

Exhibit 1016

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Tweet4Technology: LTE 5G-NR Wireless Technology Blogs

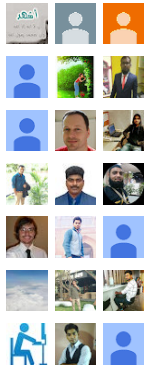
Tweet4technology: It's about LTE, 5G-NR and new Technology, 3GPP has dubbed 5G's new air interface 5G NR (New Radio).

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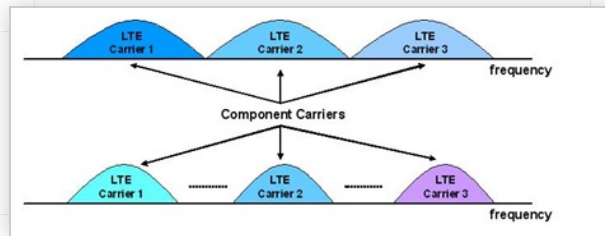
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LTE: Carrier Aggregation Tutorial

- What is component carrier?
- What is Carrier Aggregation?
- Types of LTE carrier aggregation
- Symmetric & Asymmetric CA in LTE
- Types of Component Carriers
- Carrier Aggregation – Cell Configuration
- Concept of Cross-Carrier Resource Scheduling
- Carrier Aggregation Activation/Deactivation

What is component carrier?

Aggregation means 'grouping' and carrier is 'bearer' so component carrier means Two or more component carriers can be aggregated to support wider transmission bandwidths up to 100 MHz.



What is Carrier Aggregation?

- It is of the most distinct features of 4G LTE-Advanced. Carrier aggregation allows expansion of effective bandwidth delivered to a user terminal through concurrent utilization of radio resources across multiple carriers. Multiple component carriers are aggregated to form a larger overall transmission bandwidth.
- CA supports wider bandwidths. Using CA, a spectrum of up to 5 Component Carriers (CC) can be aggregated up to a joint bandwidth of 100MHz. Rel-10 defines 5 possible deployment scenarios:

Scenario 1

- Two co-located and overlaid (Fig 1.1) (lay another surface to cover) cells which provide nearly the same coverage and where both layers (cell) allocate different bandwidth parts within the same frequency band.
- CA is possible between both layers.

Scenario 2

- Two co-located and overlaid (Fig 1.1) cells, in which only one layer provides sufficient coverage, while the other layer has smaller coverage due to higher path loss as both layers allocate bandwidth within different frequency bands.
- CA is possible between both layers.

Scenario 3

- Two co-located cells (Fig 1.1) in which the antennas of the second cell are moved towards the cell boundaries of the first cell in order to enhance cell edge performance. The basic coverage is given by the first cell, while the second cell might not provide full coverage. Again, both cells have bandwidth in different frequency bands.
- CA is possible in regions where the coverage of both cells overlaps.

Scenario 4/5

- Cell One provides basic macro coverage, while Cell Two has remote radio heads (RRH) (Scenario 4) or repeaters (Scenario 5) which provide additional capacity at hotspots within the coverage area of Cell One. Both cells transmit in different frequency bands.

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LTE-5G NR Pos

5G NR Bandwidth Pa
(BWP)Dynamic Spectrum S
DSS

5G:NR Question Ans

5G: CORESET

5G Carrier Aggregati

3GPP-Specifications-

What is DTX in LTE?

5G NR SSB Positionir
NSA Mode – Time an
Frequency Resources5G/LTE: OFDM Time
Frequency Domain

5G: Open RAN Vs vR

5G NR: SDAP Layer

5G NR: LDPC/Polar C

5G NR: Architecture

5G NR: 5G-NR Cell S
Procedure

5G NR: 4G Vs 5G

5G-NR: Protocol Sta

5G NR: Frame Struct
5G/NR5G NR: PBCH Decodi
Process in 5G5G NR: Beam-Based
Coverage Measurem
5G NR5G NR: SS/PBCH Blo
Synchronization

5G NR: mmWave in

5G NR: Massive MIM
NR5G NR: Beam Manag
in 5G NR5G:Open RAN and O
Brief

5G NR: Scheduling R

5G NR : Main differe
between Carrier aggr
and Dual Connectivit

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Labels

3G-UMTS Call
Flow (Originating
Call) (1)

5G (26)

ANR (1)

Basic Call Flow (2)

Boost your internet speed up to 200 Mbps : 100% Working Step (1)

Carrier Aggregation (2)

Cell Search (1)

CSFB (4)

CSFB Call Flow (4)

DL information transfer (1)

DRX (1)

Dual Tone Multiple-Frequency (DTMF) (1)

eICIC (1)

EVENT (1)

Frequency Search (1)

HARQ (1)

ICIC (1)

Interview Question (1)

LTE (21)

LTE Attach Call flow (2)

LTE S1HO Call Flow (1)

LTE X2HO Call Flow (1)

Measurement Control (2)

Measurement gaps (1)

Measurement Report (2)

MIB (1)

Paging in LTE (1)

PDCCH (2)

RACH (2)

Radio Bearer Types (1)

RRC Connection Process (3)

RRC Connection Reconfiguration (1)

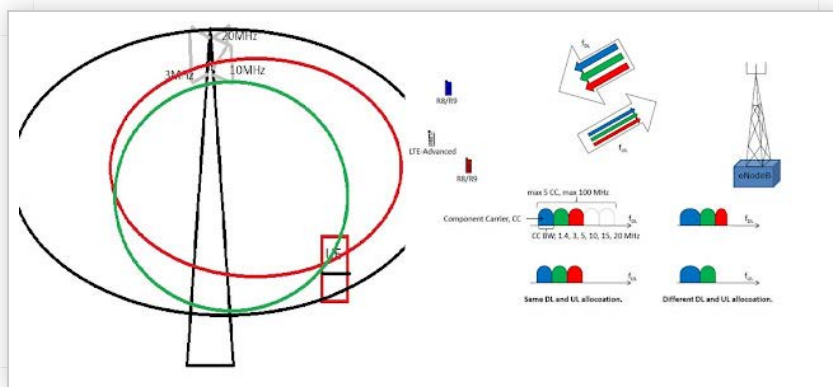
RRC Connection Release in LTE (2)

RRCConnectionReconfiguration (1)

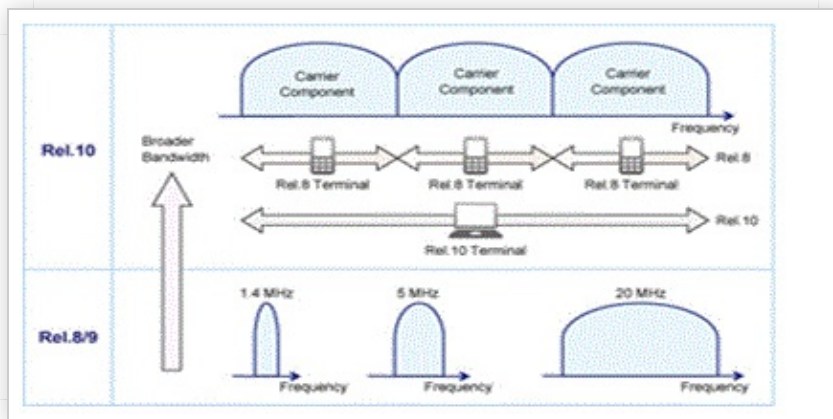
Screen Overlay Detected:

- CA is possible from the RRH or repeater cells to the underlying macro Cell One.

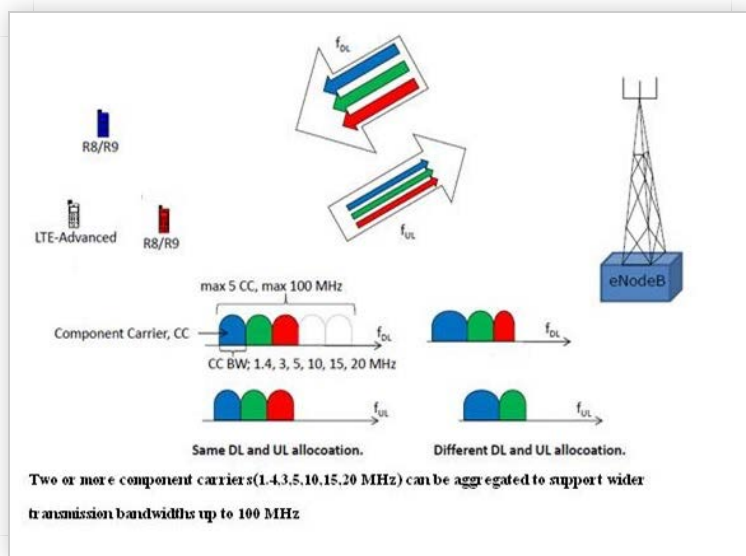
All defined CA scenarios and their coverage patterns need to be reflected in planning and optimization solutions.



(Fig 1.1)Cells (cell 1, cell 2 and cell 3) which provide nearly the same coverage and where all layers (or cells) allocate different bandwidth parts within the same and different frequency band for UE.



- Some of you may be wondering what exactly carrier aggregation is but simply put, CA is a mechanism to increase channel bandwidth, or in other words, achieve higher data rates than standard LTE, as shown in Figure 1.2 Above.
- LTE as a technology supports up to 20MHz channel bandwidth, but with CA, the same can be enhanced to 100MHz as maximum five such channels (called component carriers), up to 20 MHz each, can be combined.



LTE-5G-NR: Massive

5G NR : Dual Conner (DC) Definition & 5G (EN-DC) Bearer Con

5G NR: What is SSB

LTE: Physical Layer

LTE: Issue on UE and side

TCP UDP and IP

LTE: MAC

LTE:RRC Connection establishment requre:

LTE: Resource Alloca Type

LTE: Timing Advance

LTE: TDD Overview

LTE: MAC Header Str

LTE: All about PDCCH Aggregation Level

LTE : Selection Resel Criteria

LTE: Cell Reselection

LTE: SRS (Sounding Reference Signal)

LTE: LTE Cell Search Procedure | What ha in LTE after Mobile s

Internet: How Does : work | Amazing Jour Internet

LTE: What is DRX in DRX Mechanism

LTE: Measurement w report and ANR

LTE: PDCCH Process

5G NR: NOKIA lookir ahead to 5G

NAS : Authentication Request

LTE PLMN Selection : Different type of PLM HPLMN, VPLMN, EPLI IPLMN, FPLMN

LTE for Layman (part The Complete Picture

LTE for Layman (part Introduction and Architecture

LTE for Layman (Part Introduction and Architecture

LTE Short Question -

LTE Interview Questi

LTE S1HO Call Flow

LTE X2HO Call Flow

LTE: Attach Call flow

3G-UMTS Call Flow (Originating Call)

RSRP and Relation b SINR and RSRQ

LTE Measurement Re

Permanent Solution for any Android Phone (1)

SIB (1)

SIB 10 (1)

SIB 11 (1)

SIB 12 (1)

SIB 8 (1)

SIB 9 (1)

SIB1 (2)

SIB2 (1)

SIB3 (1)

SIB4 (1)

SIB5 (1)

SIB6 (1)

SIB7 (1)

SIBs in LTE (2)

SRVCC (2)

SRVCC Call Flow (2)

TAU (1)

Trace Start Procedures in LTE (1)

TTI(Transmission Time Interval) Bundling FDD (1)

UE Capability Enquiry (1)

UE context modification in LTE (1)

UE Context Modification Procedure (1)

UE first time switch on (2)

UL information transfer (1)

What happens when a mobile(UE) is switched on in LTE/UMTS in Hindi (1)

- Each aggregated carrier is referred to as a component carrier, CC. The component carrier can have a bandwidth of 1.4, 3, 5, 10, 15 or 20 MHz and a maximum of five component carriers can be aggregated and maximum aggregated bandwidth is 100 MHz.
- In FDD, The number of aggregated carriers can be different in DL and UL, see figure 1.3. Number of UL component carriers is always equal to or lower than the number of DL component carriers. The individual component carriers can also be of different bandwidths.
- Carrier aggregation is applicable to both FDD and TDD. In the case of TDD, the uplink-downlink sub frame configuration must be the same for all component carrier.
- For TDD the number of CCs as well as the bandwidths of each CC will normally be the same for DL and UL.
- Fig 1.3 illustrates two example of carrier aggregation-the first based upon 5 component carriers, and the second based upon 2 component carrier. The bandwidth of each component carrier is scenario dependent and does not have to be the maximum channel bandwidth of 20MHz.
- All component carriers belong to the same eNodeB and are synchronized on the air-interface. This means that a single set of timing advance command are used for all component carriers.

Types of LTE carrier aggregation

There are a number of ways in which LTE carriers can be aggregated.

- Intra-band, Contiguous
- Intra-band, non Contiguous
- Inter-band, non-contiguous

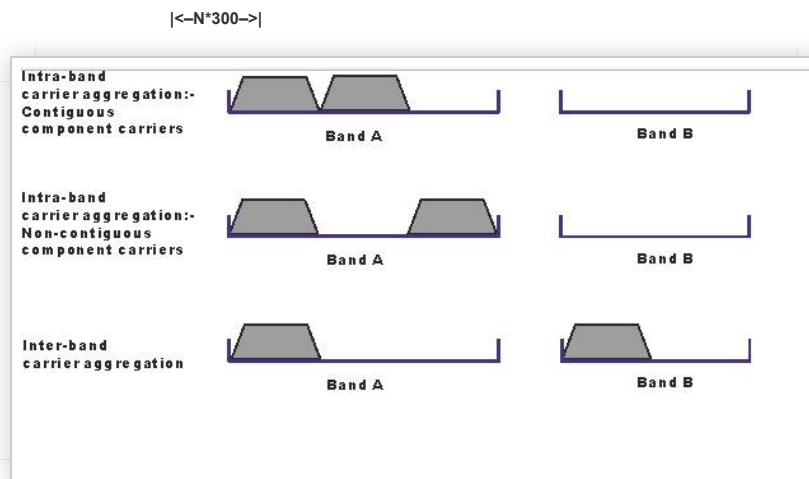


Figure 1.4. Carrier Aggregation; Intra-band and inter-band aggregation alternatives. The spacing between the centre frequencies of two contiguous CCs is $N \times 300$ kHz, $N = \text{integer}$. For non-contiguous cases the CCs are separated by one, or more, frequency gap(s).

- The Intra band scenario provide benefits in term of implementation effort. A single transceiver can transmit and receive multiple RF carrier when they are positioned within the same operating band.
- The inter-band scenario provides benefit in term of spectrum availability. An operator's spectrum is likely to be distributed across multiple operating band rather than located within single band.
- Intraband Contiguous CA: when multiple CCs are adjacent to each other within the same band.
- Intraband Non-Contiguous CA: when multiple CCs within the same band are used in a non-contiguous manner (have a gap or gap between CC.)
- Interband Non-Contiguous CA: when multiple CCs are separated along the frequency band.
- With non-contiguous CA, data transmission occurs over multiple separated carriers across a large frequency range. As a result, the radio channel characteristics, such as propagation path loss and geometry (G-) factor. When carrier aggregation is used there are a number of serving cells, one for each component carrier. The coverage of the serving cells may differ, for example due to that CCs on different frequency bands will experience different path-loss, see figure 1.5

Events (A1,A2,A3,A4,A5,B1,

ARQ Procedure

Screen Overlay Detection Permanent Solution for any Android Phone

What happens when mobile(UE) is switched on in LTE/UMTS in Hindi

How to increase your Internet speed faster 200 Mbps : 100% Working Step

Paging in LTE

UE context modification in LTE

RLC Reset procedure

RRC Message specification and Function

RRC States in LTE

Radio Bearer in LTE

RRC Connection Setup Complete

RRC Connection Setup

RRC Connection Setup

DL information transfer

UL information transfer

RRC Connection Reconfiguration

UE Capability Enquiry

TRACKING AREA UPDATE REQUEST

Dual Tone Multiple-Frequency (DTMF)

Trace Start Procedure in LTE

UE Context Modification Procedure

TTI(Transmission Time Interval) Bundling FDD

RRC Connection Release in LTE

HARQ in LTE - FDD

Measurement Report

Measurement gaps

Measurement Event

Measurement Control Connection Reconfiguration in LTE

Inter-Cell Interference Coordination(ICIC)

Enhancement Inter-Cell Interference Coordination(eICIC)

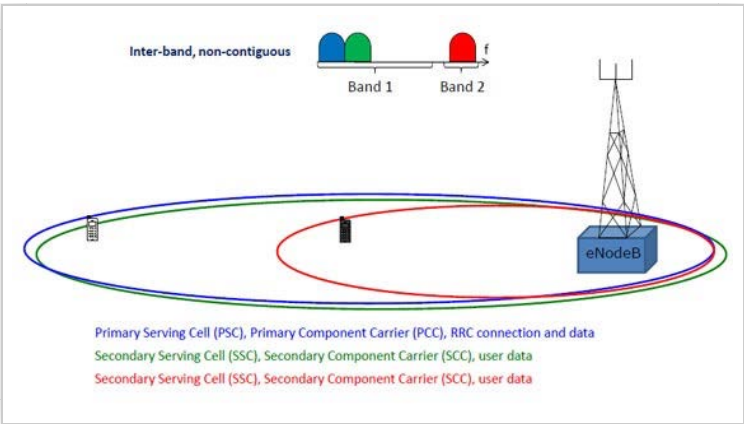
LTE: Carrier Aggregation Tutorial

CSFB Call Flow in LTE

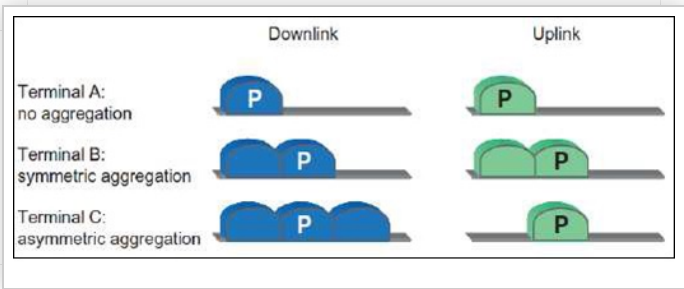
CS Fallback

SVCRC(Single Radio

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Symmetric & Asymmetric CA in LTE



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- symmetric carrier aggregation is defined as the case where there are equal number of component carriers for the downlink and uplink. In TDD downlink and uplink is always symmetric but in FDD ,the downlink and uplink can either be symmetric or not.
- In asymmetric case, the number of aggregated carrier can be different in DL/UL. However number of UL component carrier is always equal to or less than the number of DL component carriers. the individual component carrier can also be of different bandwidth.

Types of Component Carriers

- Primary Cell (P-Cell)
- Secondary/Serving Cell (S-Cell)

Primary Cell (P-Cell):

- The Primary cell is the Cell which is selected by the UE during cell search and used for RRC connection establishment . The measurement and mobility procedures are based on P-Cell. The P-Cell can never be de-activated .There is only one P-Cell per mobile device.

Secondary/Serving Cell (S-Cell):

- The Secondary /Serving cells are those cells which are selected by the Network based on the UE capability and the position/Location of the UE which can serve the UE simultaneously along with the Primary Cell.
- The Secondary cells are Activated /De-activated by MAC Layer and get assigned to the mobile device by higher layers. There can be more than one S-Cell per mobile device.
- The SCCs are added and removed as required ,while the PCC is only changed at handover.

Carrier Aggregation – Cell Configuration

- Primary Serving Cell(PCell)
- Secondary Serving Cell(SCell)
- Each components carrier corresponds to a serving cell. The coverage of the serving cells may differ – both due to component carrier frequencies but also from power planning – which is useful for
- heterogeneous network planning. one of the serving cells is designed the primary cell, while the rest are known as secondary

Call Continuity) and between CS Fallback SRVCC

SRVCC Call Flow Sce

LTE Call Flow

LTE Artitecture

LTE PROTOCOL STAC

System Information Type 12 in LTE

System Information Type 11 in LTE

System Information Type 10 in LTE

System Information Type 9 in LTE

System Information Type 8 in LTE

System Information Type 7 in LTE

System Information Type 6 in LTE

System Information Type 5 in LTE

System Information Type 4

System Information Type 3 in LTE

System Information Type 2 in LTE

System Information Type 1 in LTE

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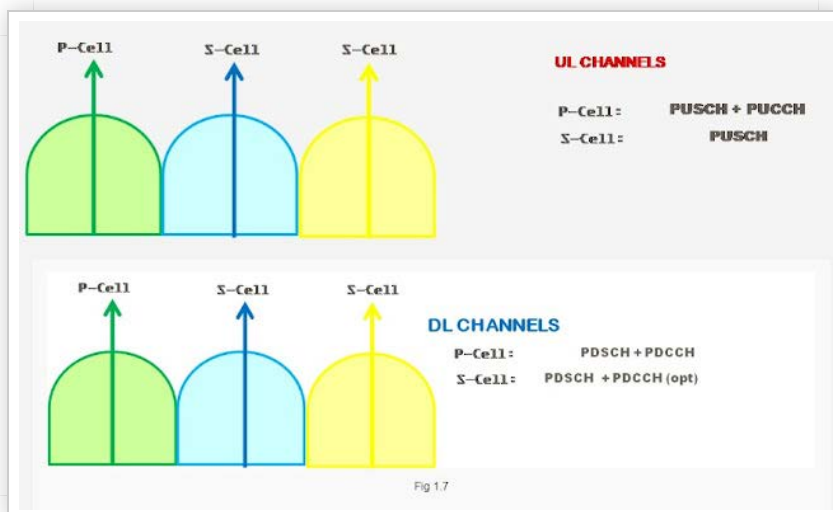
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Yahoo! Searc



cells.

- The primary cell is the most important, and manages the CA configuration. the number of serving cells that can be configured depends on the aggregation capability of the UE.



Alaska Cruises

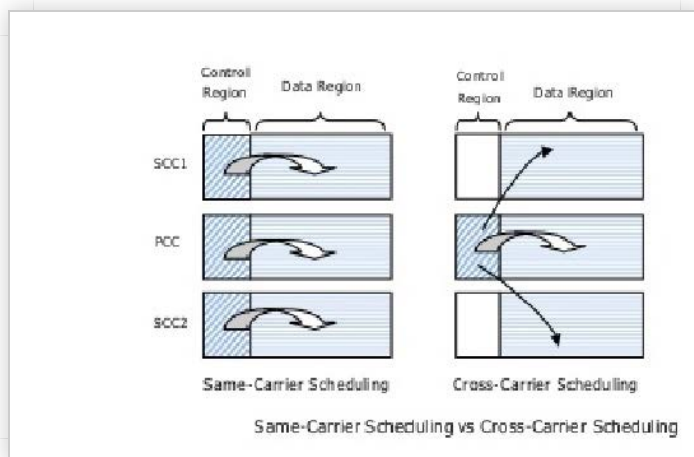
- Random access procedure is performed over PCell.
- PDCCH/PDSCH/PUCCH/PUSCH can be transmitted.
- Measurements and mobility procedure are based on PCell
- Cannot be deactivated.

Secondary Serving Cell(SCell)

- Secondary Serving Cell is configured after connection establishment to provide additional radio resources.
- RACH procedure is not allowed in a secondary cell.
- PDCCH/PDSCH/PUSCH/can be transmitted(not PUCCH)
- MAC-layer based activation/deactivation is supported for SCell for UE battery saving.
- Can be cross-scheduled.

Concept of Cross-Carrier Resource Scheduling

- Same-carrier scheduling
- Cross-Carrier scheduling



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Same- carrier scheduling:

- Resources are scheduled on the same carrier as the grant is received.
- Separate PDCCH for each component carrier.
- Reusing LTE Release 8/9 PDCCH structure and DCI formats.

Cross-Carrier scheduling: Cross carrier is scheduled is only used to schedule resources on SCC without PDCCH. The CIF(Carrier indicator field) on PDCCH indicate on which carrier the scheduled resource is located.

- Common PDCCH for multiple CCs.
- Reusing LTE Release 8/9 PDCCH structure.
- New 3-bit Carrier indicator field (CIF) added to Release 8 DCI.
- PCell shall be responsible for cross carrier scheduling of the secondary but no voice versa.
- PCell cannot to cross-scheduled; it is always scheduled through its own PDCCH.

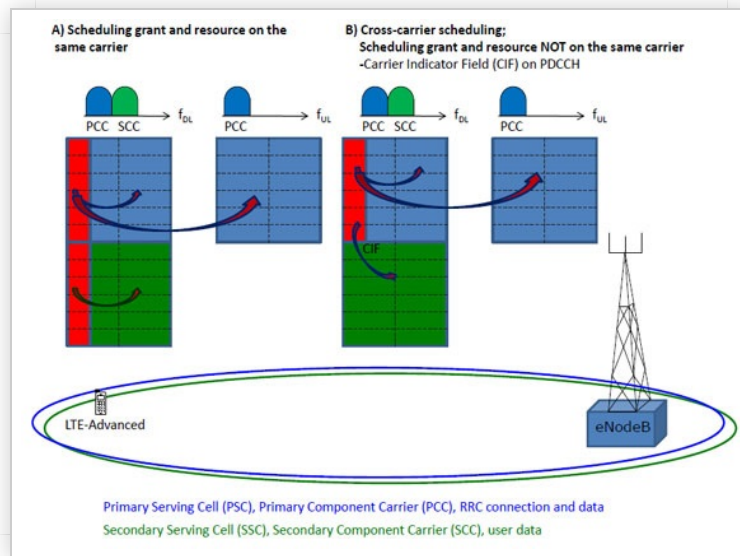
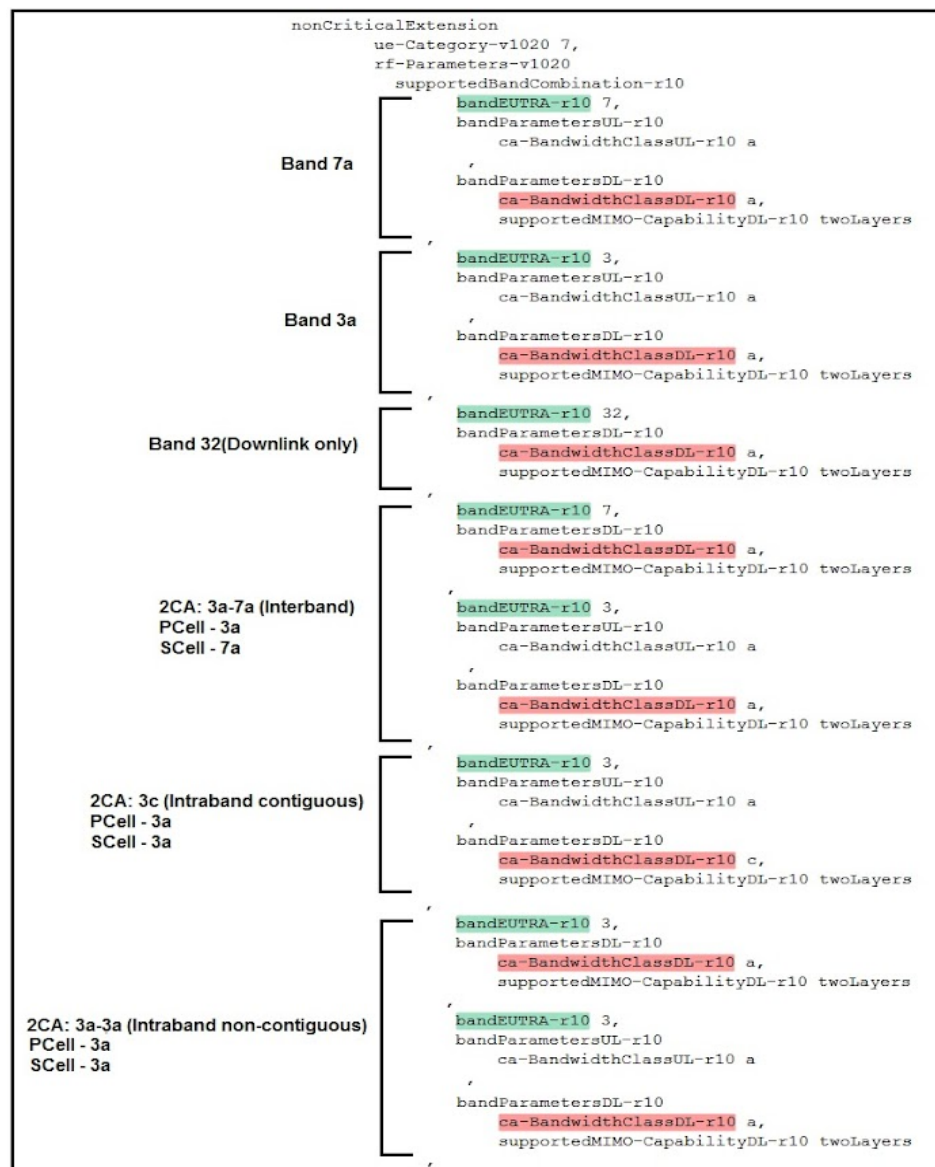


Figure 1.9 CA scheduling (FDD); Cross- carrier scheduling is only used to schedule resources on SCC without PDCCH. The CIF (Carrier Indicator Field) on PDCCH (represented by the red area) indicates on which carrier the scheduled resource is located.

2CA Uplink: 3c (Intraband contiguous)	<pre> BandCombinationParameters-r10 BandParameters-r10 bandEUTRA-r10:3 bandParametersUL-r10 CA-MIMO-ParametersUL-r10 ca-BandwidthClassUL-r10:c (2)* bandParametersDL-r10 CA-MIMO-ParametersDL-r10 ca-BandwidthClassDL-r10:c (2) supportedMIMO-CapabilityDL-r10:fourLayers (1) </pre>
2CA Uplink: 3a-20a or 20a-3a (Interband)	<pre> BandCombinationParameters-r10 BandParameters-r10 bandEUTRA-r10:3 bandParametersUL-r10 CA-MIMO-ParametersUL-r10 ca-BandwidthClassUL-r10:a (0) bandParametersDL-r10 CA-MIMO-ParametersDL-r10 ca-BandwidthClassDL-r10:a (0) supportedMIMO-CapabilityDL-r10:twoLayers (1) </pre>



Carrier Aggregation Activation/Deactivation

It is a two step process . In the first step, RRC layer configures the SCells for the CA capable UEs. In the second step MAC layer Activates/De-activates the SCells for the UEs.

- **Step 1 – Configuration of Secondary Cells**
- **Step 2 – Activation/De-activation of Secondary Cells**

There is a Mac Control element of 1 Byte defined which is a bit map of the configured SCells. For Activation of a SCell the corresponding bit has to be set to 1 for activation. For De-activation both explicit as well as implicit mechanisms are provided in the specifications. MAC Control elements can be used for fast activation and deactivation of secondary cells after they have been configured by RRC layer. The primary cell is always activated and cannot be deactivated **Carrier Aggregation scheduling Functions**

SCell Activation is done via MAC Control Element whereas the deactivation mechanism is either by using MAC control element or by the expiry of the SCellDeactivationTimer.



CA Bandwidth Class

CA Bandwidth Class	Aggregated Transmission Bandwidth configuration	Number of contiguous Component Carriers
A	NRB,agg ≤ 100	1
B	25 < NRB,agg ≤ 100	2
C	100 < NRB,agg ≤ 200	2
D	200 < NRB,agg ≤ 300	3
E	300 < NRB,agg ≤ 400	4
F	400 < NRB,agg ≤ 500	5
I	700 < NRB,agg ≤ 800	8

Intra-band contiguous channel spacing

For Intra-band contiguous we have to take in to account the nominal channel spacing. For intra-band contiguous carrier aggregation with two or more component carriers, the nominal channel spacing between two adjacent E-UTRA component carriers is defined as the following:

$$\text{Nominal channel spacing} = \left\lceil \frac{BW_{\text{Channel}(1)} + BW_{\text{Channel}(2)} - 0.1 |BW_{\text{Channel}(1)} - BW_{\text{Channel}(2)}|}{0.6} \right\rceil 0.3 \text{ [MHz]}$$

Intra-band contiguous channel spacing

For Intra-band contiguous we have to take in to account the nominal channel spacing. For intra-band contiguous carrier aggregation with two or more component carriers, the nominal channel spacing between two adjacent E-UTRA component carriers is defined as the following:

where BW Channel(1) and BWChannel(2) are the channel bandwidths of the two respective E-UTRA component carriers.

PCC – Primary Component Carrier (PCell)
 SCC – Secondary Component Carrier (SCell) For example: 2CA band 40C

If we are planning to set a PCell of bandwidth 20 MHz(BW1) and a SCell of bandwidth 20 MHz(BW2) then the nominal spacing will be calculated as follows,

Nominal Channel Spacing = $\text{FLOOR.MATH}((20+20-0.1*\text{ABS}(20-20))/0.6)*0.3$

= $\text{FLOOR.MATH}((40+0.1*0)/0.6)*0.3$

= $\text{FLOOR.MATH}(40/0.6)*0.3$

= $\text{FLOOR.MATH}(66.6666667)*0.3$

Nominal Channel Spacing = $(66)*0.3 \Rightarrow 19.8 \text{ MHz}$

NOTE: (You can put the line “ $\text{FLOOR.MATH}((20+20-0.1*\text{ABS}(20-20))/0.6)*0.3$ ” directly into Excel and it should give you 19.8).

Which means for [Intra-band contiguous](#) the Channel Spacing should be a multiple of 300 KHz and equal to (or) less than Nominal Channel Spacing,

[Channel Spacing < Nominal Channel Spacing](#)

Channel Spacing = $((BW1+BW2)/2)$.

If we take the PCC EARFCN=39000, Frequency=2335, Bandwidth=20 MHz then the SCC is calculated as,

SCC EARFCN = PCC EARFCN + $19.8 * 10$

= $39000 + 198$

= 39198

SCC EARFCN=39198, Frequency=2354.8, Bandwidth=20 MHz The Nominal Channel Spacing is 19.8 MHz ($2335 - 2354.8$) which is less than or equal to Channel Spacing of 19.8 MHz. Only when this condition is satisfied it is treated as Intra-band contiguous.

For [intra-band non-contiguous carrier aggregation](#) the channel spacing between two E-UTRA component carriers in different sub-blocks shall be larger than the nominal channel spacing. (ie) The combination is considered as 40A-40A,

[Channel Spacing > Nominal Channel Spacing](#)

Scell Addition-CA

E-UTRAN uses IE *sCellToAddModList* in *RRConnectionReconfiguration* message to add the SCell.

At the time of SCell addition, the eNodeB sends the following information to the UE via *RRConnectionReconfiguration* message, a few of which are optional.

SCellIndex: This is used to identify/address the SCell that is being configured/reconfigured/released. If the received *SCellIndex* is part of the UE's configuration already, then the UE considers the procedure as **SCell Modification**. Else if the received *SCellIndex* is not part of the UE's configuration, then the UE should consider the procedure as **SCell Addition**. Based on the UE's capability, at most four SCells can be configured but the *SCellIndex* can take values from 1 to 7.

cellIdentification: This is mandatory at the time of SCell Addition and shouldn't be present at the time SCell Modification. *cellIdentification* consists of Physical Cell Identity and Downlink Carrier Frequency (EARFCN).

radioResourceConfigCommonSCell: This is a big structure of IEs which is mandatory at the time of SCell Addition and shouldn't be present if the concerned SCell is being Modified.

When adding a new SCell, *radioResourceConfigCommonSCell* is used for sending all required system information of the SCell i.e. while in RRC_CONNECTED mode, UEs need not acquire broadcasted system information directly from the SCells.

radioResourceConfigCommonSCell contains downlink configurations such as Downlink Bandwidth, Number of Antenna Ports, List of MBSFN subframe Configurations, PHICH Configuration, PDSCH common configuration, TDD configuration (in case of TDD) etc..

In case of SCells with configured uplink (UL CA), *radioResourceConfigCommonSCell* contains uplink

information such as Uplink Bandwidth, Uplink Carrier Frequency, Uplink Power Control (Common) Information, common information of physical channels, SRS common information etc...

radioResourceConfigDedicatedSCell: This is another big structure of IEs which is mandatory at the time of SCell Addition and is optional otherwise. It contains UE specific (dedicated) configurations for SCell.

radioResourceConfigDedicatedSCell contains downlink dedicated configurations such as information related to Transmission Mode for the SCell, Cross Carrier Scheduling configuration, SCell CSI reference signal information, SCell PDSCH dedicated configuration etc...

E-UTRAN might configure the UE with uplink dedicated configuration as well. This is mandatory in case of UL CA where as it is optional for DL CA. It contains information such as Uplink Transmission Mode for SCell, Uplink dedicated Power Control information, CQI Reporting configuration for SCell, SCell's dedicated SRS configuration etc...

See an example *RRCConnectionReconfiguration* message for SCell Addition below.

```

nonCriticalExtension (SEQUENCE, optional)
{
  nonCriticalExtension (SEQUENCE, optional)
  {
    nonCriticalExtension (SEQUENCE, optional)
    {
      sCellToAddModList-r10 (SEQUENCE OF, optional)
      {
        <element-1> (SEQUENCE, multiple)
        {
          sCellIndex-r10 (INTEGER) = 1
          cellIdentification-r10 (SEQUENCE, optional)
          {
            physCellId-r10 (INTEGER) = 2
            dl-CarrierFreq-r10 (INTEGER) = 6200
          }
          radioResourceConfigCommonSCell-r10 (SEQUENCE, optional)
          {
            nonUL-Configuration-r10 (SEQUENCE, mandatory)
            {
              dl-Bandwidth-r10 (INTEGER) = n50
              antennaInfoCommon-r10 (SEQUENCE, mandatory)
              {
                antennaPortsCount (INTEGER) = anl
              }
              phich-Config-r10 (SEQUENCE, mandatory)
              {
                phich-Duration (INTEGER) = normal
                phich-Resource (INTEGER) = one
              }
              pdsch-ConfigCommon-r10 (SEQUENCE, mandatory)
              {
                referenceSignalPower (INTEGER) = 18
                p-b (INTEGER) = 0
              }
            }
          }
          radioResourceConfigDedicatedSCell-r10 (SEQUENCE, optional)
          {
            physicalConfigDedicatedSCell-r10 (SEQUENCE, optional)
            {
              nonUL-Configuration-r10 (SEQUENCE, optional)
              {
                antennaInfo-r10 (SEQUENCE, optional)
                {
                  transmissionMode-r10 (INTEGER) = tml
                  ue-TransmitAntennaSelection (CHOICE, mandatory)
                  {
                    release (NULL) = NullValue
                  }
                }
                pdsch-ConfigDedicated-r10 (SEQUENCE, optional)
                {
                  p-a (INTEGER) = d80
                }
              }
              ul-Configuration-r10 (SEQUENCE, optional)
              {
                cqi-ReportConfigSCell-r10 (SEQUENCE, optional)
                {
                  cqi-ReportModeAperiodic-r10 (INTEGER) = rm30
                  nomPDSCH-RS-EPRE-Offset-r10 (INTEGER) = -1
                  cqi-ReportPeriodicSCell-r10 (CHOICE, optional)
                  {
                    setup (SEQUENCE, choice)
                    {
                      cqi-PUCCH-ResourceIndex-r10 (INTEGER) = 100
                      cqi-pmi-ConfigIndex (INTEGER) = 0
                      cqi-FormatIndicatorPeriodic-r10 (CHOICE, mandatory)
                      {
                        widebandCQI-r10 (SEQUENCE, choice)
                        {
                          simultaneousAckNackAndCQI (BOOLEAN) = TRUE
                          cqi-Mask-r9 (INTEGER) = setup
                        }
                      }
                    }
                  }
                }
              }
            }
          }
        }
      }
    }
  }
}

```

Scell Activation-CA

MAC CE - SCell Activation/Deactivation

The purpose and the mechanism of NR SCell Activation/Deactivation is same as LTE SCell Activation/Deactivation. It is used to activate or deactivate data transmission for SCell while it is in Carrier Aggregation as illustrated below. That is, setting up carrier aggregation is done by RRC process but once RRC job is done, the real switch on/off of data transmission is done by this MAC CE.

The LCID for MAC CE is defined as below. As in LTE Rel 13 or later, there are two types of SCell Activation / Deactivation MAC CE depending on how many SCells are in the aggregated cells.

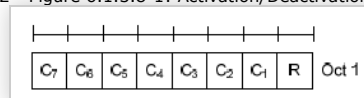
< 38.321- Table 6.2.1-1 Values of LCID for DL-SCH>		< 38.321- Table 6.2.1-2 Values of LCID for UL-SCH>	
Index	LCID values	Index	LCID values
000000	CCCH	000000	CCCH
000001-100000	Identity of the logical channel	000001-100000	Identity of the logical channel
100001-101111	Reserved	100001-110110	Reserved
110000	SP ZP CSI-RS Resource Set Activation/Deactivation	110111	Configured Grant Confirmation
110001	PUCCH spatial relation Activation/Deactivation	111000	Multiple Entry PHR
110010	SP SRS Activation/Deactivation	111001	Single Entry PHR
110011	SP CSI reporting on PUCCH Activation/Deactivation	111010	C-RNTI
110100	TCI State Indication for UE-specific PDSCH	111011	Short Truncated BSR
110101	TCI States Activation/Deactivation for UE-specific PDSCH	111100	Long Truncated BSR
110110	Aperiodic CSI Trigger State Subselection	111101	Short BSR
110111	SP CSI-RS / CSI-M Resource Set Activation/Deactivation	111110	Long BSR
111000	Duplication Activation/Deactivation	111111	Padding
111001	SCell Activation/Deactivation (4 octet)		
111010	SCell Activation/Deactivation (1 octet)		
111011	Long DRX Command		
111100	DRX Command		
111101	Timing Advance Command		
111110	UE Contention Resolution Identity		
111111	Padding		

The way to activate or deactivate a SCell is to set 1 or 0 in the each field of the following data structure. If the aggregated cell has less than 8 SCells in it, it uses the data structure Figure 6.1.3.10-1 and if it has more than 7 SCells it uses the data structure Figure 6.1.3.10-2.

MAC CE - Activation/Deactivation MAC Control Element

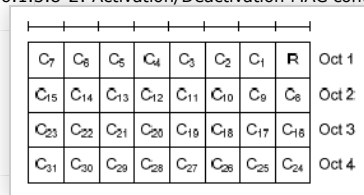
Refer to 36.321 6.1.3.8 Activation/Deactivation MAC Control Element if you want to have formal description. The field structure is as shown below.

< 36.321 Rel 10,11,12 - Figure 6.1.3.8-1: Activation/Deactivation MAC control element >



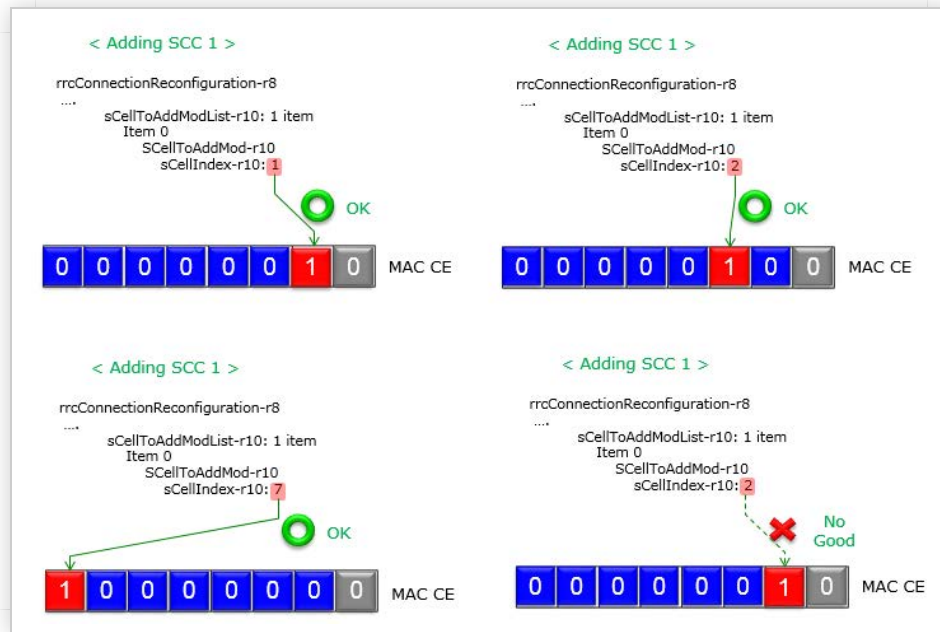
From Rel 13, UE Category 17 is added. Based Category 17, we can achieve 32 CC Carrier Aggregation and 25 Gbps. To support 32 CC (31 SCC), a new Activation/Deactivation MAC CE is added as shown below.

< 36.321 Rel 13 - Figure 6.1.3.8-2: Activation/Deactivation MAC control element of four octets >



Now the question is to figure out what does C1, C2, C3 etc mean ? Does it automatically mean C1 = SCC1, C2 = SCC2 etc ?

No.. the mapping between C1, C2,...,C7 and SCC1, SCC2,..., SCC7 is defined in RRC Connection Reconfig message. One example is as follows : (In example, sCellIndex-r10 for SCC1 (the first SCC) is set to be 2. It means C2 field in MAC CE is mapped to SCC1. Therefore, in this case 00000100 means that the first SCC shall be activated. This mean that absolute bit position in MAC CE does not specify whether it is for SCC1 or SCC2 etc. The meaning of each bit in MAC is indicated by RRC message. It means what is important is the matching between sCellIndex-r10 and MAC CE bit position. I hope following illustration would sound clearer to you.



Following is an example of RRC Connection Reconfiguration message to add SCC1.

```

rrcConnectionReconfiguration-r8
radioResourceConfigDedicated
physicalConfigDedicated
pucch-ConfigDedicated-v1020
pucch-Format-r10: channelSelection-r10 (1)
channelSelection-r10
n1PUCCH-AN-CS-r10: setup (1)
setup
n1PUCCH-AN-CS-List-r10: 2 items
Item 0
N1PUCCH-AN-CS-r10: 4 items
Item 0
N1PUCCH-AN-CS-r10 item: 361
Item 1
N1PUCCH-AN-CS-r10 item: 362
Item 2
N1PUCCH-AN-CS-r10 item: 363
Item 3
N1PUCCH-AN-CS-r10 item: 364
Item 1
N1PUCCH-AN-CS-r10: 4 items
Item 0
N1PUCCH-AN-CS-r10 item: 365
Item 1
N1PUCCH-AN-CS-r10 item: 366
Item 2
N1PUCCH-AN-CS-r10 item: 367
Item 3
N1PUCCH-AN-CS-r10 item: 368
nonCriticalExtension
nonCriticalExtension
nonCriticalExtension
sCellToAddModList-r10: 1 item
Item 0
SCellToAddMod-r10
sCellIndex-r10: 2
cellIdentification-r10
physCellId-r10: 1
dl-CarrierFreq-r10: 3100
radioResourceConfigCommonSCell-r10
nonUL-Configuration-r10
dl-Bandwidth-r10: n50 (3)
antennaInfoCommon-r10
antennaPortsCount: an1 (0)
pich-Config-r10
pich-Duration: normal (0)

```

```

p-b: 0
radioResourceConfigDedicatedSCell-r10
physicalConfigDedicatedSCell-r10
nonUL-Configuration-r10
antennaInfo-r10
transmissionMode-r10: tm1 (0)
ue-TransmitAntennaSelection: release (0)
release: NULL
pdsch-ConfigDedicated-r10
p-a: dB0 (4)
ul-Configuration-r10
cqi-ReportConfigSCell-r10
nomPDSCH-RS-EPRE-Offset-r10: 0dB (0)
cqi-ReportPeriodicSCell-r10: release

```

PCell Vs SCell:

- PCell always have both **Uplink(UL)** and **Downlink(DL)**. SCell **always have DL** (While activated) but may or **may not have UL**.
- **PCell** is always **activated** whereas **SCell** has to be **activated or deactivated** using **MAC-CE**.
- **UE does not required to acquire** System Information and decode Paging from SCell.
- For **SCell SI** is passed to UE while **adding** the SCell.
- When an SCell is added using RRC Connection Reconfiguration Message it remains in the **deactivated** state till it is activated using MAC-CE.
- If SCell **activation/deactivation** MAC-CE is received on Subframe n the SCell is activated/deactivated on Subframe **n+24 or n+34**. (TS 36.133 Section 7.7.2)
- When **sCellDeactivationTimer** expires then SCell is deactivated.
- Once SCell is deactivated
 - **PDCCH** on SCell and **PDCCH** for SCell is not monitored.
 - **PUSCH** is not transmitted and **PDSCH** is not received.
 - The **SRS** is not transmitted.
 - The **CQI/PMI/RI** for SCell is not reported.

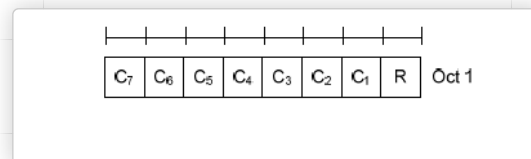
Activation/Deactivation MAC-CE:

- The MAC-CE can activate and deactivate SCell(s) which is already configured using RRC Connection Reconfiguration Message.
- Control Element is identified by a MAC PDU subheader with LCID.

Values of LCID for DL-SCH

Index	LCID values
11011	Activation/Deactivation

- fixed size and consists of a single octet containing seven C-fields and one R-field.



Activation/Deactivation MAC control element

- The Ci field is set to "1" to indicate that the SCell with SCellIndex i shall be activated.
- The Ci field is set to "0" to indicate that the SCell with SCellIndex i shall be deactivated.
- R: Reserved bit, set to "0".

Pcell and SCell Concepts:

- **Pcell can be changed** using RRC Connection Reconfiguration With MobilityControlInfo i.e. **Handover**.
- **Scell can be changed** using RRC Connection Reconfiguration message.
- During **Radio Link Failure**, the SCell is release first before initiating RRC Connection **Re-establishment** procedure.
- On receiving **Handover Command** i.e. RRC Connection Reconfiguration With MobilityControlInfo, **UE deactivates the SCell**, if configured.
- **TTI Bundling is not supported** when configured with one or more SCell with Configured Uplink.

- The RSRP and RSRQ measurement for Pcell shall follow time domain measurement resource restriction in accordance with **measSubframePatternPCell**, if configured.

Procedure	Pcell	Scell
Radio Link Monitoring	Y	N
System Information Acquisition	Y	N
Random Access Procedure	Y	N
Time Alignment	Y	N
SPS	Y	N
Connected Mode DRX	Y	Y
Paging	Y	N
NAS Mobility Information	Y	N
Data Transmission	Y	Y
S-measure Criteria	Y	N
Power Control	Y	Y
Link Adaptation	Y	Y
Pathloss Measurement	Y	Y= when pathloss reference=Scell N= when pathloss reference=Pcell

Channel	Pcell	Scell
PDCCH	Y	Y - No Cross Carrier Scheduling N - Cross Carrier Scheduling (UE does not look at PDCCH when CCS but eNodeB might be transmitting PDCCH.)
PDSCH	Y	Y
PUCCH	Y	N
PUSCH	Y	Y
PRACH	Y	N
SRS	Y	Y
PBCH	Y	N - UE does not look at PBCH But eNodeB might be transmitting it.
PSS/SSS	Y	N - UE does not look at PSS/SSS but to get timing information eNodeB might be transmitting PSS/SSS.
PCFICH	Y	Y - No Cross Carrier Scheduling N - Cross Carrier Scheduling (UE does not look at PCFICH when CCS but eNodeB might be transmitting PCFICH.)
PHICH	Y	Y - No Cross Carrier Scheduling N - Cross Carrier Scheduling (UE does not look at PHICH when CCS but eNodeB might be transmitting PHICH.)

What are new for the new DCI format : Format 2B and 2C ? I created a comparative table for you to see the difference between these new format and the existing field.

Format 2 (Rel 10)	Format 2A (Rel 10)	Format 2B (Rel 10)	Format 2C (Rel 10)
Carrier indicator	Carrier indicator	Carrier indicator	Carrier indicator
RA header	RA header	RA header	RA header
Resource block assignment	Resource block assignment	Resource block assignment	Resource block assignment
TPC command for PUCCH	TPC command for PUCCH	TPC command for PUCCH	TPC command for PUCCH
Downlink Assignment Index(TDD only)	Downlink Assignment Index(TDD only)	Downlink Assignment Index(TDD only)	Downlink Assignment Index(TDD only)
HARQ process number	HARQ process number	HARQ process number	HARQ process number
		Scrambling identity	Antenna ports Scrambling identity Number of Layers
		SRS request(TDD Only)	SRS request(TDD Only)

TB to CW flag	TB to CW flag	TB to CW flag	TB to CW flag
MCS for TB1	MCS for TB1	MCS for TB1	MCS for TB1
NDI for TB1	NDI for TB1	NDI for TB1	NDI for TB1
RV for TB1	RV for TB1	RV for TB1	RV for TB1
MCS for TB2	MCS for TB2	MCS for TB2	MCS for TB2
NDI for TB2	NDI for TB2	NDI for TB2	NDI for TB2
RV for TB2	RV for TB2	RV for TB2	RV for TB2
Precoding information	Precoding information	Precoding information	Precoding information

The totally new DCI introduced in Release 10, Format 4, carries the information as shown below.

Format 4
Carrier indicator (0 or 3 bits)
Resource block assignment
TPC command for scheduled PUSCH (2 bits)
Cyclic shift for DM RS and OCC index (3 bits)
Downlink Assignment Index (DAI) (2 bits)
CSI request (1 or 2 bits)
SRS request (2 bits)
Resource allocation type (1 bit)
MCS and RV for TB1 (5 bits)
NDI for TB1 (1 bit)
MCS and RV for TB2 (5 bits)
NDI for TB2 (1 bit)
Precoding information and number of layers

< DCI 1 Examples > -----

Example 1 > DCI Format 1 - 20 Mhz, Value = 0x0FC00005DC40

Field	Value	Value (Binary)
CarrierIndicator	0 (Dec)	000
RA header	RAType0	0
Resource block assignment	111111000000000000000000	111111000000000000000000000000
MCS	23 (Dec)	10111
HARQ process number	3 (Dec)	011

NDI	1	1
RV	0 (Dec)	00
TPC	01	01

Example 2 > DCI Format 1 - 20 Mhz, Value = 0x2FC00005DC00

Field	Value	Value (Binary)
CarrierIndicator	1 (Dec)	001
RA header	RAType0	0
Resource block assignment	1111110000000000000000000000	1111110000000000000000000000000000
MCS	23 (Dec)	10111
HARQ process number	3 (Dec)	011
NDI	1	1
RV	0 (Dec)	00
TPC	0 (Dec)	00

< DCI 2A Examples > -----

Example 1 > DCI Format 2A - 20 Mhz, Value = 0x7E000010BCBC

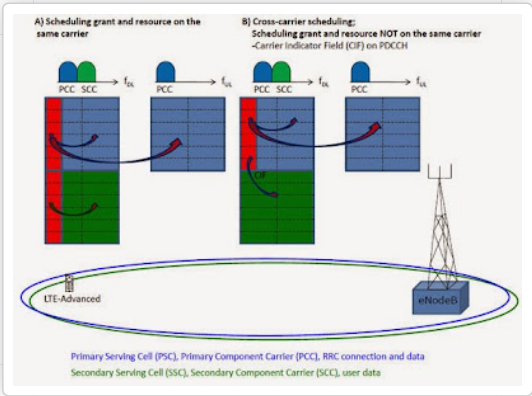
Field	Value	Value (Binary)
RA header	RAType0	0
Resource block assignment	1111110000000000000000000000	1111110000000000000000000000000000
TPC command for PUCCH	01	01
HARQ process number	0 (Dec)	000
TB to CW flag	0	0
MCS for TB1	23 (Dec)	10111
NDI for TB1	1	0
RV for TB1	0 (Dec)	00
MCS for TB2	23 (Dec)	10111
NDI for TB2	1	1
RV for TB2	0 (Dec)	00

< DCI 2C Examples > -----

Example 1 > DCI Format 2C - 10 Mhz, Value = 0x7FFDC3435C0

Field	Value	Value (Binary)
RA header	RAType0	0
Resource block assignment	1111111111111111	1111111111111111
TPC command for PUCCH	01	01
HARQ process number	6 (Dec)	110
Ports-SCID-Number of Layers	0	000
MCS for TB1	26 (Dec)	11010
NDI for TB1	0	0
RV for TB1	0 (Dec)	00
MCS for TB2	26 (Dec)	11010
NDI for TB2	1	1
RV for TB2	3 (Dec)	11

- Cross Carrier Scheduling(CCS):**
- **Downlink Scheduling or Uplink Grant** information of One Component Carrier(CC) can be carried by the **PDCCH of another Component Carrier(CC)**.
 - **3 bit CIF** field indicates target CC.
 - **Pcell** shall always be scheduled by **Pcell only**.
 - Scell can be cross scheduled by **Pcell** or **by other Scell**.
 - UE **indicates** whether it **supports** CCS or not.
 - Cross Carrier Scheduling is **not applicable** for **PDCCH order**. It is transmitted on Pcell.
 - CCS is applicable for **aperiodic SRS** transmission.



- The **cif-Presence-r10** in **physicalConfigDedicated** indicates whether CIF will be present in PDCCH of Pcell.
- The **RadioResourceConfigDedicatedSCell-r10.PhysicalConfigDedicatedSCell-r10.CrossCarrierSchedulingConfig-r10** indicates CCS status of SCell.

```

CrossCarrierSchedulingConfig-r10 ::= SEQUENCE {
    schedulingCellInfo-r10 CHOICE {
        own-r10 SEQUENCE {
            cif-Presence-r10 BOOLEAN -- No cross carrier
        },
        other-r10 SEQUENCE {
            schedulingCellId-r10 ServCellIndex-r10,
            pdsch-Start-r10 INTEGER (1..4) -- Cross carrier
        }
    }
}

```

- **cif-Presence** indicates whether carrier indicator field is present (value TRUE) or not (value FALSE) in PDCCH DCI formats.
- **pdsch-Start** indicates the starting OFDM symbol of PDSCH for the concerned SCell. Values 1, 2, 3 are applicable when dl-Bandwidth for the concerned SCell is greater than 10 resource blocks, values 2, 3, 4 are applicable when dl-Bandwidth for the concerned SCell is less than or equal to 10 resource blocks.
- **schedulingCellId** Indicates which cell signals the downlink allocations and uplink grants, if applicable, for the concerned SCell. (When SCell cross scheduled other SCell.)
- The **other-r10.schedulingCellId-r10** and **cif-Presence-r10** of that cell should be consistent.

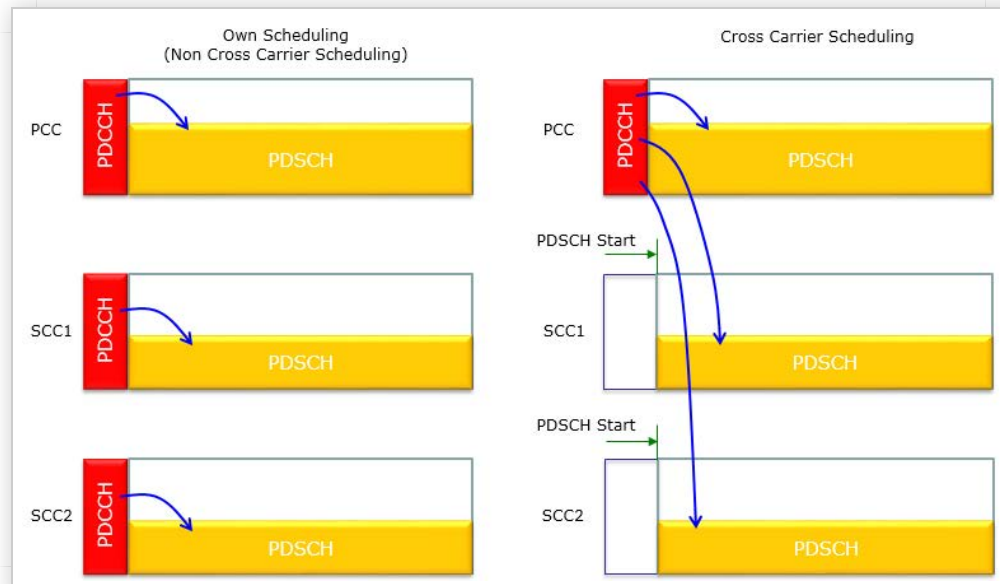
Who Schedule Each Component Carriers ?

When you have multiple Carriers in Carrier Aggregation, you naturally have a question. That is, who (which carrier) will be schedule resource allocation for each sub carriers ?

There are two types of method we can think of as illustrated below. In one case (Own Scheduling), each component carrier schedules for its own carrier. In the other case (Cross Carrier Scheduling), Primary Component Cell (or any specified serving cell) schedules the resource for all the component carriers.

Then you would have another question. How UE knows whether eNB is doing "cross carrier scheduling" or "non cross carrier scheduling" ?

This information is informed to UE via Higher Layer Signaling (RRC Message) as shown below.



< Own (Non Cross Carrier) Scheduling >

If Network (eNB) decided to do Own(Non-Cross carrier) Scheduling, it notifies UE using RRC message as shown below.

```

rrcConnectionReconfiguration
rrc-TransactionIdentifier: 0
criticalExtensions: c1 (0)
c1: rrcConnectionReconfiguration-r8 (0)
rrcConnectionReconfiguration-r8
radioResourceConfigDedicated
physicalConfigDedicated
nonCriticalExtension
lateNonCriticalExtension: <MISSING>
nonCriticalExtension
nonCriticalExtension
sCellToAddModList-r10: 1 item

```

```

Item 0
  SCellToAddMod-r10
    sCellIndex-r10: 1
    radioResourceConfigDedicatedSCell-r10
      physicalConfigDedicatedSCell-r10
        nonUL-Configuration-r10
          crossCarrierSchedulingConfig-r10
            schedulingCellInfo-r10: own-r10 (0)
            own-r10
              .... .0. cif-Presence-r10: False

```

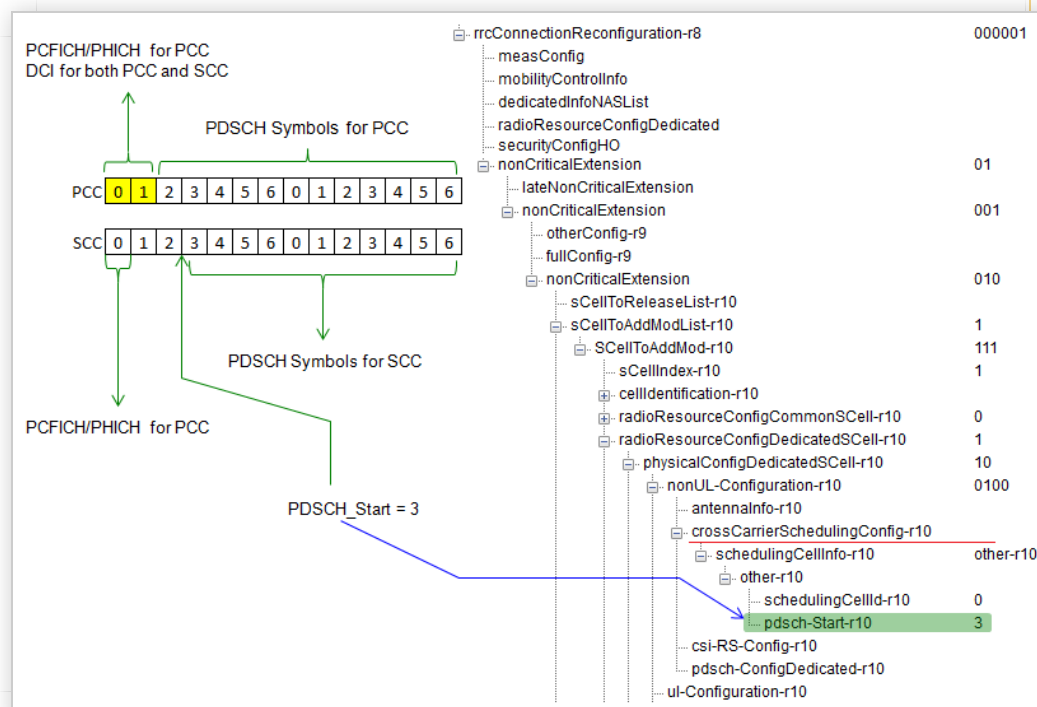
< Cross Carrier Scheduling >

If Network (eNB) decided to do Cross carrier Scheduling, it notifies UE using RRC message as shown below.

```

rrcConnectionReconfiguration
  rrc-TransactionIdentifier: 0
  criticalExtensions: c1 (0)
    c1: rrcConnectionReconfiguration-r8 (0)
      rrcConnectionReconfiguration-r8
        radioResourceConfigDedicated
          physicalConfigDedicated
            nonCriticalExtension
              lateNonCriticalExtension: <MISSING>
            nonCriticalExtension
              nonCriticalExtension
                sCellToAddModList-r10: 1 item
                  Item 0
                    SCellToAddMod-r10
                      sCellIndex-r10: 1
                      radioResourceConfigDedicatedSCell-r10
                        physicalConfigDedicatedSCell-r10
                          nonUL-Configuration-r10
                            crossCarrierSchedulingConfig-r10
                              schedulingCellInfo-r10: other-r10 (1)
                              other-r10
                                schedulingCellId-r10: 0
                                pdsch-Start-r10: 3

```



Carrier Aggregation and Measurement Events:

- Definition of **Serving Cell Measurement** is Modified.
- For Event A1 and Event A2 The **Carrier Frequency** in **Measurement Object** indicates whether this event is for Pcell or any Scell.
- The eNodeB shall configure separate A1/A2 events for each serving cell.
- Event A3 - Neighbor becomes offset better than **Pcell**.

- Event A5 - **Pcell** becomes worse than threshold1 and neighbour becomes better than threshold2.
 - For Event A3 and Event A5 the frequency mentioned in the associated measObjectEUTRA indicates neighbours.
 - For Event A3 and Event A5 the SCell become neighbouring cell.
- Event B2 - **Pcell** becomes worse than threshold1 and inter RAT neighbour becomes better than threshold2.
- **Event A6 - Intra Frequency Neighbour becomes offset better than SCell.**
- **No change** in the definition of **Event A4** and **Event B1**.

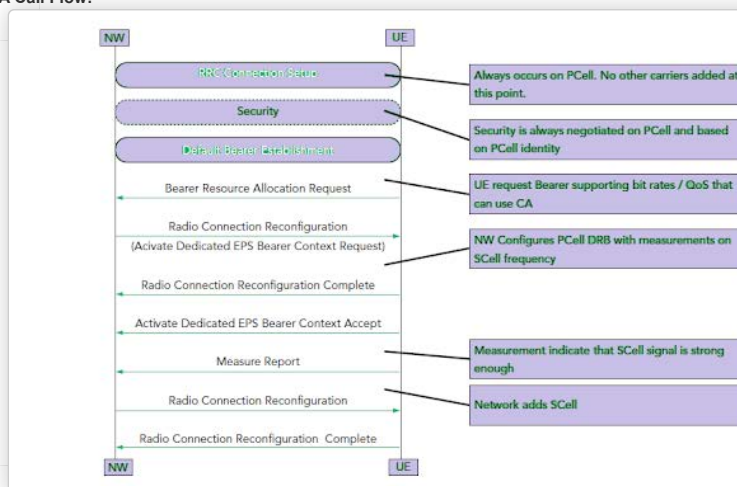
Carrier Aggregation and Periodic Measurement:

- If (**Purpose == reportStrongestCells && reportAmount > 1**)
UE initiates a first MR immediately after the quantity to be reported becomes available for the Pcell.
- If (**Purpose == reportStrongestCells && reportAmount == 1**)
UE initiates a first MR immediately after the quantity to be reported becomes available for the Pcell and for the strongest cell among the applicable cells.
- If (**Purpose == reportStrongestCellsForSON**)
UE initiates a first MR when it has determined the strongest cells on the associated frequency.

Carrier Aggregation and Measurement Gap:

- UE shall be able to carry out Measurement on any serving frequency without measurement gap i.e. intra-frequency measurement for any serving frequency.
- UE may require measurement gap to perform inter-frequency or inter-RAT measurement.

Typical CA Call Flow:



CA	Scell-Range	Scell-Add	Scell-Del	Scell-CHG	
Mode-1	Cell Contiguous as Colocated	When Attaching to Pcell, eNB report and set the capability	Impossibility	Impossibility	
Mode-2	Cell Contiguous as Colocated	When Attaching to Pcell, eNB report and set the capability that use A4 event.	Available A2 event	Impossibility	
Mode-3	All Cell with Intra or Inter	Use A4 event	A2 event	A6 event support terminal is possible	
Mode-4	All cell in the Intra or Inter Enb	When Attaching to Pcell, eNB report and set the capability	?	A6 event support terminal is possible	Operation Method in which Mode-1 and Mode-3 is combined

Scenario:::

Antennas of the cells are co-located and the cells are overlaid with small frequency separation; component carriers in the same band. Almost same coverage is provided due to similar path loss. Mobility is supported on either carrier. Higher data rates are achievable throughout the cell by CA.

Antennas of the cells are collocated and the cells are overlaid with large frequency separation; component carriers in different bands. Different coverage is provided on different carriers; and the higher frequency carriers do show smaller coverage due to larger path loss. Mobility is supported on the carrier in the lower frequency band providing sufficient coverage. Higher data rates and throughput are ensured by the carrier in the higher frequency band

Antennas of the cells are collocated; but the antenna directions are different in order to fill the coverage hole at the cell boundary; component carriers are in different bands. Coverage holes exist for cells in the higher frequency band due to the larger path loss. CA is supported in areas with overlapping coverage. Mobility management is typically not performed on the cells in the higher frequency band. Antennas oriented to the cell edge to achieve improved cell edge data rates and throughput.

Scenario for SCell-CA

At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. Some of the possible scenarios (considering only one SCell) are given below.

- SCell is already configured in the source PCell and the SCell is left modified/ unmodified i.e., same SCell is used even in the target PCell.
 - SCell is already configured in the source PCell and the SCell is left released during handover. i.e., release of the existing SCell during handover
 - SCell1 is configured in the source PCell and during the handover, SCell1 released and a new SCell (SCell2) is configured for use in the target PCell i.e., change of SCell during handover.
 - SCell is not already configured in the source PCell and an SCell is configured during handover for use in the target PCell.
 - SCell is not already configured in the source PCell and an SCell is added during handover for use in the target PCell.
 - SCell is already configured in the source PCell and UE receives handover command to handover to configured SCell i.e., Handover to SCell. In this case, *RRConnectionReconfiguration* message contains SCell Release and also *mobilityControlInfo* containing *carrierFreq* and *phyCellId* which are same as that of SCell.
 - SCell is already configured in the source PCell and UE receives handover command to handover to configured SCell and a new SCell is added whose frequency is same as that of source PCell i.e., Swapping PCell with SCell and vice versa. In this case, *RRConnectionReconfiguration* message contains SCell Release (SCell1) and also *mobilityControlInfo* containing *carrierFreq* and *phyCellId* which are same as that of SCell1, SCell Addition whose *carrierFreq* and *phyCellId* are same as that of source PCell.
- SCell can also be added during Handover from another RAT (e.g. GERAN or UTRAN) to E-UTRAN.

Q.How carrier aggregation is communicated to the device ? A carrier indication field (3 bits) is added to the DCI formats providing the index of the component carrier for which the scheduling grant / scheduling assignment is valid. The Carrier indication field is optional in the DCI formats. **The higher layer provides this information to the mobile device.** **Q.How the Uplink HARQ Ack/Nack function works for DL in carrier aggregation?** **Q.How the SRs function works in carrier aggregation?** **Q.How the Downlink CQI reporting function works in Carrier aggregation?** **Q.How the SRS function works in carrier aggregation ?** **Q.How the Downlink Ack/Nack function works for UL in carrier aggregation?** **Q.How TPC function works for uplink PUCCH/PUSCH channels?** **Q.How synchronisation function works ?**

- Support for carrier aggregation feature requires enhancement to the 3GPP LTE Release 8 & 9 physical, MAC, and RRC protocol layers. To an LTE Release 8 terminal, each component carrier will appear as an LTE carrier, while an LTE-Advanced terminal can use the total aggregated bandwidth.

Q.How does the eNodeB scheduler allocate the resource blocks on the secondary cell SCell from the primary cell PCell ? A: By using Carrier Indicator Field on PCell to convey allocation on SCell. **Q.How does the PCell communicate with the SCell ?** **What is the physical connection between the PCell and SCell ?** A: At this time, PCell and SCell are essentially different carrier frequencies covering the same geographic area (e.g., a given 120 degree cell). So, the same eNodeB controls both and there is no "connection" between the PCell and the SCell. When CoMP is implemented, two eNodeBs controlling two cells will communicate via regular X2. **Q.For Carrier Aggregation to work, a second 3-cell eNB is deployed (most likely co-located) but I am very unclear as of how these two eNBs (PCell and SCell) will communicate and how the RBs are assigned. Would appreciated detailed information on this incl White Papers, etc.** A. Such info is proprietary and implementation-specific. Conceptually, the MAC scheduler at the eNodeB

distributes data between the cells (e.g., 1 transport block on 1 cell). For the uplink, the eNodeB allocates resources on multiple UL cells and the UE's MAC layer distributes bits between the cells. One of the best references on LTE-Advanced is attached.

Posted by **Tweet4technology** at **Wednesday, November 02, 2016**

Labels: Carrier Aggregation, LTE

4 comments:



Bollylife Tuesday, 19 June 2018 at 14:56:00 GMT+5:30

What is criteria to activate Secondary cell???

Reply

Replies



Unknown Wednesday, 7 August 2019 at 14:25:00 GMT+5:30

Gautam ji, UE send measurement report to the eNB. Which S-Cell has strongest RSRP/RSRQ, Network will activate that Cell as S_Cell.



Unknown Wednesday, 7 August 2019 at 14:26:00 GMT+5:30

Somit Mishra-

Reply



Bollylife Tuesday, 19 June 2018 at 14:59:00 GMT+5:30

How the Uplink HARQ Ack/Nack function works for DL in carrier aggregation?

Reply

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