5G-NR (EN-DC) Bearer Concept

Here we will discuss about EN-DC bearer concept.

MCG (Master Cell Group) Bearer

SCG (Secondary Cell Group) Bearer

Split Bearer (MCG Split, SCG Split)

Assumption is reader is aware about LTE bearer concept.

MCG (Master Cell Group) Bearer: A bearer terminating at MN node (in case of EN-DC, more specifically at eNB)

SCG (Secondary Cell Group) Bearer: A bearer terminating at SN node (in case of EN-DC, more specifically at gNB)

(E-PDCP/NR-PDCP: MN node support both E-PDCP and NR-PDCP) Here terminating means, which node (MN/SN) PDCP is being used for the bearer. If PDCP is used from MN node then we call it MN terminating. If NR-PDCP is used from SN node then we call it SN terminating.

E-PDCP or NR-PDCP. two variationA MCG bearer can be configured with either Thus MCG bearer can be configured in (E-UTRA PDCP -> E-UTRA-RLC/MAC, E-UTRA-PHY) and (NR-PDCP -> E-UTRA-RLC/MAC, E-UTRA-PHY)

Whereas a SCG bearer is always configured with NR-PDCP only (NR-PDCP -> NR-RLC/MAC, NR-PHY)

Split Bearer:SCG split or MCG split A bearer for which traffic is routed via LTE and/or NR bearer. Split bearer is further either .

MCG Split: Traffic is splitted at MN node, refer Fig 0.

SCG Split: Traffic is splitted at SN node, refer Fig 0.

(a) MCG split bearer (b) SCG bearer (c) SCG split bearer
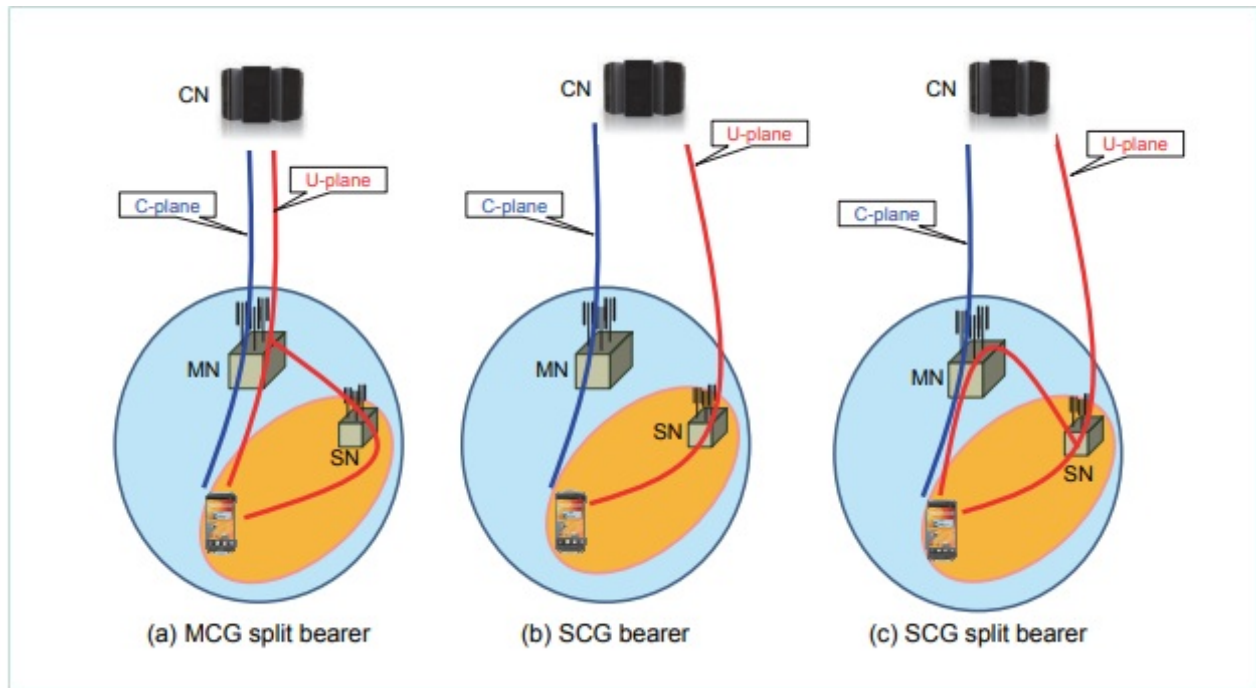
Refer Fig 1 for the pictorial representation of bearer concept.
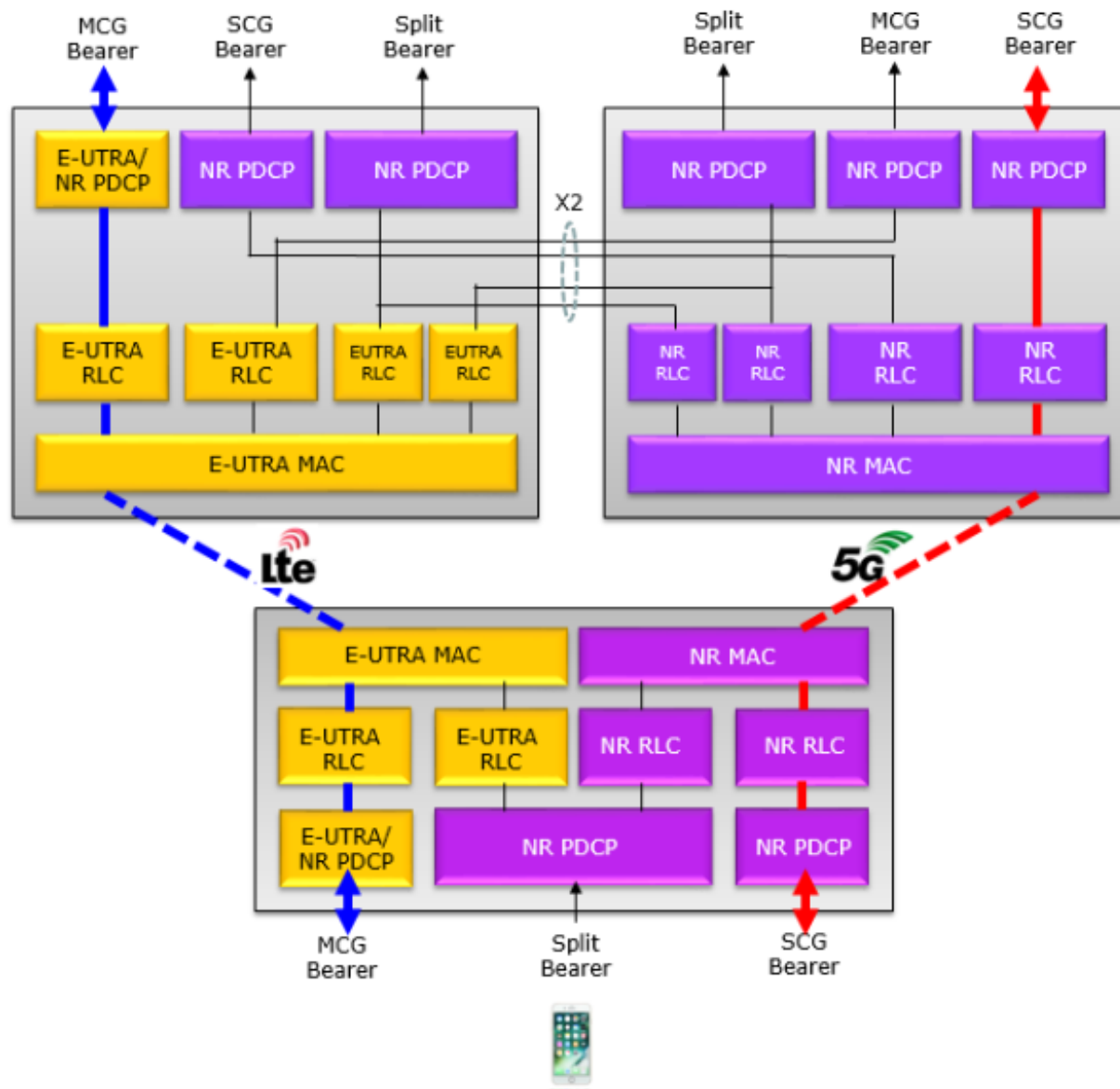
How n/w configure these bearer in case of EN-DC

1. During LTE attach, n/w configure one DRB. This DRB can be configured either via . Please refer Fig 2 and Fig 3, both snippet are taken from RRC reconfiguration message during LTE attach procedure. Here we are trying to show n/w configure the DRB with NR-PDCP and this NR-PDCP is MN terminating

```
                drb-ToAddModList
                {
                    {
                        eps-BearerIdentity 5,
                        drb-Identity 1,
                        rlc-Config am :
                            {
                                ul-AM-RLC
                                {
                                    t-PollRetransmit ms40,
                                    pollPDU p32,
                                    pollByte kB25,
                                    maxRetxThreshold t32
                                },
                                dl-AM-RLC
                                {
                                    t-Reordering ms50,
                                    t-StatusProhibit ms50
                                }
                            },
                        logicalChannelIdentity 3,
```

```
[Sequence] : RadioBearerConfigClass
  [] : srb_ToAddModList  :  NULL
  [] : srb3_ToRelease  :  eRadioBearerConfig_srb3_ToRelease_true
  [] : drb_ToAddModList [1..29]
     [Sequence] : DRB_ToAddMod
       [Choice] : cnAssociation
         [] : eps_BearerIdentity  :  5
         [Sequence] : sdap_Config
       [] : drb_Identity  :  1
       [] : reestablishPDCP  :  eDRB_ToAddMod_reestablishPDCP_true
       [] : recoverPDCP  :  eDRB_ToAddMod_recoverPDCP_true
       [Sequence] : pdcp_Config
         [Sequence] : drb
           [] : discardTimer  :  ePDCP_Config_drb_discardTimer_infinity
           [] : pdcp_SN_SizeUL  :  ePDCP_Config_drb_pdcp_SN_SizeUL_len18bits
           [] : pdcp_SN_SizeDL  :  ePDCP_Config_drb_pdcp_SN_SizeDL_len18bits
           [Choice] : headerCompression
             [Byte] : notUsed  :  NULL
             [Sequence] : rohc
             [Sequence] : uplinkOnlyROHC
           [] : integrityProtection  :  ePDCP_Config_drb_integrityProtection_enabled
           [] : statusReportRequired  :  ePDCP_Config_drb_statusReportRequired_true
           [] : outOfOrderDelivery  :  ePDCP_Config_drb_outOfOrderDelivery_true
         [Sequence] : moreThanOneRLC  :  NULL
           [] : t_Reordering  :  ePDCP_Config_t_Reordering_ms200
           [] : cipheringDisabled  :  ePDCP_Config_cipheringDisabled_true
  [] : drb_ToReleaseList  :  NULL
  [Sequence] : securityConfig
     [Sequence] : securityAlgorithmConfig
       [] : cipheringAlgorithm  :  eCipheringAlgorithm_nea2
       [] : integrityProtAlgorithm  :  eIntegrityProtAlgorithm_nia2
     [] : keyToUse  :  eSecurityConfig_keyToUse_master  <————MN terminating
```

So by referring Fig 2 & 3, n/w configure a standalone MCG bearer with NR-PDCP.

here we are taking the example of SCG split bearer, refer Fig 4.2. Now during NR cell addition, n/w may configure either standalone SCG bearer or split bearer (a split bearer may be further either MCG split or SCG split),

```
[Sequence] : RadioBearerConfigClass
  [] : srb_ToAddModList  :  NULL
  [] : srb3_ToRelease  :  eRadioBearerConfig_srb3_ToRelease_true
  [] : drb_ToAddModList [1..29]
    [Sequence] : DRB_ToAddMod
      [Sequence] : cnAssociation  :  NULL
      [Int32] : drb_Identity  :  1
      [] : reestablishPDCP  :  eDRB_ToAddMod_reestablishPDCP_true
      [] : recoverPDCP  :  eDRB_ToAddMod_recoverPDCP_true
      [Sequence] : pdcp_Config
        [Sequence] : drb  :  NULL
        [Sequence] : moreThanOneRLC
          [Sequence] : primaryPath
            [Int32] : cellGroup  :  1
            [Int32] : logicalChannel  :  1
          [] : ul_DataSplitThreshold  :  eUL_DataSplitThreshold_infinity
          [Boolean] : pdcp_Duplication  :  NULL
        [] : t_Reordering  :  ePDCP_Config_t_Reordering_ms300
        [] : cipheringDisabled  :  ePDCP_Config_cipheringDisabled_true
  [] : drb_ToReleaseList  :  NULL
  [Sequence] : securityConfig
    [Sequence] : securityAlgorithmConfig
      [] : cipheringAlgorithm  :  eCipheringAlgorithm_nea2
      [] : integrityProtAlgorithm  :  eIntegrityProtAlgorithm_nia0
    [] : keyToUse  :  eSecurityConfig_keyToUse_secondary
```
                                                                    ← **SN Terminating**

By referring Fig 2 (EUTRA-RLC associated with DRB ID 1 during LTE attach time) and Fig 5 (NR-RLC is associated with same DRB ID 1 during NR cell addition time).

```
[Sequence] : secondaryCellGroup
  [] : cellGroupId  :  1
  [] : rlc_BearerToAddModList [1..32]
    [Sequence] : RLC_BearerConfig
      [] : logicalChannelIdentity  :  1
      [Choice] : servedRadioBearer
        [Sequence] : srb_Identity
        [] : drb_Identity  :  1
      [] : reestablishRLC  :  eRLC_BearerConfig_reestablishRLC_true
      [Choice] : rlc_Config
        [Sequence] : am
          [Sequence] : ul_AM_RLC
            [] : sn_FieldLength  :  eSN_FieldLengthAM_size18
            [] : t_PollRetransmit  :  eT_PollRetransmit_ms40
            [] : pollPDU  :  ePollPDU_p32
            [] : pollByte  :  ePollByte_kB25
            [] : maxRetxThreshold  :  eUL_AM_RLC_maxRetxThreshold_t32
          [Sequence] : dl_AM_RLC
            [] : sn_FieldLength  :  eSN_FieldLengthAM_size18
            [] : t_Reassembly  :  eT_Reassembly_ms40
            [] : t_StatusProhibit  :  eT_StatusProhibit_ms20
```

split bearer As both EUTRA and NR is associated with same DRB ID(1), hence it is case of and NR-PDCP is terminating at SN node (Fig 4, keyToUse), hence it is case of SCG split bearer.

Uplink Split Bearer (Refer Fig 6 for uplink split bearer setting)

When a PDCP entity is associated with more than one RLC entity (split bearer case) then there is Primary RLC path setting as shown in Fig 6.

```
[] : drb_ToAddModList [1..29]
  [] : DRB_ToAddMod
    [] : cnAssociation  :  NULL
    [] : drb_Identity  :  1
    [] : reestablishPDCP  :  eDRB_ToAddMod_reestablishPDCP_true
    [] : recoverPDCP  :  eDRB_ToAddMod_recoverPDCP_true
    [] : pdcp_Config
      [] : drb  :  NULL
      [] : moreThanOneRLC
        [] : primaryPath
          [] : cellGroup  :  1
          [] : logicalChannel  :  1
        [] : ul_DataSplitThreshold  :  eUL_DataSplitThreshold_infinity
      [Boolean] : pdcp_Duplication  :  NULL
    [] : t_Reordering  :  ePDCP_Config_t_Reordering_ms300
```

How PDCP entity select the path for data uplink transmission, refer Fig 7.

When submitting a PDCP PDU to lower layer, the transmitting PDCP entity shall:

-   if the transmitting PDCP entity is associated with one RLC entity:

    -   submit the PDCP PDU to the associated RLC entity;

-   else, if the transmitting PDCP entity is associated with two RLC entities:

    -   if the PDCP duplication is activated:

        -   if this is a Data PDU

            -   duplicate the data PDU and submit to both associated RLC entities;

        -   else:

            -   submit the Control PDU to the primary RLC entity;

    -   else:

        -   if the two associated RLC entities belong to the different Cell Groups; and   // In case of split bearer MCG & SCG cell group

        -   if the total amount of data volume is equal to or larger than ul-*DataSplitThreshold*:

            -   submit the PDCP PDU to either the primary RLC entity or the secondary RLC entity;

        -   else:

            -   submit the PDCP PDU to the primary RLC entity.

Note — In current version of specification, Primary Path setting for SRB is always MCG cell group ID only whereas for DRB it can be either MCG or SCG cell group ID.