3GPP TSG-RAN #90-e
Electronic Meeting, Dec 7 - 11, 2020

RP-202622

Clarification on single uplink operation (SUO) for intra-band EN-DC

Huawei, HiSilicon, Telus

Background of introduction of SUO

- Single UL operation (SUO) was initially introduced in RAN4 for the reason of MSD degradation caused by intermodulation products in dual uplink operation, and some conditions should be met for such claim as "single UL allowed" in RAN4 spec (Annex I of TS 38.101-3).
  - *"…**indicated by column single uplink allowed if the intermodulation products caused by the dual uplink operation do not interfere with its own primary downlink transmission channel bandwidth of PCell or PSCell**. For intermodulation products falling into any secondary downlink channel bandwidth, UE single UL capability is not considered."*

- For intra-band EN-DC, besides the potential IMD issue, most importantly, no RF requirements are defined for dual uplink operation for most of intra-band combinations. For these band combinations, along with "single UL allowed" indication, there is a note highling that "**Only single switched UL is supported**" .

- According to the RAN4 specification, RAN2 defined the capability "*singleUL-Transmission*"

Definitions for parameters	Per	M	FDD-TDD DIFF	FR1-FR2 DIFF
singleUL-Transmission Indicates that the UE does not support simultaneous UL transmissions as defined in TS 38.101-3 [4]. The UE may only include this field for certain band combinations defined in TS 38.101-3 [4]. If included for a particular band combination, the field applies to all fallback band combinations of this band combination that are defined in TS 38.101-3 [4] as being allowed to include this field and does not apply to any other fallback band combinations defined in TS 38.101-3 [4].	BC	No	N/A	N/A

RAN4 spec status of SUO for intra-band EN-DC

Table 5.5B.2-1: Intra-band contiguous EN-DC configurations

EN-DC configuration	Uplink EN-DC configuration (NOTE 1)	Single UL allowed
DC_(n)5AA	DC_(n)5AA[6]	Yes[6]
DC_(n)12AA	DC_(n)12AA[6]	Yes[6]
DC_(n)38AA[5]	DC_(n)38AA[6]	Yes[6]
DC_(n)41AA[5] DC_(n)41AB[5] DC_(n)41CA[5] DC_(n)41DA[5]	DC_(n)41AA	Yes[3]
DC_(n)41AB[5] DC_(n)41CA[5] DC_(n)41DA[5]	DC_41A_n41A	Yes[3]
DC_(n)48AA[5]	DC_(n)48AA[6]	Yes[6]
DC_(n)48CA[5]	DC_(n)48AA[6] DC_48A_n48A[6]	Yes[6]
DC_(n)48DA[5]	DC_(n)48AA[6] DC_48A_n48A[6]	Yes[6]
DC_(n)71AA[2]	DC_(n)71AA	No[4]

NOTE 1: Uplink EN-DC configurations are the configurations supported by the present release of specifications.
NOTE 2: Requirements in this specification apply for NR SCS of 15 kHz only.
NOTE 3: Single UL allowed due to potential emission issues, not self-interference.
NOTE 4: For UE(s) supporting dynamic power sharing it is mandatory to do dual simultaneous UL. For UE(s) not supporting dynamic power sharing single UL is allowed.
NOTE 5: The minimum requirements only apply for non-simultaneous Tx/Rx between all carriers.
NOTE 6: Only single switched UL is supported

Table 5.5B.3-1: Intra-band non-contiguous EN-DC configurations

EN-DC configuration	Uplink EN-DC configuration (NOTE 1)	Single UL allowed
DC_2A_n2A	DC_2A_n2A[5]	Yes[5]
DC_3A_n3A	DC_3A_n3A[2]	Yes[2]
DC_5A_n5A	DC_5A_n5A[5]	Yes[5]
DC_7A_n7A[6]	DC_7A_n7A[5]	Yes[5]
DC_41A_n41A[3] DC_41C_n41A[3] DC_41D_n41A[3]	DC_41A_n41A	Yes[4]
DC_48A_n48A[3]	DC_48A_n48A[5]	Yes[5]
DC_48A_(n)48AA[3]	DC_(n)48AA[5] DC_48A_n48A[5]	Yes[5]
DC_48A-48A_n48A[3]	DC_48A_n48A[5]	Yes[5]
DC_48C_n48A[3]	DC_48A_n48A[5]	Yes[5]
DC_48D_n48A[3]	DC_48A_n48A[5]	Yes[5]
DC_66A_n66A	DC_66A_n66A[5]	Yes[5]

NOTE 1: Uplink EN-DC configurations are the configurations supported by the present release of specifications.
NOTE 2: Only single switched UL is supported in Rel.15
NOTE 3: The minimum requirements only apply for non-simultaneous Tx/Rx between all carriers.
NOTE 4: Single UL allowed due to potential emission issues, not self-interference.
NOTE 5: Only single switched UL is supported.
NOTE 6: Requirements in this specification apply for NR SCS of 15 kHz only.

Observation 1: Besides DC_71_n71, DC_41_n41 and DC_3_n3, all other intra-band combinations can only support single switched UL
Observation 2: No dual uplink RF requirements are defined for EN-DC band combinations for which only single switched UL is supported
Observation 3: For some band combinations, e.g. DC_3_n3, only single switched UL is supported in Rel-15 while dual UL can be supported in Rel-16

Latest RAN4 agreement on SUO

- **RAN4 agreement on only single switched UL (R4-2011934)**
  - The existing capability “singleUL-Transmission” can be reused for these EN-DC band combinations for which only single switched UL is supported.

- **Observations**
  - Optional capability “singleUL-Transmission” is reused to indicate supporting only single switched UL
  - For UE supporting only single switched UL, NR could be dropped if dual UL scheduled by network
  - For UE supporting only single switched UL, it may violate the regulatory requirements if dual UL is scheduled by network as no RF requirements are specified for these EN-DC combinations in RAN4
  - For band combination which supports “only single switched UL” in early release, but dual UL in later release once the requirements for dual UL are specified, network cannot distinguish these two kinds of UE without capability indication
  - Relying on specific note in RAN4 spec rather than available UE capability needs frequent update of NW software version once new intra-band EN-DC combinations are added into RAN4 spec

Proposal for RAN#90-e

- To avoid unexpected performance degradation and possible violation of regulatory requirements, clarify in RAN2 specification that for intra-band EN-DC combinations which support only single switched UL, the capability ***singleUL-Transmission*** must be reported.

Proposed changes to TS 38.306

Definitions for parameters	Per	M	FDD-TDD DIFF	FR1-FR2 DIFF
singleUL-Transmission Indicates that the UE does not support simultaneous UL transmissions as defined in TS 38.101-3 [4]. The UE may only include this field for certain band combinations defined in TS 38.101-3 [4]. If included for a particular band combination, the field applies to all fallback band combinations of this band combination that are defined in TS 38.101-3 [4] as being allowed to include this field and does not apply to any other fallback band combinations defined in TS 38.101-3 [4]. For intra-band EN-DC band combinations indicated as “only single switched UL is supported” in TS 38.101-3 [4], the field shall be set to be supported.	BC	No	N/A	N/A