

5G/NR - Split Bearer

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As mentioned in [deployment Scenario](#) page, NR can be deployed in many different forms. Especially at the early stage of NR deployment, it is highly likely that NR is deployed as a supplementary node (i.e, SN (Secondary Node)) to LTE (MN (Master Node)). This type of deployment is called NSA (Non-StandAlone) deployment. In this case, there are several different ways to construct a bearer as 37.340 - 4.2.2 states :

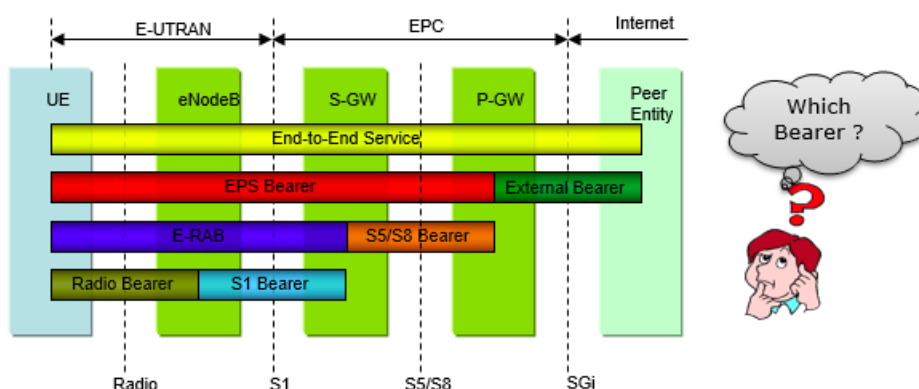
'In MR-DC, from a UE perspective, three bearer types exist: MCG bearer, SCG bearer and split bearer. These three bearer types are depicted in Figure 4.2.2-1 for MR-DC with EPC (EN-DC) and in Figure 4.2.2-2 for MR-DC with 5GC (NGEN-DC, NE-DC).

In this page, I will explain only on a specific type of bearer mentioned above called 'Split Bearer' since it may be a kind of confusing concept.

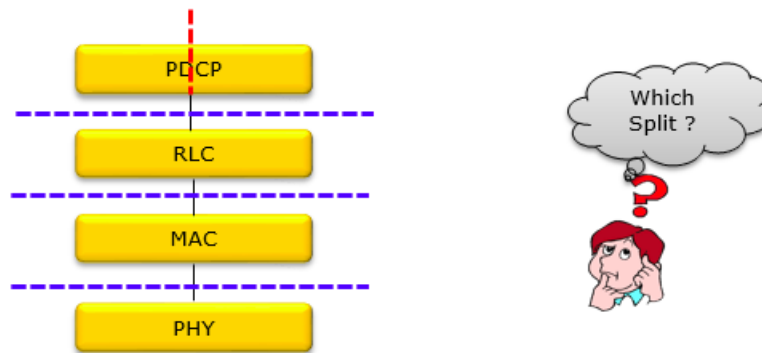
Which Bearer ? Which Split ?

The term 'SplitBearer' can be confusing because the two keywords 'Bearer' and 'Split' would be confusing terms. Do let's clarify on these two keywords first.

First, let's think of what kind of Bearer are defined. In case of LTE, roughly several different types of Bearer are defined as shown below (I would not describe any detailed on each of these bearers here). Just as a conclusion, when we say 'SplitBearer', the Bearer in this case is more related to the last one. More accurate location of bearer split will be explained later.

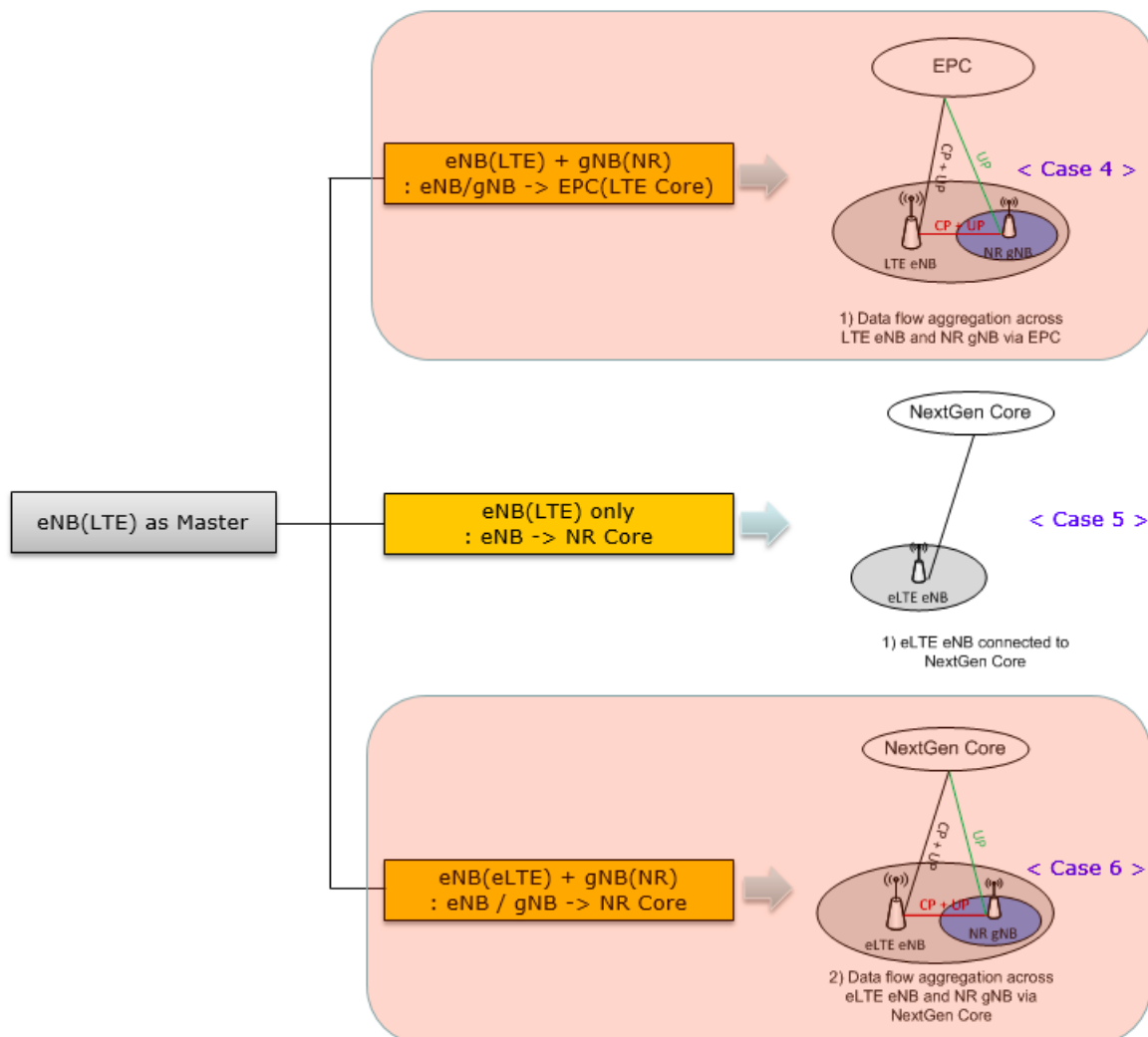


In short, when we say SplitBearer. The bearer would mean 'Radio Bearer'. Then the question is exactly at which point in Radio Bearer the 'Split' happens. Technically you can split the radio bearer at various different way as indicated by dotted lines as shown below. Just as a conclusion, the Split in SplitBearer mean the split marked in Red Dotted line. The split indicated by Blue dotted lines are called 'Separation'. You can see a example of this separation in [CU/DU Separation](#).



SplitBearer Usecase in deployment scenario

Typical situation where SplitBearer can be used in terms of network deployment plan is < Case 4 > and < Case 6 > as shown below. Especially at early stage of NR deployment called NSA, < Case 4 > would be the most typical deployment scenario. However, it doesn't mean that < Case 4 >, < Case 6 > always use split bearer. It can use MCG bearer only, SCG Bearer only or MCG and SCG separately. SplitBearer is only an option among many different options for these deployment scenario.

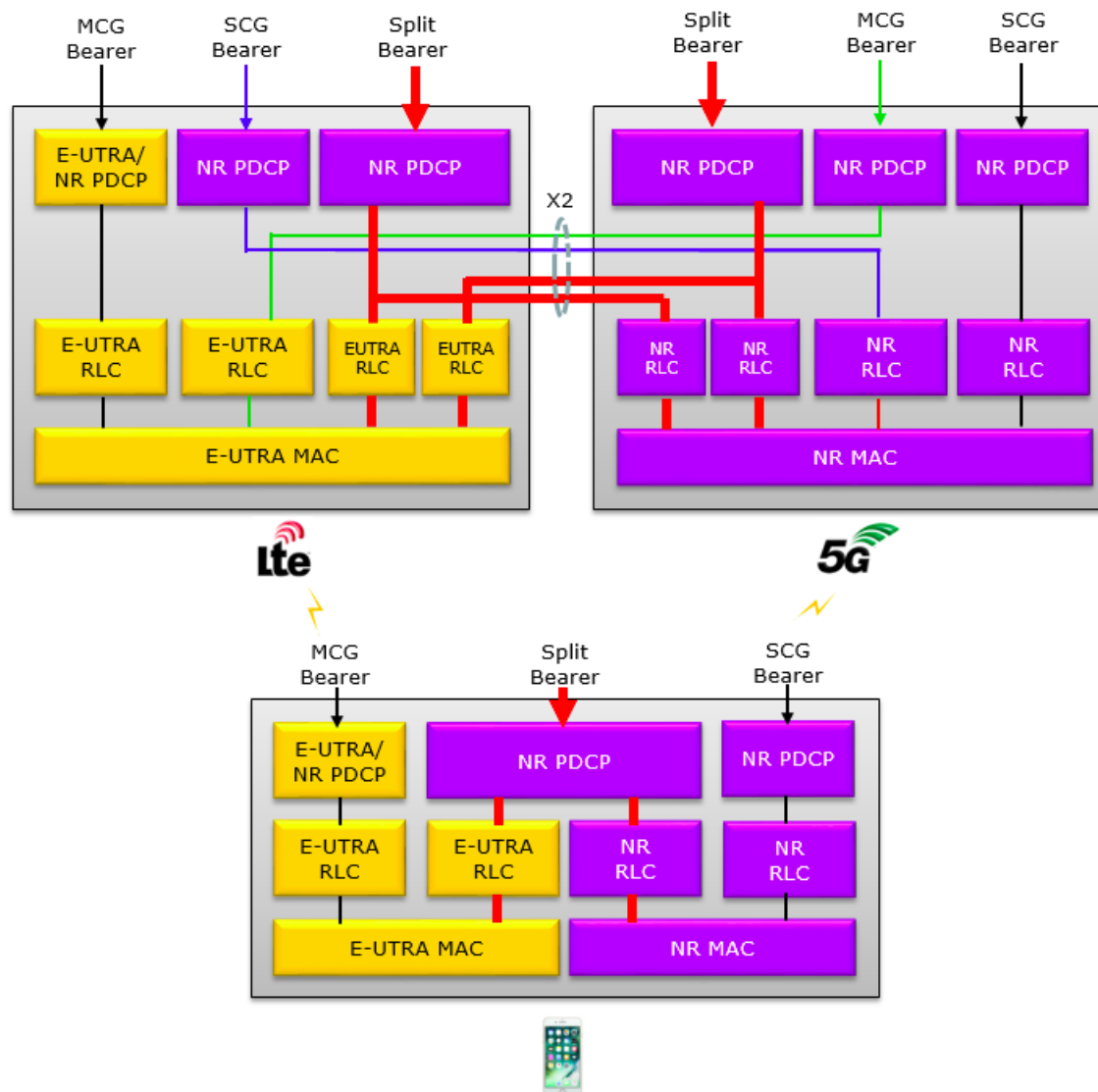


Exact Point of Split in Radio Bearer

Now let's look more in details on what's happening inside the radio bearer with split bearer. Following is the

illustration highlighting the data path of splitbearer based on 37.340 - Figure 4.2.2-3 and Figure 4.2.2-1. Following through the solid red arrows and lines, you would read out followings :

- In splitbearer, NR PDCP is used both in LTE Anchor and NR.
- Splitting of data stream is done by PDCP

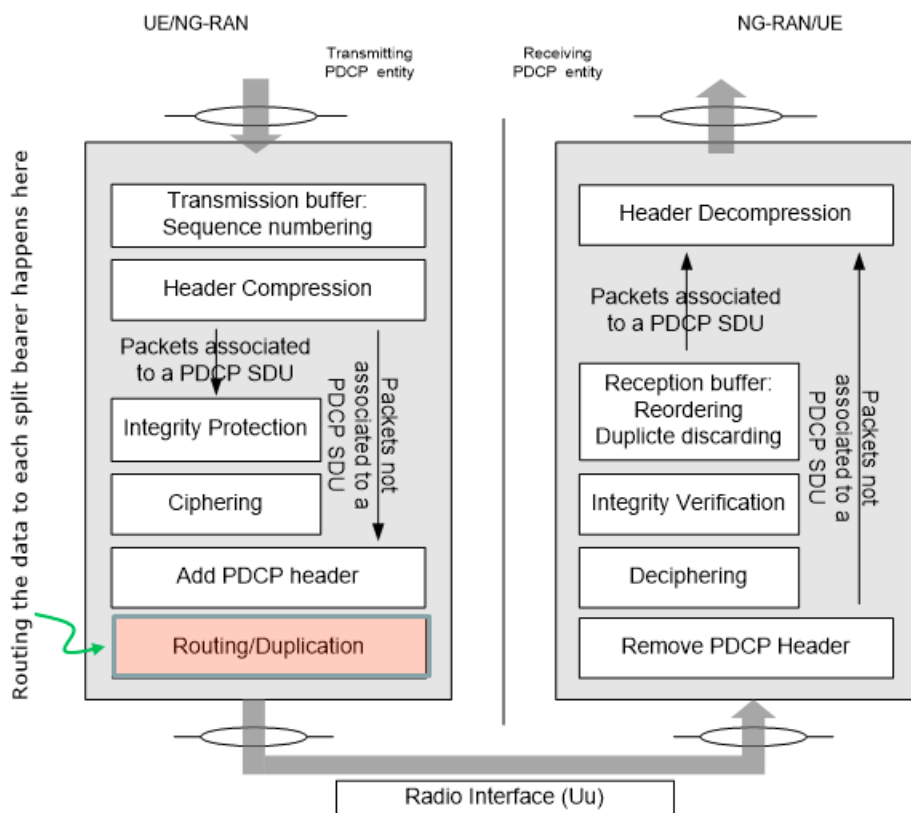


Now getting further into details, let's think of exactly at which point within PDCP the split happens. According to 38.323 4.2.2 PDCP entities, it is stated as follows :

For split bearers, routing is performed in the transmitting PDCP entity.

In 3GPP NR Specification, not so much details are explained about SplitBearer mechanism. For now, you may get a little bit more detailed idea from LTE specification described in 36.323 4.2.2 PDCP entities. This is the specification for LTE Dual Connectivity (not NR splitbearer) but I think similar idea would apply to NR split bearer as well.

Based on this, the point of the bearer split within PDCP can be highlighted as shown below.



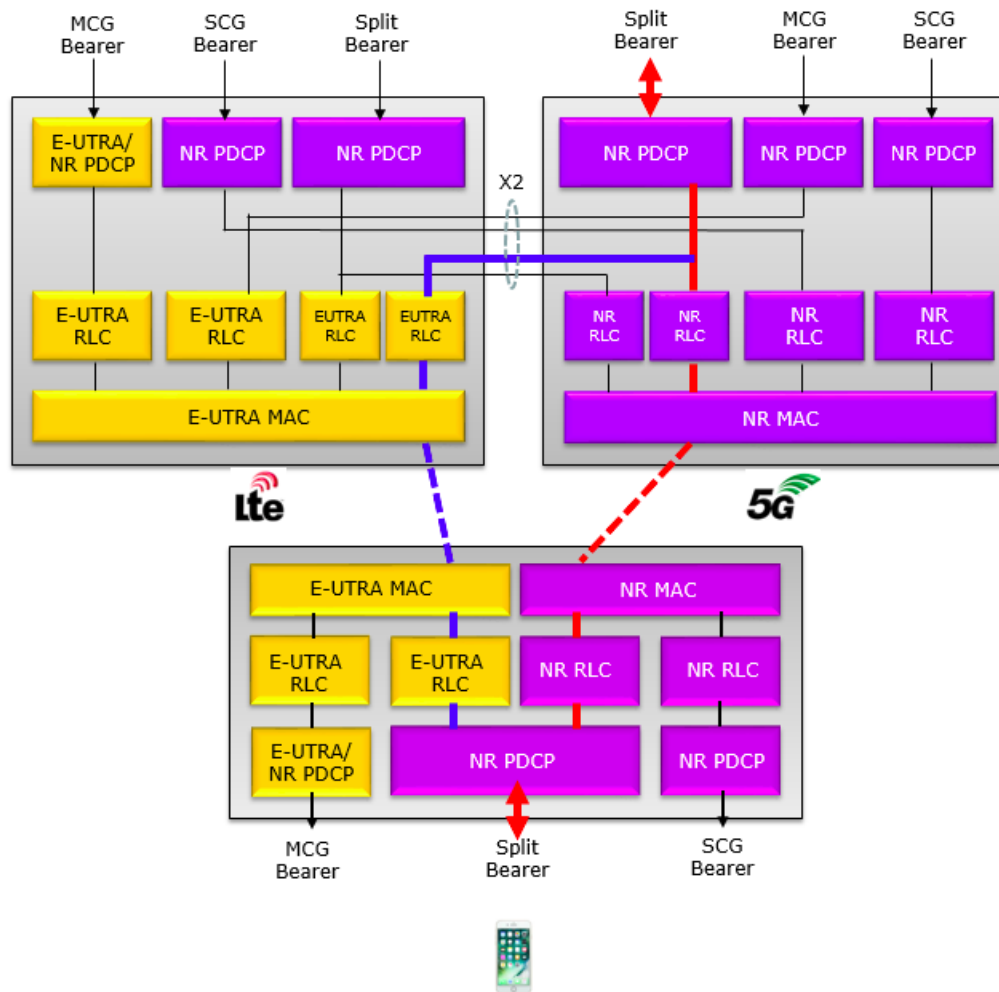
Would SplitBearer can confuse RLC ?

A couple of weeks ago I had a chat with my friend about this splitbearer and there was a question that I couldn't answer clearly at the moment. Putting it in simple way, the question was what would happen when SplitBearer was supported in downlink only and not supported in Uplink. As of now, I haven't confirmed on 3GPP specification whether only one directional SplitBearer (downlink only or Uplink only) is supported or not, but I think we can think of this case at least conceptually.

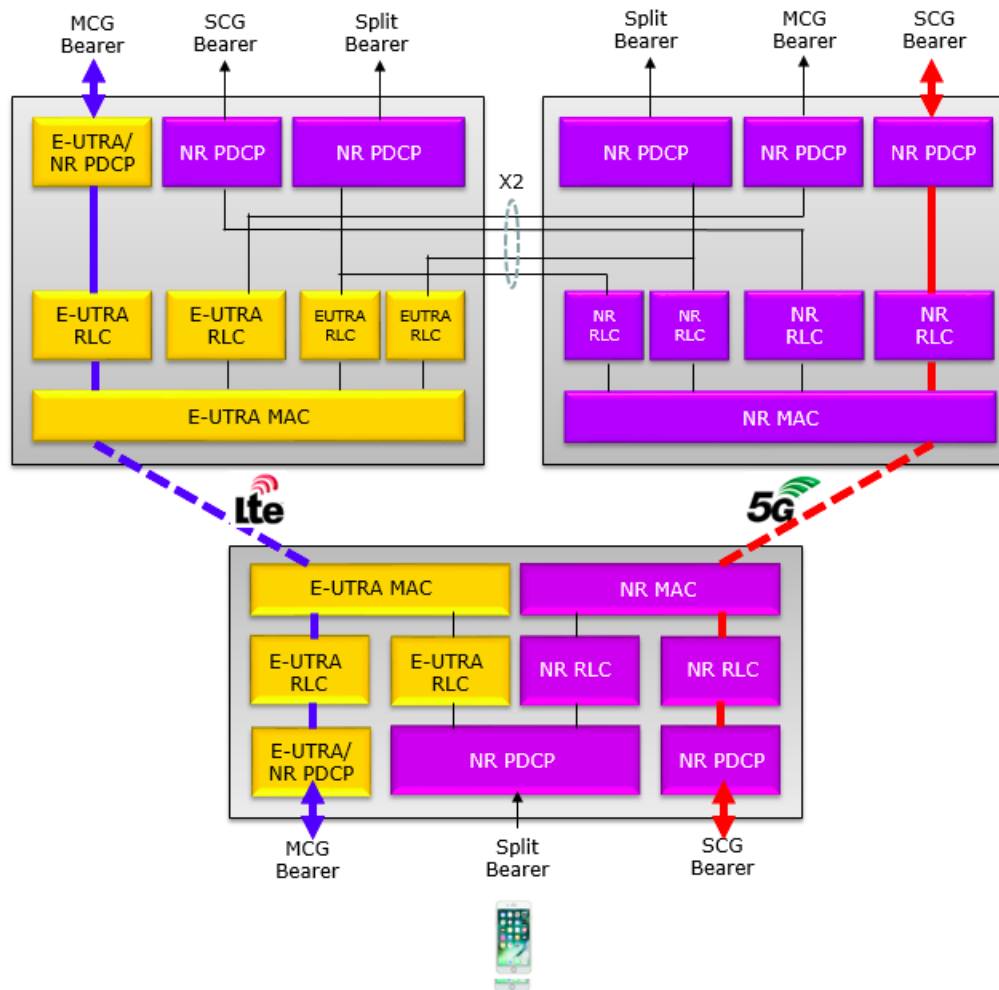
At first, we thought there might be some confusion in UL RLC on UE side when DL is configured for SplitBearer but UL is not configured for SplitBearer. However, putting some more thought on this, I realized that there wouldn't be such a confusion.

There was a situation brought up. When network sent data using splitbearer, meaning that both NR RLC and LTE RLC is transmitting the data to UE, how UE can get the RLC ACK to each of the corresponding network ? We got confused because we assumed that UE will have only one RLC path when SplitBearer is configured for downlink only (as shown in < Case 3 >). But come to think of it, it doesn't seem to be right. Even if the SplitBearer is configured for downlink only, UE should still handle two RLC stream (both in LTE and NR) in receiving side as shown in < Case 1 >. Downlink only SplitBearer mean that both UE and Network have data path in < Case 1 > and Uplink will have the data path as in < Case 2 >. The data path like < Case 3 > would not exist.

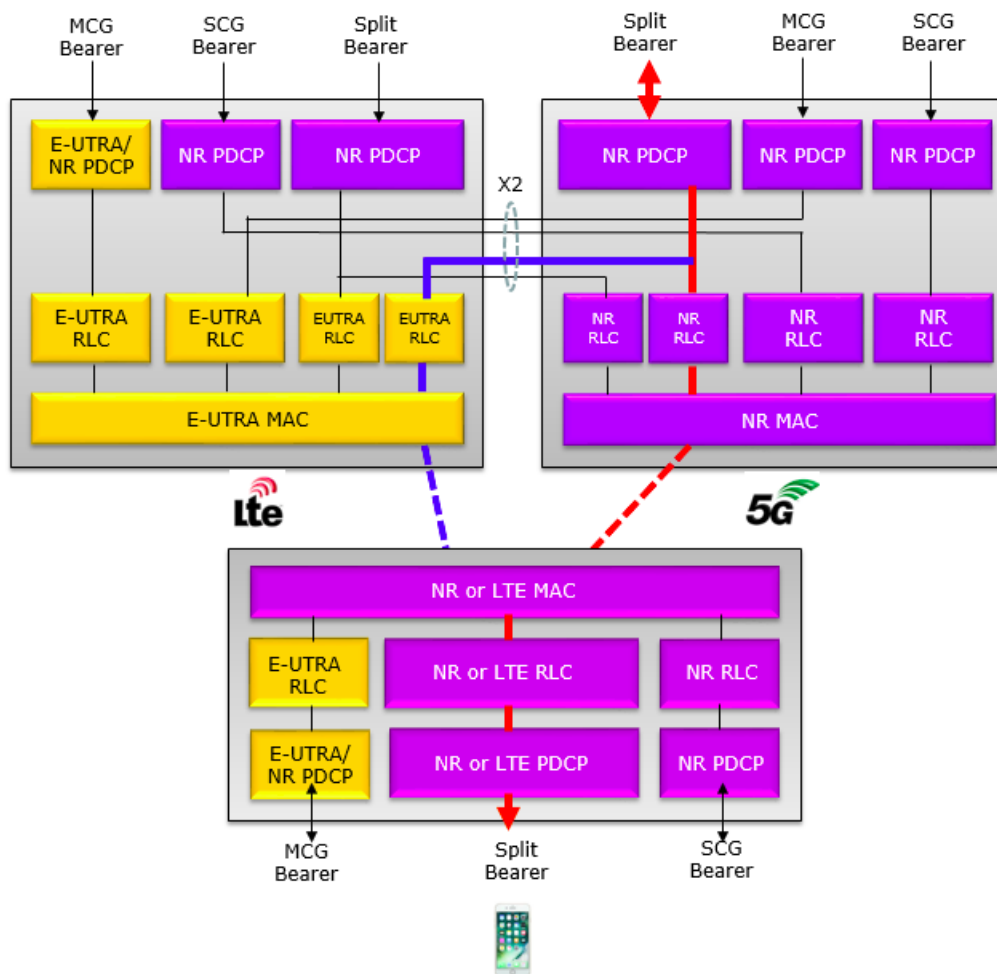
< Case 1 : Split Bearer >



< Case 2 : Non-Split Bearer >



< Case 3 : Is this possible ? >



RRC Parameters

```

PDCP-Config ::= SEQUENCE {
  drb SEQUENCE {
    discardTimer ENUMERATED {ms10, ms20, ms30, ms40, ms50, ms60, ms75, ms100, ms150, ms200,
      ms250, ms300, ms500, ms750, ms1500, infinity} OPTIONAL, --Cond Setup
    pdcp-SN-SizeUL ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup2
    pdcp-SN-SizeDL ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup2
    headerCompression CHOICE {
      notUsed NULL,
      rohc SEQUENCE {
        maxCID INTEGER (1..16383) DEFAULT 15,
        profiles SEQUENCE {
          profile0x0001 BOOLEAN,
          profile0x0002 BOOLEAN,
          profile0x0003 BOOLEAN,
          profile0x0004 BOOLEAN,
          profile0x0006 BOOLEAN,
          profile0x0101 BOOLEAN,
          profile0x0102 BOOLEAN,
          profile0x0103 BOOLEAN,
          profile0x0104 BOOLEAN
        },
        drb-ContinueROHC ENUMERATED { true } OPTIONAL -- Need N
      },
      uplinkOnlyROHC SEQUENCE {
        maxCID INTEGER (1..16383) DEFAULT 15,
        profiles SEQUENCE {
          profile0x0006 BOOLEAN
        },
        drb-ContinueROHC ENUMERATED { true } OPTIONAL -- Need N
      }
    }
  }
}

```

```

    },
    ...
  },
  integrityProtection ENUMERATED { enabled } OPTIONAL, -- Cond ConnectedTo5GC
  statusReportRequired ENUMERATED { true } OPTIONAL, -- Cond Rlc-AM
  outOfOrderDelivery ENUMERATED { true } OPTIONAL -- Need R
} OPTIONAL, -- Cond DRB
moreThanOneRLC SEQUENCE {
  primaryPath SEQUENCE {
    cellGroup CellGroupId OPTIONAL, -- Need R
    logicalChannel LogicalChannelIdentity OPTIONAL -- Need R
  },
  ul-DataSplitThreshold UL-DataSplitThreshold OPTIONAL, -- Cond SplitBearer
  pdcp-Duplication BOOLEAN OPTIONAL -- Need R
} OPTIONAL, -- Cond MoreThanOneRLC
t-Reordering ENUMERATED {
  ms0, ms1, ms2, ms4, ms5, ms8, ms10, ms15, ms20, ms30, ms40,
  ms50, ms60, ms80, ms100, ms120, ms140, ms160, ms180, ms200, ms220,
  ms240, ms260, ms280, ms300, ms500, ms750, ms1000, ms1250,
  ms1500, ms1750, ms2000, ms2250, ms2500, ms2750,
  ms3000, spare28, spare27, spare26, spare25, spare24,
  spare23, spare22, spare21, spare20,
  spare19, spare18, spare17, spare16, spare15, spare14,
  spare13, spare12, spare11, spare10, spare09,
  spare08, spare07, spare06, spare05, spare04, spare03,
  spare02, spare01 } OPTIONAL, -- Need S
...,
[[
  cipheringDisabled ENUMERATED {true} OPTIONAL -- Cond ConnectedTo5GC
]]
}

UL-DataSplitThreshold ::= ENUMERATED {
  b0, b100, b200, b400, b800, b1600, b3200, b6400, b12800, b25600, b51200, b102400, b204800,
  b409600, b819200, b1228800, b1638400, b2457600, b3276800, b4096000, b4915200, b5734400,
  b6553600, infinity, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1}

RLC-BearerConfig ::= SEQUENCE {
  logicalChannelIdentity LogicalChannelIdentity,
  servedRadioBearer CHOICE {
    srb-Identity SRB-Identity,
    drb-Identity DRB-Identity
  } OPTIONAL, -- Cond LCH-SetupOnly
  reestablishRLC ENUMERATED {true} OPTIONAL, -- Need N
  rlc-Config RLC-Config OPTIONAL, -- Cond LCH-Setup
  mac-LogicalChannelConfig LogicalChannelConfig OPTIONAL, -- Cond LCH-Setup
  ...
}

```

CellGroupId : The IE CellGroupId is used to identify a cell group. 0 identifies the master cell group. Other values identify secondary cell groups. In Jun 2018 Specification, only values 0 and 1 are supported.

LogicalChannelIdentity : LogicalChannelIdentity is used to identify one logical channel (LogicalChannelConfig) and the corresponding RLC bearer (RLC-BearerConfig).