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Technical Report

**3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
Evolved Universal Terrestrial Radio Access (E-UTRA);
LTE Advanced Intra-band Non-contiguous Carrier Aggregation
in Band 25 Work Item Technical Report
(Release 12)**



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3GPP

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

<http://www.3gpp.org>

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Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

The present document is a technical report of the LTE Advanced Intra-band Non-contiguous Carrier Aggregation in Band 25 work item which was approved at TSG RAN #53 [2]. The objective of this work item is to provide specification support for intra-band non-contiguous carrier aggregation in LTE FDD Band 25.

The report provides motivation, requirements and a list of recommended changes to the specifications.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] RP-111242: "New WID for Intra-band, Non-contiguous CA for Band 25 for LTE". (revised to RP-130179 at RAN#59 March 2013))

3 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

4 Background

4.1 Task description

The purpose of this WI is:

- Specify the band-combination specific RF requirements for band 25 intra-band non-contiguous CA.
- Finalise the DL with 5 MHz and 10 MHz transmission bandwidths per component carrier (up to 2CC) (see clause 10).
- Add the performance requirements for this band combination in the relevant specifications.

5 Study of E-UTRA requirements

5.1 Operating bands and channel bandwidths

5.1.1 Operating bands for CA

E-UTRA CA for Band 25 is defined to operate in the entire Band 25 range, as defined in Table 5.1.1-1.

Table 5.1.1-1 Intra band CA operating band definition for Band 25

E-UTRA CA Band	E-UTRA Band	Uplink (UL) operating band			Downlink (DL) operating band			Duplex Mode
		BS receive / UE transmit			BS transmit / UE receive			
		FUL_low	–	FUL_high	FDL_low	–	FDL_high	
CA_25A-25A	25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD

5.1.2 Channel bandwidths for CA

Table 5.1.2-1 defines the supported E-UTRA bandwidths for intra-band non-contiguous CA in Band 25. As shown, only 5 and 10 MHz component carrier channel bandwidths are proposed to be supported in Band 25 carrier aggregation.

Table 5.1.2-1: Supported E-UTRA bandwidths for intra-band non-contiguous CA in Band 25

CA operating band / channel bandwidth							
E-UTRA CA Band	E-UTRA Bands	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
CA_25A-25A (Note)	25			Yes	Yes		
NOTE: Combinations of component carriers with unequal channel bandwidth should also be considered. The maximum number of CCs for combination is two.							

Combinations of component carriers with unequal channel bandwidth should also be considered for Band 25, specifically combinations of 5 + 10 MHz.

5.2 Supporting intra-band CA with 1 CC UL

It is proposed to support the case of a UE capable of 2 CC on the DL and 1 CC on the UL

5.2.1 Co-existence studies for 1 UL/2 DL

The 2nd and 3rd order harmonics and IMD products caused in the BS by transmitting of Band 25 non-contiguous DL carriers can be calculated as shown in Table 5.2.1-1 below:

Table 5.2.1-1: Band 25 non-contiguous DL harmonics and IMD products

BS DL carriers	f-low	f-high
DL frequency (MHz)	1930	1995
2nd harmonics frequency limits (MHz)	3860	3990
3rd harmonics frequency limits (MHz)	5790	5985
2nd order IMD products	(f-low – f-high)	(f-high – f-low)
IMD frequency limits (MHz)	-65	65
3rd order IMD products	(2*f-low – f-high)	(2*f-high – f-low)
IMD frequency limits (MHz)	1865	2060

It can be seen from Table 5.2.1-1 that the 2nd and 3rd harmonics as well as the 2nd IMD products of BS transmitting non-contiguous carriers in Band 25 do not fall into the BS receive band of any operating band, while the 3rd IMD products of BS supporting non-contiguous carrier aggregation of Band 25 may fall into the BS receive band of Bands 1,

2, 23, 25, 33, 34, 35, 36, 37 and 39. Note that the calculation in Table 5.2.1-1 assumes the BS is transmitting with the whole 65 MHz DL frequency of Band 25.

Assume that the 2 non-contiguous CC transmitted by the Band 25 BS are a and b MHz channel bandwidth and c and d MHz from the edges of Band 25 DL frequency band as shown in Figure 5.2.1-1 below:

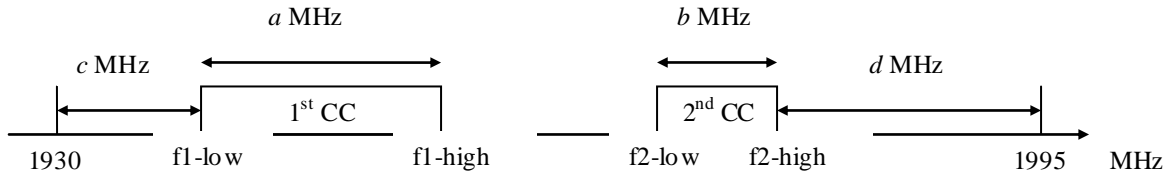


Figure 5.2.1-1: Non-contiguous CC transmitted by the Band 25 BS

And the corresponding BS receive blocks are as shown in Figure 5.2.1-2 below:

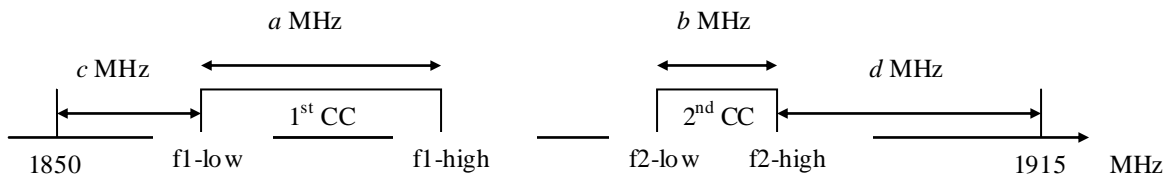


Figure 5.2.1-2: Non-contiguous CC received by the Band 25 BS

Then the 3rd order IMD products caused in the BS by transmitting of the 2 CC can be calculated as shown in Table 5.2.1-2 below:

Table 5.2.1-2: Band 25 BS DL 3rd order IMD products

3rd order IMD products	IMD frequency limits (MHz)
$(2 \cdot f1\text{-low} - f2\text{-high})$	$1865 + 2 \cdot c + d$
$(2 \cdot f1\text{-high} - f2\text{-low})$	$1865 + 2 \cdot c + d + 2 \cdot a + b$
$(2 \cdot f2\text{-low} - f1\text{-high})$	$2060 - 2 \cdot d - c - 2 \cdot b - a$
$(2 \cdot f2\text{-high} - f1\text{-low})$	$2060 - 2 \cdot d - c$
$(f1\text{-low} - f2\text{-high} + f2\text{-low})$	$1930 + c - b$
$(f1\text{-high} + f2\text{-high} - f2\text{-low})$	$1930 + c + b + a$
$(f2\text{-low} - f1\text{-high} + f1\text{-low})$	$1995 - d - a - b$
$(f2\text{-high} + f1\text{-high} - f1\text{-low})$	$1995 - d + a$

Comparing the IMD frequency limits in Table 5.2.1-2 with the BS receive blocks in Figure 5.2.1-2, it can be deduced that the 3rd order IMD products caused in the BS by transmitting of the 2 CC will only fall into the BS own receive blocks of Band 25 under one of the transmit configurations shown in Table 5.2.1-3 below (note that a and b can only be 5 or 10 as stated in the WIDS):

Table 5.2.1-3: Band 25 BS transmit configurations with 3rd IMD within Band 25 BS own receive blocks

1st CC channel bandwidth (a MHz)	2nd CC channel bandwidth (b MHz)	1st and 2nd CC position (c and d MHz)
5	5	$15 < c + d < 25$
10	5	$10 < c + d < 25$
5	10	$10 < c + d < 25$
10	10	$5 < c + d < 25$

Note that Bands 1, 33, 34 and 39 are not intended for use in the same geographical area as Band 25. Moreover, co-location of Band 25 transmitter and Band 35, 36 or 37 transceiver implies FDD/TDD co-location on adjacent frequencies which requires the use of certain site-engineering solutions to avoid mutual interference. Consequently, the focus here will be on the 3rd order IMD products falling into Bands 2, 23 and 25.

With the performances of the current BS antenna system, transmit and receive path components, amplifiers, pre-distortion algorithms and filters, it is expected that the Band 25 BS transmit filter and the Band 2, 23 or 25 BS receive filter would not be able to provide substantial attenuation to reduce the IMD interference generated within the Band 2, 23 or 25 BS receive band to well below the receiver noise floor to prevent receiver desensitization, as there is not a large frequency gap between Band 25 DL and Band 2, 23 or 25 UL.

Therefore, it is recommended that Band 25 BS transmitters supporting non-contiguous CA should not share the same antenna with other Band 2, 23 or 25 BS receiver, or the own Band 25 BS receiver if the BS transmit configurations shown in Table 5.2.1-3 are used, in order to not to cause Band 2, 23 or 25 BS receiver desensitization. Note that antenna sharing may be allowed as the state-of-the-art continues to evolve in the future.

5.3 Specific UE RF requirements

The specific UE RF requirements were developed as part of the Rel-11 LTE_CA_enh work item and are contained in the technical report for that work item, TR 36.823.

5.4 Specific BS RF requirements

The specific BS RF requirements were developed as part of the Rel-11 LTE_CA_enh work item and are contained in the technical report for that work item, TR 36.823.

5.5 Specific UE RRM requirements

A study of the existing technical specifications was conducted. The study concluded that no impact to UE RRM specifications is required.

6 Summary of required changes to E-UTRA specifications

6.1 Required changes to TS 36.101

Required changes in UE RF specification TS 36.101 are shown in Table 6.1-1.

Table 6.1-1: Required changes in TS 36.101

Clause	Requirement	Required changes in TS 36.101
5.5A	Operating bands for CA	A new row is expected to be added in Table 5.5A-1 to add CA_25 to the supported intra-band CA operating bands.
5.6A.1	Channel bandwidths per operating band for CA	A new row is expected to be added in Table 5.6A.1-1 for the supported E-UTRA bandwidths of intra-band contiguous B25 CA.
5.6A-1	Supported CC combinations	Add new table: Table 5.6A.1-3: Supported E-UTRA bandwidths per CA configuration for intra-band non-contiguous CA
6.2.2A	UE Maximum Output Power for intra-band non-contiguous CA	A new Table 6.6.6A-2 is expected to be added to specify CA UE class for intra-band NC CA. It's proposed to evaluate the appropriate UE maximum output power requirement for intra-band non-contiguous B25 CA.
6.2.4A	UE Maximum Output Power with additional requirements for CA	It's proposed to evaluate the appropriate A-MPR requirement for intra-band non-contiguous Band 25 CA with 1 CCs on the UL.
6.6.3.2A	Spurious emission band UE co-existence for CA	A new row is expected to be added to table 6.6.3.2A-1 for B25 intra-band non-contiguous CA
7.3.1A	Minimum requirements (QPSK) for CA	A new row is expected to be added in Table 7.3.1A-1 for intra-band CA uplink configuration for reference sensitivity.
7.6.1.1A	In-band blocking for intra-band non-contiguous CA	Appropriate changes are expected in Table 7.6.1.1A-2. It's proposed to evaluate whether the existing CA blocking requirements are valid for CA_25A-25A or not.
7.6.2.1A	Out-of-band blocking for intra-band non-contiguous CA	Appropriate changes are expected in Table 7.6.2.1A-2. It's proposed to evaluate whether the existing CA out-of-band blocking requirements are valid for CA_25A-25A or not.

6.2 Required changes to TS 36.104

Required changes in BS RF specification TS 36.104 are shown in Table 6.2-1.

Table 6.2-1: Required changes in TS 36.104

Clause	Requirement	Required Changes in TS 36.104
5.5	Operating bands	A new row is expected to be added in Table 5.5-4 to support B25 intra-band non-contiguous carrier aggregation configuration.

6.3 Required changes to TS 36.133

No changes required in TS 36.133.

6.4 Required changes to TS 36.141

Required changes in BS test specification TS 36.141 are shown in Table 6.4-1.

Table 6.4-1: Required changes in TS 36.141

Clause	Requirement	Required Changes in TS 36.141
5.5	Operating bands	A new row is expected to be added in Table 5.5-4 to support B25 intra-band non-contiguous carrier aggregation configuration.

6.5 Required changes to TS 36.307

Required changes in TS 36.307 are shown in Table 6.5-1.

Table 6.5-1: Required changes in TS 36.307

Clause	Requirement	Required Changes in TS 36.307
TBD	Band 25 independent of release	Expect to add some changes to 36.307 Rel-10 to provide the appropriate pointers to the Rel-11 spec to enable backdating of band 25 CA to Rel-10.

6.6 Required changes to TS 37.104

No changes required in TS 37.104.

6.7 Required changes to TS 37.141

Required changes in TS 37.141 are shown in Table 6.7-1.

Table 6.7-1: Required changes in TS 37.141

Clause	Requirement	Required changes in TS 37.141
4.4	Operating bands and band categories	A new table is expected to be added Table 4.4-5 to support B25 intra-band non-contiguous carrier aggregation configuration.

Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2012-03	RAN4#62 b	R4-121970			Skeleton	N/A	0.0.1
2012-08	RAN4#64	R4-123990			Incorporated approved contribution R4-123177 "Text Proposal on Coexistence Studies of Harmonics and Intermodulation Products for Non-contiguous Carrier Aggregation of Band 25"	0.0.1	0.1.0
2012-10	RAN4#64 bis	R4-125055			Incorporated approved contributions R4-123989 "Specification changes needed for intra-band non-contiguous CA in band 25" and R4-124857 "Operating bands and bandwidths for CA in band 25"	0.1.0	0.2.0
2012-10	RAN4#64 bis	R4-125991			Note in 5.1.2 and table 5.1.2-1 changed to match. 5.2 removed also, to clarify that only the 2-DL and 1-UL case is to be considered	0.2.0	0.2.1
2012-10	RAN4#64 bis	R4-126072			Updated Table 6.1-1 lines 7.6.1-1A and 7.6.2-1A to update the reference to class A	0.2.1	0.2.2
2013-05	RAN4#67	R4-132195			Incorporated approved contribution R4-131678 "Text proposal for TR 36.841 LTE Advanced Intra-band Non-contiguous Carrier Aggregation in Band 25"	0.2.2	0.3.0
2013-06	RAN#60	RP-130651			Submitted to RAN#60 for 1-step Approval (no submission sheet)	0.3.0	1.0.0
2013-06	-	-			MCC clean-up	1.0.0	1.0.1