-standard Carrier Aggregation band combination.

Additional Information

Find additional information about Dynamic SCell Selection for Carrier Aggregation:

— 3GPP TS 36.331 v 10.5.0

— 3GPP TS 36.306 v 10.9.0

— 3GPP TS 36.133 v 10.11.0

— Carrier Aggregation

— Uplink Carrier Aggregation

4.7 Supplemental Downlink for Carrier Aggregation Overview

Access Type:	LTE
Feature Identity:	FAJ 121 3068
Value Package Name:	Carrier Aggregation
Value Package Identity:	FAJ 801 0405
Node Type:	Baseband Radio Node DU Radio Node
Licensing:	Licensed feature. Once license per radio.

Summary

A cell typically consists of two component carriers: uplink and downlink. Supplemental downlink only cells are an exception where there is only a downlink component carrier.

For FDD, this feature allows a carrier aggregation capable UE to use the supplemental downlink only cell as a secondary component carrier. The Supplemental Downlink for Carrier Aggregation feature makes it possible to add and unlock a `EUtranCellFDD` with only a downlink carrier, for example Band 29. This means that no uplink carrier is needed. The downlink only cell is utilized as a downlink secondary cell by the Carrier Aggregation feature.

Additionally, an FDD or TDD cell which has been configured as barred through setting parameter `cellBarred` (`EUtranCellFdd.cellBarred` or `EUtranCellTdd.cellBarred`) = 1 (BARRED), can also be used as an SCell when the Supplemental Downlink for Carrier Aggregation feature is active and the cell is configured as an SCell candidate.

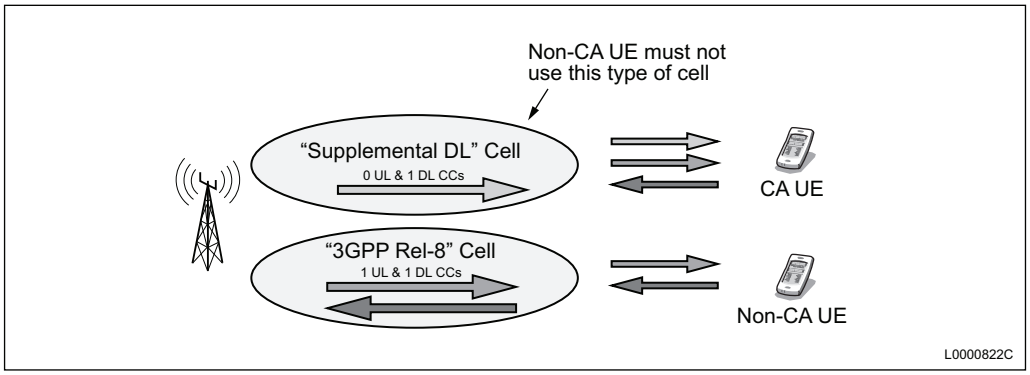

Figure 3 The Carrier Aggregation Function

The Dynamic SCell Selection for Carrier Aggregation and Supplemental Downlink for Carrier Aggregation features can operate together.

The main benefits of Supplemental Downlink for Carrier Aggregation are the following:

— Spectrum utilization on bands defined as downlink only, for example: Band 29 using `Carrier Aggregation`

— Increased downlink User Equipment (UE) peak throughput

— Increased aggregated downlink throughput and capacity

Additional Information

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

— *3GPP 36.104 V11.4.0, Band 29*

4.8 Supplemental Downlink with License-Assisted Access Overview

Access Type:	LTE
Feature Identity:	FAJ 121 4573
Value Package Name:	Carrier Aggregation
Value Package Identity:	FAJ 801 0405
Node Type:	Baseband Radio Node
Licensing:	Licensed feature. One license per node.

Summary

LAA expands LTE connectivity in the unlicensed 5 GHz band. The unlicensed spectrum can be shared by other access technologies, such as Wi-Fi.

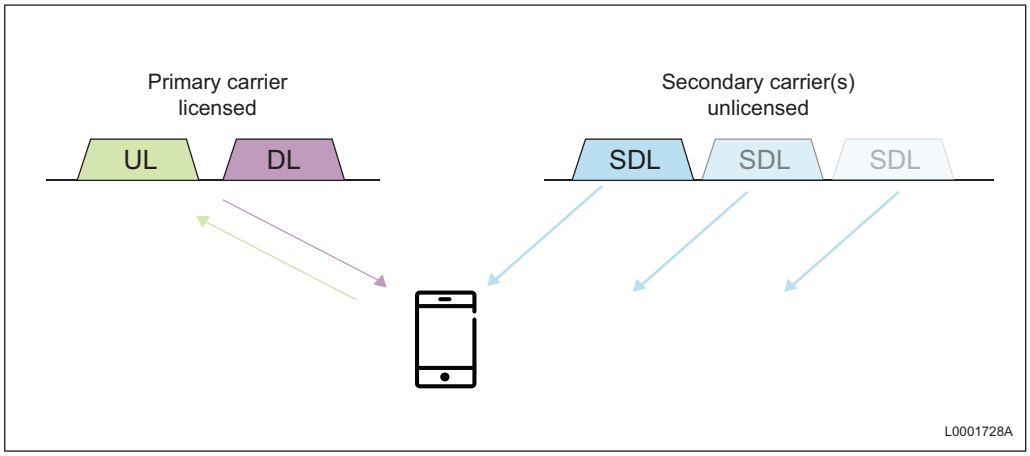

Figure 4 Principle of Licensed-Assisted Access with Three SCells

The Supplemental Downlink with License-Assisted Access feature has the following specifics:

— Dynamic Channel Selection (DCS) functionality which enables the eNodeB to automatically select suitable LAA carrier frequencies from the allowed frequencies in the unlicensed spectrum.

— LAA that requires a primary carrier for control signaling.

— Supplemental Downlink with License-Assisted Access that is based on the legacy Carrier Aggregation feature.

— A suitable LAA carrier frequency that is the one less occupied with interfering traffic

— The Carrier Aggregation LAA SCells that are "downlink only" Supplemental Downlinks.

— LAA cells that can be configured as external cells

— Up to three LAA SCells can be configured.

The benefits include the following:

— In areas with LAA deployment, it is suggested to make the licensed spectrum available for other purposes.

— There is a large amount of bandwidth available in the unlicensed 5 GHz band, which can be used for mobile broadband and to increase downlink data throughput.

— DCS enables the eNodeB to automatically select suitable LAA carriers from the allowed frequencies in the unlicensed spectrum.

In the unlicensed 5 GHz spectrum, there are regulations on how the spectrum can be used. An LBT algorithm is required to ensure that the carrier is free before transmission. LBT is performed in the radio, and when it senses that there is no interfering traffic, data is transmitted.

Supplemental Downlink with License-Assisted Access cell is supported for 4x4 MIMO.

Additional Information

LAA is introduced in 3GPP Release 13, and the updated 3GPP specifications are the following:

— TS 36.331 Radio Resource Control (RRC); Protocol specification

— TS 36.211 Physical channels and modulation

— TS 36.212 Multiplexing and channel coding

— TS 36.213 Physical layer procedures

4.9 Uplink Carrier Aggregation Overview

Identity:	FAJ 121 4425
Licensing:	Licensed feature. One license per node.
Introduced in:	L16B
Replaces:	N/A
Belongs to:	Carrier Aggregation, FAJ 801 0405

Summary

With UL Carrier Aggregation, the UE can use up to five DL and two UL component carriers at the same time.

A UE is using one cell as PCell and up to four other cells as SCells. The PCell has both a DL and a UL component carrier. The SCells can be supporting either DL and UL or only DL, but not only UL. A cell can be PCell for some UEs and SCell for other UEs.

The main benefits of UL Carrier Aggregation are the following:

— The UE can transmit data on more than one carrier simultaneously

— Up to doubled uplink user throughput

— Increased uplink user average throughput

— Increased app coverage for uplink demanding services

4.10 IDC for Uplink Carrier Aggregation Overview

IDC for Uplink Carrier Aggregation makes it possible for IDC-capable UEs to host multiple radio transceivers in a way that prevents interference between those transceivers.

Feature Identity:	FAJ 121 4894
Value Package Name:	Carrier Aggregation
Value Package Identity:	FAJ 801 0405 R12
Node Type:	Baseband Radio Node, DU Radio Node
Licensing:	Licensed feature. One license per node.

Summary

IDC is the ability to host multiple radio transceivers in the same UE in a way that prevents interference between those transceivers. The UE informs the eNodeB that it experiences radio interference. This makes it possible for the eNodeB to prevent Carrier Aggregation from using SCells on problematic frequencies.

UEs capable of reporting IDC indications addressing Uplink Carrier Aggregation interference declare this capability by the RRC IE `inDeviceCoexInd-UL-CA-r11`, and report detected interference problems using the RRC IEs `VictimSystemType-r11` and `AffectedCarrierFreqCombList-r11`. The eNodeB then remedies the interference problem by disabling inter-band and intra-band uplink grants for the reported problematic frequencies.

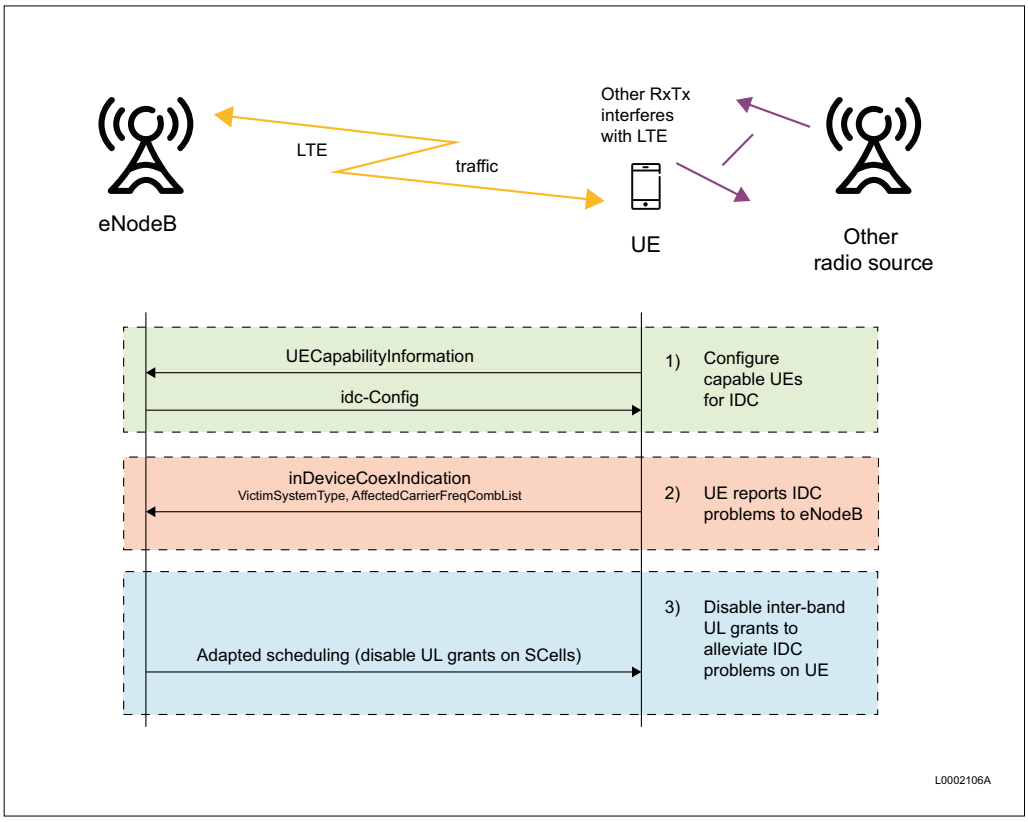

Figure 5 IDC for Uplink Carrier Aggregation Overview

IDC for Uplink Carrier Aggregation has the following main benefits:

— IDC for Uplink Carrier Aggregation capable UEs experience that uplink radio interference from SCells during Uplink Carrier Aggregation operation is significantly reduced.

Note: The benefit only affects the UEs.

— It prevents possible UE malfunction caused by radio interference between transceivers in live networks which can happen when the UE uses Carrier Aggregation to carry uplink data.

— Operators do not need to deactivate the Uplink Carrier Aggregation feature because in some UE devices, harmonic with multiple Uplink Carrier Aggregation transmission causes interference in other device components like GNSS.

Additional Information

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

— *3GPP TS 36.331, Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*

- *3GPP TS 36.101, Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception; Protocol specification*
- *3GPP TS 36.413, Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP); Protocol specification*
- *3GPP TS 36.423, Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 Application Protocol (X2AP); Protocol specification*