**3GPP TSG RAN WG1 #100bis-e R1-2002454**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on UE features for MR-DC/CA

Agenda Item: 7.2.11.10

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the discussions and proposals in AI 7.2.11.10 regarding UE features for MR-DC/CA.

In R1-2001484 [1] which is the version after [100e-NR-Rel-16-UEFeatures] email discussion, there are following feature groups for MR-DC/CA.

* 18-1 Basic UL power sharing for DC
* 18-1a Semi-static UL power sharing mode 2 for DC
* 18-1b Dynamic UL power sharing for DC
* [18-1] Synchronous NR-DC operation
* [18-1a] Non-SFN synchronous NR-DC operation
* [18-1b] Asynchronous NR-DC operation
* 18-2 Single UL TX operation for TDD PCell in intra-band EN-DC
* 18-2a Enhanced single UL TX operation for FDD Pcell EN-DC
* 18-3 Dual Tx transmission for EN-DC with FDD PCell(TDM pattern for dual Tx UE)
* 18-3a Semi-statically configured LTE UL transmissions in all UL subframes not limited to tdm-pattern
* 18-4 SCell dormancy within active time
* 18-4a SCell dormancy outside active time
* 18-5 Cross-carrier scheduling with different SCS
* [18-5a] Default QCL assumption for cross-carrier scheduling
* 18-6 Cross-carrier A-CSI RS triggering with different SCS
* [18-6a] Default QCL assumption for cross-carrier A-CSI-RS triggering
* 18-7 CA with non-aligned frame boundaries
* 18-8 HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group

Based on the discussions summarized in Section 2-11, following is the suggested list of issues to be discussed and priority order considering RAN2 impact especially for capability signaling design.

**FL proposal of list of issues/proposals and priority:**

**1st priority issues (such as a certain FG is necessary or not):**

* **18-1**
	+ **Whether to adopt FG18-1/18-1a/18-1b or FG[18-1]/[18-1a]/[18-1b]**
		- **Alt.1: Adopt FG18-1/18-1a/18-1b (i.e., remove FG[18-1]/[18-1a]/[18-1b])**
			* **It is clarified that FG18-1 is for both synchronous and asynchronous NR-DC scenarios**
			* **It is clarified that FG18-1a is for synchronous NR-DC scenario only**
			* **It is clarified for FG18-1b that T\_offset is only used for dynamic power sharing with look-ahead**
		- **Alt.2: Adopt FG[18-1]/[18-1a]/[18-1b] (i.e., remove FG18-1/18-1a/18-1b)**
			* **Whether [18-1] is removed or not, and whether it should be discussed in RAN or RAN1**
		- **Alt.3: Other if any**
* **18-4**
	+ **Whether new FG18-4b for “SCell dormancy indication without data scheduling within active time” is added or not**
* **18-5**
	+ **Confirm that FG[18-5a] for “Default QCL assumption for cross-carrier scheduling” is kept (i.e., remove bracket)**
		- **It is clarified that FG18-5a is only for same SCS**
	+ **Whether new FG for “UL CA with mixed numerologies” is added or not**
	+ **Whether new FG for “Cross-carrier scheduling with different SCS for URLLC” is added or not**
* **18-6**
	+ **Whether FG[18-6a] for “Default QCL assumption for cross-carrier A-CSI-RS triggering” is kept (i.e., remove bracket) or removed (i.e., added in 18-6)**
	+ **Whether new FG for “Cross-carrier A-CSI-RS triggering with different SCS for URLLC” is added or not**

**2nd priority issues (such as components, type and xDD/FRx differentiation that have capability signaling impacts):**

* **18-2/3**
	+ **Whether 18-3a is per band combination or per UE**
	+ **Whether the component 5 “if UE indicates that it does not support simultaneous UL transmissions as defined in TS 38.101-3 [4] using singleUL-Transmission, NR (SCG) UL transmission is dropped when an overlapping LTE (MCG) UL transmission is present (for type 1 UE)” for FG18-2/2a is kept (i.e., remove bracket) or removed**
	+ **Whether/how the FG18-2a/3a are modified so that the capabilities generally allow LTE UL transmissions outside the HARQ-ACK designated subframes for single-Tx operation**
* **18-4**
	+ **Whether FG18-4/4a/[4b] are per band combination or per UE**
* **18-5**
	+ **Whether per band is added for FG18-5/[5a] or not**
	+ **Whether the component 2 of 18-5 “Processing up to X unicast DCI scheduling (DL and UL) per scheduled CC” is kept or removed**
	+ **Whether the component 3 of 18-5 is added to FG[18-5a] or not**
	+ **Whether or not to define the maximum number of unicast DCIs in one scheduling slot/span across all scheduled cells**
* **18-6**
	+ **Whether per band is added for FG18-6/[6a] or not**
* **18-7**
	+ **Whether/how to define a signaling structure where the UE can indicate the grouping of cells across which the UE is capable of applying time offsets**

**3rd priority issues (can be postponed):**

* **18-2/3**
	+ **Whether/how to clarify some details for FG18-2/2a/3/3a as below**
		- **“LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern” or “LTE UL transmissions scheduled/triggered by a DCI in any UL subframe (for type1 UE)”**
		- **Whether or not to clarify that EN-DC single-Tx operation is for synchronous EN-DC**
		- **For 18-2 component 3, whether or not to clarify HARQ subframe offset is optional for EN-DC with LTE TDD PCell**
		- **For 18-3a component 3, whether or not to clarify it is for dynamic LTE UL transmissions**
		- **For 18-2, whether or not “intra-band” in the name of FG should be removed**
		- **For 18-2a, whether “TDD” should be removed from “Applicable to in FDD-LTE TDD-NR EN-DC” or not**
		- **Whether 18-3 is prerequisite for 18-3a or not**
* **18-4**
	+ **Whether/how to clarify some details for FG18-4/4a as below**
		- **FG6-5/6-6 are prerequisite for 18-4/4a**
		- **Clarify that a prerequisite condition is UE capability of supporting at least 2 BWPs**
* **18-8**
	+ **Whether the FG18-8 is mandatory for Rel-16 UE supporting FG6-7 or optional**
	+ **Whether the FG6-8 is prerequisite for FG18-8 or not**

Companies are encouraged to check above FL proposals and to provide feedback if any in below.

|  |  |
| --- | --- |
| Company | Comment |
| Apple | Regarding the priority summary of UE features in MR-DC/CA, may I suggest to move the following 2 items to priority 2: (they currently categorized to priority 3)  **18-2/3**  **Whether/how to clarify some details for FG18-2/2a/3/3a as below**  **For 18-2, whether or not “intra-band” in the name of FG should be removed**  **For 18-2a, whether “TDD” should be removed from “Applicable to in FDD-LTE TDD-NR EN-DC” or not**For the 1st item: the newly added text “intra-band” will directly impact FG type, i.e. whether it is per band or per BC. We believe this newly added text is not correct.For the 2nd item: the wording will impact the “TDD vs FDD” differentiation.I believe both of them fit into your criterion of priority 2. |
| MTK | Regarding the priority summary of UE features in MR-DC/CA, we suggest to move the following 2 items to priority 2: (which currently categorized to priority 3)* **18-2/3**
	+ **Whether/how to clarify some details for FG18-2/2a/3/3a as below**
		- **Whether or not to clarify that EN-DC single-Tx operation is for synchronous EN-DC**
			* **Reason: This highly impacted UE-implementation, and it is not clear to us how the TDM pattern defined in 18-2/3 can work for asynchronous EN-DC. Hence, this item should be clarified.**
		- **For 18-2 component 3, whether or not to clarify HARQ subframe offset is optional for EN-DC with LTE TDD PCell**
			* **Reason: RAN1 #98 agreement stated that the offset is optional for LTE TDD PCell for Type I UE (FFS for Type II UE). Therefore, at least the part for Type I UE should be captured.**

Agreements: (RAN1 #98)* Support HARQ-offset for SUO case1 in EN-DC with LTE TDD PCell
* Note: from UE perspective, it is expected that HARQ-offset value doesn’t violate the DL/UL configuration (in SIB1).
* For type 1 UE, the feature **is optional**. FFS for type 2 UE.
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| Huawei, HiSilicon | Regarding the priority summary of UE features in MR-DC/CA, we suggest to move the following 4 items to priority 2: (which currently categorized to priority 3)* **18-2/3**
	+ **Whether/how to clarify some details for FG18-2/2a/3/3a as below**
		- **For 18-2, whether or not “intra-band” in the name of FG should be removed**
		- **For 18-2a, whether “TDD” should be removed from “Applicable to in FDD-LTE TDD-NR EN-DC” or not**
		- **For 18-2 component 3, whether or not to clarify HARQ subframe offset is optional for EN-DC with LTE TDD PCell**
		- **Whether 18-3 is prerequisite for 18-3a or not**

As explained in our tdoc, the above first two corrections are important and sustained by agreements. For the third one, sustained by the agreement cited by MediaTek. For the forth one, sustained by the following RAN1#99 agreementsAgreements:For a UE configured with DL-reference DL/UL configuration in Rel-16 (including single Tx with LTE TDD PCell or LTE FDD PCell, and dual Tx cases):* For type 2 UE (i.e., UE without dynamic power sharing capability), any LTE UL transmissions should take place only in UL subframes designated for HARQ-ACK feedback.
* For type 1 UE (i.e., UE with dynamic power sharing capability),
	+ Confirm that any LTE UL transmissions scheduled/triggered by DCI can take place in UL subframes not designated for HARQ-ACK feedback.
	+ FFS UE is not expected to transmit semi-statically configured LTE UL transmissions in the UL subframes other than those designated as UL in the DL-reference configuration if such transmission collide with NR UL transmissions.

AgreementsFor the FFS part in the agreement above, * semi-statically configured LTE UL transmissions are allowed in all UL subframes.
	+ Note: In case of collision, LTE transmission is prioritized
	+ Note: this configuration is subject to UE capability

The following item is missing in the summary and should be added into the priority 2 along with the relevant issue about “component 5” which is also about the association with UE capability***singleUL-Transmission***  **For 18-2 and 2a, There should be a space between “single” and “UL” as captured in TS 38.306. Also its Italic format should be removed. This comment is also applied to FG 18-2a.**---------    In my previous response, the following item was proposed as the second priority. However, it should be categorized into the first priority because it will result in a new row for a new capability signaling.²  **For 18-2 component 3, whether or not to clarify HARQ subframe offset is optional for EN-DC with LTE TDD PCell** * High priority:

•                 Any change to the number of rows, i.e., deletion of rows, merging of rows, splitting of rows … |
| Qualcomm | * FG18-2, 18-3:

Ø  Agree with MediaTek’s proposal on the 2 items (should be moved to the 2nd priority).Ø  Following items under the 3rd priority highly depend on how we conclude a 2nd priority item *“Whether/how the FG18-2a/3a are modified so that the capabilities generally allow LTE UL transmissions outside the HARQ-ACK designated subframes for single-Tx operation”*. As long as we will discuss them based on the priority order, no problem to keep them under the 3rd priority for now.²  *“LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern” or  “LTE UL transmissions scheduled/triggered by a DCI in any UL subframe (for type1 UE)”*²  *For 18-3a component 3, whether or not to clarify it is for dynamic LTE UL transmissions*Ø  Following should be generic at this moment.²  *~~Whether 18-3~~ What is prerequisite for 18-3a ~~or not~~* |

# **Updated FL Proposals**

The moderator recommends following email discussions for FL Proposals 1 and 2 (only if following condition is met).

* High priority items are recommended for discussion starting Monday, April 20th, 2020. Ideally, discussions on high priority items can be concluded by Friday, April 24, 2020.
* Medium priority items are recommended for discussion starting at the time that high priority items are (almost) converged before Monday, April 27th, 2020, otherwise starting at Monday, April 27th, 2020.
* Low priority items are recommended for discussion starting at Monday, April 27th, 2020 only if high and medium priority items are converged before Monday, April 27th, 2020. Otherwise, discussion on low priority items will be postponed to next RAN1 meeting.

**FL Proposal 1 (high priority): Email discussion/approval on feature group structure for UL power sharing for NR-DC (20th-24th April)**

* **Discuss whether to adopt FG18-1/18-1a/18-1b or FG[18-1]/[18-1a]/[18-1b]**
	+ **Alt.1: Adopt FG18-1/18-1a/18-1b (i.e., remove FG[18-1]/[18-1a]/[18-1b])**
		- **It is clarified that FG18-1 is for both synchronous and asynchronous NR-DC scenarios**
		- **It is clarified that FG18-1a is for synchronous NR-DC scenario only**
		- **It is clarified for FG18-1b that T\_offset is only used for dynamic power sharing with look-ahead**
	+ **Alt.2: Adopt FG[18-1]/[18-1a]/[18-1b] (i.e., remove FG18-1/18-1a/18-1b)**
		- **Whether [18-1] is removed or not, and whether it should be discussed in RAN or RAN1**
	+ **Alt.3: Other if any**

**FL Proposal 2 (high priority): Email discussion/approval on feature group structure for cross-carrier operation with different SCS (20th-24th April)**

* **Confirm that FG[18-5a] for “Default QCL assumption for cross-carrier scheduling” is kept (i.e., remove bracket)**
	+ **It is clarified that FG18-5a is only for same SCS**
* **Discuss whether new FG for “UL CA with mixed numerologies” is added or not**
* **Discuss whether new FG for “Cross-carrier scheduling with different SCS for URLLC” is added or not**
* **Discuss whether FG[18-6a] for “Default QCL assumption for cross-carrier A-CSI-RS triggering” is kept (i.e., remove bracket) or removed (i.e., added in 18-6)**
* **Discuss whether new FG for “Cross-carrier A-CSI-RS triggering with different SCS for URLLC” is added or not**
* **Confirm to keep FG18-5/6**

**FL Proposal 3 (high priority): Email discussion/approval on feature group structure for other MR-DC/CA enhancements than UL power sharing for NR-DC and cross-carrier operation with different SCS (20th-24th April)**

* **For 18-2 component 3, discuss whether or not to clarify HARQ subframe offset is optional for EN-DC with LTE TDD PCell**
* **Discuss whether new FG18-4b for “SCell dormancy indication without data scheduling within active time” is added or not**
* **Confirm to keep FG18-2/2a/3/3a/4/4a/7/8**

**FL Proposal 4 (medium priority): Email discussion/approval on issues with capability signaling impacts for Enhancements to Single Tx Switched Uplink Solution for EN-DC (TBD)**

* **Discuss followings on FG18-2/2a/3/3a**
	+ **Whether 18-3a is per band combination or per UE**
	+ **Whether the component 5 “if UE indicates that it does not support simultaneous UL transmissions as defined in TS 38.101-3 [4] using singleUL-Transmission, NR (SCG) UL transmission is dropped when an overlapping LTE (MCG) UL transmission is present (for type 1 UE)” for FG18-2/2a is kept (i.e., remove bracket) or removed**
	+ **Whether/how the FG18-2a/3a are modified so that the capabilities generally allow LTE UL transmissions outside the HARQ-ACK designated subframes for single-Tx operation**
	+ **Whether/how to clarify some details for FG18-2/2a/3/3a as below**
		- **Whether or not to clarify that EN-DC single-Tx operation is for synchronous EN-DC**
		- **For 18-2, whether or not “intra-band” in the name of FG should be removed**
		- **For 18-2a, whether “TDD” should be removed from “Applicable to in FDD-LTE TDD-NR EN-DC” or not**
		- **What is prerequisite for 18-3a**

**FL Proposal 5 (medium priority): Email discussion/approval on issues with capability signaling impacts for other MR-DC/CA enhancements than single Tx switched uplink solution for EN-DC (TBD)**

* **Discuss whether FG18-4/4a/[4b] are per band combination or per UE**
* **Discuss followings on FG18-5**
	+ **Whether per band is added for FG18-5/[5a] or not**
	+ **Whether the component 2 of 18-5 “Processing up to X unicast DCI scheduling (DL and UL) per scheduled CC” is kept or removed**
	+ **Whether the component 3 of 18-5 is added to FG[18-5a] or not**
	+ **Whether or not to define the maximum number of unicast DCIs in one scheduling slot/span across all scheduled cells**
* **Discuss whether per band is added for FG18-6/[6a] or not**
* **Discuss whether/how to define a signaling structure where the UE can indicate the grouping of cells across which the UE is capable of applying time offsets**

# **18-1/18-1a/18-1b/[18-1]/[18-1a]/[18-1b]: UL power sharing for DC**

In [1], FG18-1/18-1a/18-1b and alternatives ([18-1]/[18-1a]/[18-1b]) are captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 18. MR-DC/CA enhancement | 18-1 | Basic UL power sharing for DC | Semi-static power sharing mode1 between MCG and SCG cells of same FR for NR dual connectivity. |  | Yes | N/A | Intra-frequency range DC is not supported by the UE | Per band combination | N/A | N/A |  | Absence means intra-FR DC is not supported.  | Optional with capability signalling |
| 18-1a | Semi-static UL power sharing mode 2 for DC | Semi-static power sharing mode 2 between MCG and SCG cells of same FR for NR dual connectivity. | 18-1 |  |  |  | Per band combination | N/A | N/A |  |  | Optional with capability signalling |
| 18-1b | Dynamic UL power sharing for DC | Dynamic power sharing between MCG and SCG cells of same FR for NR dual connectivity.1. Supported scenario for dynamic power sharing

T\_offset | 18-1 |  |  |  | Per band combination | N/A | N/A |  | 1) {Synch DC only, Sync and Async DC}2) {short, long} | Optional with capability signalling |
| [18-1] | Synchronous NR-DC operation | NR-DC operation with synchronization between MCG and SCGPower-sharing mode within the frequency range1. semi-static power-sharing mode 1
2. semi-static power-sharing mode 2
3. dynamic power-sharing and the value of T\_offset
 |  |  |  |  | Per band combination | N/A | N/A |  | Absence means synchronous NR-DC operation for the given band combination is not supported. 1) {Supported}2) {not supported, supported}3) {not supported, short, long} | Optional with capability signalling |
| [18-1a] | Non-SFN synchronous NR-DC operation | Operation with non-zero slot offset between MCG and SCGPower-sharing mode within the frequency range1. semi-static power-sharing mode 1
2. semi-static power-sharing mode 2
3. dynamic power-sharing and the value of T\_offset
 | 18-1 |  |  |  | Per band combination | N/A | N/A |  | Absence means non-SFN synchronous NR-DC operation for the given band combination is not supported.1) {Supported}2) {not supported, supported}3) {not supported, short, long} | Optional with capability signalling |
| [18-1b] | Asynchronous NR-DC operation | Operation with no slot alignment between MCG and SCGPower-sharing mode within the frequency range1. semi-static power-sharing mode 1
2. dynamic power-sharing and the value of T\_offset
 | 18-1 |  |  |  | Per band combination | N/A | N/A |  | Absence means asynchronous NR-DC operation for the given band combination is not supported. 1) {Supported}2) {not supported, supported}3) {not supported, short, long} | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| [3] | MediaTek Inc. | For the current RAN1 UE feature table of MR-DC/CA, we think the alternative 18-1/1a/1b structure marked in [ ] for intra-FR DC UL power control is more clear. Hence, we support the alternative ones.**Proposal 1: Adopt the alternative 18-1/1a/1b structure marked in [ ] for intra-FR DC UL power control in current RAN1 UE feature table.**

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| 18-1 | Synchronous NR-DC operation | NR-DC operation with synchronization between MCG and SCGPower-sharing mode within the frequency range1. semi-static power-sharing mode 1
2. semi-static power-sharing mode 2
3. dynamic power-sharing and the value of T\_offset
 |  |  |  |  | Per band combination | N/A | N/A |  | Absence means synchronous NR-DC operation for the given band combination is not supported. 1) {Supported}2) {not supported, supported}3) {not supported, short, long} | Optional with capability signalling |
| 18-1a | Non-SFN synchronous NR-DC operation | Operation with non-zero slot offset between MCG and SCGPower-sharing mode within the frequency range1. semi-static power-sharing mode 1
2. semi-static power-sharing mode 2
3. dynamic power-sharing and the value of T\_offset
 | 18-1 |  |  |  | Per band combination | N/A | N/A |  | Absence means non-SFN synchronous NR-DC operation for the given band combination is not supported.1) {Supported}2) {not supported, supported}3) {not supported, short, long} | Optional with capability signalling |
| 18-1b | Asynchronous NR-DC operation | Operation with no slot alignment between MCG and SCGPower-sharing mode within the frequency range1. semi-static power-sharing mode 1
2. dynamic power-sharing and the value of T\_offset
 | 18-1 |  |  |  | Per band combination | N/A | N/A |  | Absence means asynchronous NR-DC operation for the given band combination is not supported. 1) {Supported}2) {not supported, supported}3) {not supported, short, long} | Optional with capability signalling |

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| [4] | Intel Corporation | According to [1], two alternatives are proposed for features on power control. i.e. * Alt-1: FG 18-1/18-1a/18-1b;
* Alt-2: FG [18-1]/[18-1a]/[18-1b]

The key difference is which information is used to organize the features, the type of power control mode (Alt-1) or the type of synchronization (Alt-2). We prefer Alt-1 since it is aligned with the way to define UE features for power control for other cases, e.g. EN-DC. Based on Alt-1, further information needs to be added under 18-1/18-1a/18-1b for the behavior related to synchronization, look-ahead, etc. we provide our views below. * 18-1a: since semi-static PS mode 2 only applies to synchronized NN-DC, a clarification is needed
* 18-1b: it is not clear if T\_offset only applies to dynamic PS with look-ahead or applies to dynamic PS in general. A clarification is needed

**Proposal 1: Adopt FG18-1/18-1a/18-1b for dynamic power sharing of NN-DC** * **FG 18-1a, to clarify it is limited to synchronized NN-DC**
* **FG 18-1b: to clarify T\_offset is only used for dynamic PS with look-ahead**
 |
| [5] | Ericsson | * Proposed FGs [18-1], [18-1a], [18-1b],
	+ SFN sync between MCG and SCG is related to Rel15 parameter *sfn-SyncNRDC*. Since discussion related to this issue is ongoing in RAN (i.e., as per [2]), we propose to treat any related Rel16 discussion in RAN plenary instead of RAN1.
	+ If specifying a separate UE capability for synchronous NR-DC and asynchronous NR-DC, we propose to define ‘synchronous’ and ‘asynchronous’ according to requirements in 38.133 (i.e., NR-DC can have similar requirements as that of sync and async EN-DC currently captured in 38.133).
 |
| [6] | Nokia, Nokia Shanghai Bell | **18-1/1a/1b:** The suggested restructuring along Synchronous and Asynchronous DC does not seem necessary as the differentiation is not meaningful with all PC modes. Still it appears relevant to clarify the scenarios supported with each PC mode as follows:

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| 18-1 | Basic UL power sharing for DC | Semi-static power sharing mode1 between MCG and SCG cells of same FR for NR dual connectivity for both synchronous and asynchronous NR-DC scenarios. |  | Absence means intra-FR DC is not supported.  |
| 18-1a | Semi-static UL power sharing mode 2 for DC | Semi-static power sharing mode 2 between MCG and SCG cells of same FR for NR dual connectivity for synchronous NR-DC scenario. | 18-1 |  |
| 18-1b | Dynamic UL power sharing for DC | Dynamic power sharing between MCG and SCG cells of same FR for NR dual connectivity.1. Supported scenario for dynamic power sharing
2. T\_offset
 | 18-1 | 1) {Synch DC only, Sync and Async DC}2) {short, long} |

 |
| [7] | Qualcomm Incorporated | We believe the original 18-1, 18-1a, and 18-1b, should be replaced by the proposed [18-1], [18-1a], and [18-1b]. |
| [8] | Huawei, HiSilicon | The new added FG [18-1] with bracket should be removed. FG [18-1] is about Synchronous NR-DC operation, which should not be separated from FG18-1a since it is a special case of FG18-1a (non-SFN sync NR-DC), and RAN plenary decision RP-192345 mandates all Rel-16 UEs to support non-SFN sync NR-DC.***Proposal 1:*** *The new added FG 18-1 with bracket should be removed*

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 |

**Based on above, following points should be discussed for FG18-1/18-1a/18-1b.**

* **Whether to adopt FG18-1/18-1a/18-1b or FG[18-1]/[18-1a]/[18-1b]**
	+ **Alt.1:** **Adopt FG18-1/18-1a/18-1b (i.e., remove FG[18-1]/[18-1a]/[18-1b])**
		- **It is clarified that FG18-1 is for both synchronous and asynchronous NR-DC scenarios**
		- **It is clarified that FG18-1a is for synchronous NR-DC scenario only**
		- **It is clarified for FG18-1b that T\_offset is only used for dynamic power sharing with look-ahead**
	+ **Alt.2: Adopt FG[18-1]/[18-1a]/[18-1b] (i.e., remove FG18-1/18-1a/18-1b)**
		- **Whether [18-1] is removed or not, and whether it should be discussed in RAN or RAN1**
	+ **Alt.3: Other if any**

# **18-2/18-2a/18-3/18-3a:** **Enhancements to Single Tx Switched Uplink Solution for EN-DC**

In [1], FG18-2, 18-2a, 18-3 and 18-3a are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 18. MR-DC/CA enhancement | 18-2 | Single UL TX operation for TDD PCell in intra-band EN-DC | TDM restriction to LTE TDD PCell in EN-DC for *singleUL-Transmission* associated functionality when *tdm-patternConfig-r16* is configured1) TDD UL/DL configuration#2, #4, #5 configured as DL-reference UL/DL configuration 2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (for type 1 UE)3) HARQ subframe offset4) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern[5) if UE indicates that it does not support simultaneous UL transmissions as defined in TS 38.101-3 [4] using *singleUL-Transmission*, NR (SCG) UL transmission is dropped when an overlapping LTE (MCG) UL transmission is present (for type 1 UE).”] | EN-DC |  | N/A |  | Per band combination | Applicable to TDD-TDD EN-DC only | Applicable to FR1 only |  | Extension of the R15 capability *tdm-Pattern* to TDD PCell3) {not supported, supported} | Optional with capability signalling |
| 18-2a | Enhanced single UL TX operation for FDD Pcell EN-DC | TDM restriction to LTE FDD Pcell in EN-DC for *singleUL-Transmission* associated functionality when *tdm-patternConfig-r16* is configured1) DL-reference UL/DL configuration defined for LTE-FDD-SCell in LTE-TDD-FDD CA with LTE-TDD-PCell2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (for type 1 UE)3) HARQ sub-frame offset4) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern (for type 1 UE)[5) if UE indicates that it does not support simultaneous UL transmissions as defined in TS 38.101-3 [4] *using singleUL-Transmission*, NR (SCG) UL transmission is dropped when an overlapping LTE (MCG) UL transmission is present (for type 1 UE).”] | 6-13 |  | N/A |  | Per band combination | Applicable to in FDD-LTE TDD-NR EN-DC | Applicable to FR1 only |  | Enhancement to the R15 capability *tdm-Pattern* | Optional with capability signalling |
| 18-3 | Dual Tx transmission for EN-DC with FDD PCell(TDM pattern for dual Tx UE) | TDM restriction to LTE FDD PCell in EN-DC for dual UL Tx operation when *tdm-patternConfig-r16* is configured1) DL-reference UL/DL configuration defined for LTE-FDD-SCell in LTE-TDD-FDD CA with LTE-TDD-PCell2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (for type 1 UE)3) HARQ subframe offset4) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern | EN-DC |  | N/A |  | Per band combination | Applicable to EN-DC with LTE FDD PCell only | Applicable to FR1 only |  | Extension of the R15 capability *tdm-Pattern* to a 2Tx UE | Optional with capability signalling |
| 18-3a | Semi-statically configured LTE UL transmissions in all UL subframes not limited to tdm-pattern | UE configured with *tdm-patternConfig-r16* can be semi-statically configured with LTE UL transmissions in all UL subframes not limited to the reference tdm-pattern | 18-2, 18-2a |  |  |  | Per UE |  |  |  |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
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| [2] | ZTE Corporation | For Component 4 of FG-2, FG-2a and FG-3, the description ‘LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern’ is not very clear. ‘Any UL subframe of the TDM pattern’ seems to refer to the UL subframes designated as UL by TDM. However, FG-2a says this is only for type1 UE, which make this description confusing. We propose to update the Component 4 of FG-2, FG-2a and FG-3 as below.4) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe ~~of the TDM pattern~~ (for type1 UE). |
| [4] | Intel Corporation | HARQ subframe offset is agreed as optional feature for EN-DC with LTE TDD PCell in RAN1#98, which is not clearly reflected in FG 18-2 “3) HARQ subframe offset”. Since FG 18-3a was created for semi-static configured LTE UL transmission, component 4) in FG 18-2/2a/3 could be revised to apply to dynamic LTE UL transmission only. “3) Dynamic LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern (for type 1 UE)”. **Proposal 2: for single TX** * **FG 18-2, component 3, to clarify ARQ subframe offset is optional for EN-DC with LTE TDD PCell**
* **FG 18-3a, component 3, to clarify it is for dynamic LTE UL transmissions**
 |
| [5] | Ericsson | * FGs 18-2,18-2a
	+ Regarding component 5,
		- We propose to confirm addition of component 5. If shorter description is desirable it can be reworded as follows – “dropping of NR (SCG) UL transmission when an overlapping LTE (MCG) UL transmission is present (for Type 1 UEs that indicate lack of support of simultaneous UL transmissions using *singleUL-Transmission*)”.
 |
| [7] | Qualcomm Incorporated | We propose to update the latest feature groups as following. * Some changes on top of Rapporteur’s updated list are suggested.
* We propose to clarify that EN-DC single-Tx operation is for synchronous EN-DC.
* FG18-2a and FG18-3a can be UE capabilities that generally allows LTE UL transmissions outside the HARQ-ACK designated subframes for single-Tx operation.
* Some editorial changes have been made. Component [5] added in the Rapproteur’s version is not necessary, as it is the UE behavior, not the component of the UE feature group.

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| 18-2 | Single UL TX operation for TDD Pcell in intra-band EN-DC | TDM restriction to LTE TDD Pcell in EN-DC for *singleUL-Transmission* associated functionality when *tdm-patternConfig-r16* is configured1) TDD UL/DL configuration#2, #4, #5 configured as DL-reference UL/DL configuration 3) HARQ subframe offset] | EN-DC |  | N/A |  | Per band combination | Applicable to synchronous EN-DC with TDD-Pcell only | Applicable to FR1 only |  | Extension of the R15 capability *tdm-Pattern* to TDD Pcell3) {not supported, supported} | Optional with capability signalling |
| 18-2a | Enhanced single UL TX operation for FDD Pcell EN-DC | TDM restriction to LTE FDD Pcell in EN-DC for *singleUL-Transmission* associated functionality when *tdm-patternConfig-r16* is configured1) DL-reference UL/DL configuration defined for LTE-FDD-Scell in LTE-TDD-FDD CA with LTE-TDD-Pcell2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (for type 1 UE)3) HARQ sub-frame offset4) LTE UL transmissions scheduled/triggered by a DCI in any UL subframes (for type 1 UE)5) semi-statically configured LTE UL transmissions in any UL subframes (for type 1 UE)] | 6-13 |  | N/A |  | Per band combination | Applicable to synchronous EN-DC with FDD-Pcell only | Applicable to FR1 only |  | Enhancement to the R15 capability *tdm-Pattern* | Optional with capability signalling |
| 18-3 | Dual Tx transmission for EN-DC with FDD Pcell(TDM pattern for dual Tx UE) | TDM restriction to LTE FDD Pcell in EN-DC for dual UL Tx operation when *tdm-patternConfig-r16* is configured1) DL-reference UL/DL configuration defined for LTE-FDD-Scell in LTE-TDD-FDD CA with LTE-TDD-Pcell2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (for type 1 UE)3) HARQ subframe offset4) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern5) semi-statically configured LTE UL transmissions in any UL subframes (for type 1 UE) | EN-DC |  | N/A |  | Per band combination | Applicable to EN-DC with LTE FDD PCell only | Applicable to FR1 only |  | Extension of the R15 capability *tdm-Pattern* to a 2Tx UE | Optional with capability signalling |
| 18-3a | LTE UL transmissions in all UL subframes for FG18-2 | For a UE configured with *tdm-patternConfig-r16* for EN-DC single-Tx operation with TDD-Pcell, LTE UL transmissions in all UL subframes, not limite to tdm-pattern, is allowed1) PRACH transmission in non-designated UL subframes given by the DL-reference configuration (for type 1 UE)2) LTE UL transmissions scheduled/triggered by a DCI in any UL subframes (for type 1 UE)3) semi-statically configured LTE UL transmissions in any UL subframes (for type 1 UE) | 18-2 |  |  |  | Per band combination | Applicable to synchronous EN-DC with TDD-Pcell only |  |  |  | Optional with capability signaling |

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| [8] | Huawei, HiSilicon | * **FG 18-2**

The “intra-band” in the name of FG 18-2 should be removed, because it is not aligned with WID nor agreements. In the WID or agreements of RAN1 for single TX enhancement, there is no limitations that the MCG and the SCG should be in the same band.“3) HARQ subframe offset” should be modified to “HARQ subframe offset (Optional feature with Rel-15 FG 8-1 as prerequisite feature)”. This is exactly shown in the agreement, since it should be a separate capability signaling for HARQ subframe offset. One alternative is to take this component out and create a new FG for it.”There should be a space between “single” and “UL” as captured in TS 38.306. Also its Italic format should be removed. This comment is also applied to FG 18-2a.“Component 5” about association with 38.101-3 should be removed because it causes big confusion by overlapping with component 4, and not sustained by any agreement. This comment is also applied to FG 18-2a.***Proposal 2:*** *For FG 18-2 the following should be accepted.** *The “intra-band” in the name of FG 18-2 should be removed*
* *“3) HARQ subframe offset” should be modified to “HARQ subframe offset (Optional feature with Rel-15 FG 8-1 as prerequisite feature)”*
* *There should be a space between “single” and “UL”*
* *“Component 5” about association with 38.101-3 should be removed, as well as in FG 18-2a*
* **FG 18-2a**

“TDD” should be removed from “Applicable to in FDD-LTE TDD-NR EN-DC”, which is not aligned with agreements.***Proposal 3:*** *Remove “TDD” from “Applicable to in FDD-LTE TDD-NR EN-DC” in FG 18-2a.** **FG 18-3a**

Add 18-3 as prerequisite according to the RAN1#99 agreement***Proposal 4:*** *Add 18-3 as prerequisite in FG 18-3a according to the RAN1#99 agreement.*

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| 18-2 | Single UL TX operation for TDD PCell in EN-DC | TDM restriction to LTE TDD PCell in EN-DC for *singleUL-Transmission* associated functionality when *tdm-patternConfig-r16* is configured1) TDD UL/DL configuration#2, #4, #5 configured as DL-reference UL/DL configuration 2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (for type 1 UE)3) HARQ subframe offset (Optional feature with Rel-15 FG 8-1 as prerequisite feature)4) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern |  | Per band combination | Applicable to TDD-TDD EN-DC only | Applicable to FR1 only | Extension of the R15 capability *tdm-Pattern* to TDD PCell3) {not supported, supported} | Optional with capability signalling |
| 18-2a | Enhanced single UL TX operation for FDD Pcell EN-DC | TDM restriction to LTE FDD Pcell in EN-DC for *singleUL-Transmission* associated functionality when *tdm-patternConfig-r16* is configured1) DL-reference UL/DL configuration defined for LTE-FDD-SCell in LTE-TDD-FDD CA with LTE-TDD-PCell2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (for type 1 UE)3) HARQ sub-frame offset4) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern (for type 1 UE) |  | Per band combination | Applicable to in FDD-LTE NR EN-DC | Applicable to FR1 only | Enhancement to the R15 capability *tdm-Pattern* | Optional with capability signalling |
| 18-3a | Semi-statically configured LTE UL transmissions in all UL subframes not limited to tdm-pattern | UE configured with *tdm-patternConfig-r16* can be semi-statically configured with LTE UL transmissions in all UL subframes not limited to the reference tdm-pattern | 18-2, 18-2a, *18-3* | Per UE |  |  |  | Optional with capability signaling |

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**Based on above, following point should be discussed for FG18-2/2a/3/3a.**

* **Whether 18-3a is per band combination or per UE**
* **Whether the component 5 “if UE indicates that it does not support simultaneous UL transmissions as defined in TS 38.101-3 [4] using singleUL-Transmission, NR (SCG) UL transmission is dropped when an overlapping LTE (MCG) UL transmission is present (for type 1 UE)” for FG18-2/2a is kept (i.e., remove bracket) or removed**
* **Whether/how the FG18-2a/3a are modified so that the capabilities generally allow LTE UL transmissions outside the HARQ-ACK designated subframes for single-Tx operation**
* **Whether/how to clarify some details for FG18-2/2a/3/3a as below**
	+ **“LTE UL transmissions scheduled/triggered by a DCI in any UL subframe of the TDM pattern” or “LTE UL transmissions scheduled/triggered by a DCI in any UL subframe (for type1 UE)”**
	+ **Whether or not to clarify that EN-DC single-Tx operation is for synchronous EN-DC**
	+ **For 18-2 component 3, whether or not to clarify HARQ subframe offset is optional for EN-DC with LTE TDD PCell**
	+ **For 18-3a component 3, whether or not to clarify it is for dynamic LTE UL transmissions**
	+ **For 18-2, whether or not “intra-band” in the name of FG should be removed**
	+ **For 18-2a, whether “TDD” should be removed from “Applicable to in FDD-LTE TDD-NR EN-DC” or not**
	+ **Whether 18-3 is prerequisite for 18-3a or not**

# **18-4/18-4a: SCell dormancy indication**

In [1], FG18-4 and 18-4a are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 18. MR-DC/CA enhancement | 18-4 | SCell dormancy within active time | Support for SCell dormancy indication sent within the active time on PCell with DCI format 0\_1/1\_1 |  |  | N/A |  | Per UE | No | No |  |  | Optional with capability signalling |
| 18-4a | SCell dormancy outside active time | Support for SCell dormancy indication sent outside the active time on PCell with DCI format 2\_6 | [19-1] |  |  |  | Per UE | No | No |  |  | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [3] | MediaTek Inc. | For FG 18-4, two Cases of SCell dormancy indication are supported when the indication is sent within DRX Active Time.* Case 1 SCell dormancy indication:
	+ DCI format 0\_1 and 1\_1 with additional bit field “SCell dormancy indication” are used.
	+ Case 1 DCI can still schedule PDSCH/PUSCH, and the timeline for HARQ-ACK information feedback is the same as N1 in Rel-15.
	+ 1 bit in “SCell dormancy indication” indicates SCell dormancy/non-dormancy for a group of SCells.
* Case 2 SCell dormancy indication:
	+ DCI format 1\_1 with some repurposed bit fields is used.
	+ Case 2 DCI cannot schedule PDSCH but UE still needs to report HARQ-ACK information. Its HARQ-ACK report timeline is tighter than in Case 1. (working assumption: timeline is the same as in HARQ-ACK information report for SPS PDSCH release).
	+ 1 bit of SCell dormancy indication indicates SCell dormancy/non-dormancy for a SCell.

Because of many differences between Case 1 and Case 2 SCell dormancy indication, it is more reasonable to have separated FGs for them. We suggest the following revisions:**Proposal 2:*** **FG 18-4: SCell dormancy indication with data scheduling within active time**
	+ **Support for SCell dormancy indication sent within the active time on PCell with DCI format 0\_1/1\_1 scheduling PUSCH/PDSCH**
* **Add FG 18-4b: SCell dormancy indication without data scheduling within active time**
	+ **Support for SCell dormancy indication sent within the active time on PCell via DCI format 1\_1 without PDSCH scheduling**

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| 18-4 | SCell dormancy indication with data scheduling within active time | Support for SCell dormancy indication sent within the active time on PCell with DCI format 0\_1/1\_1 scheduling PUSCH/PDSCH |  |  | N/A |  | Per UE | No | No |  |  | Optional with capability signalling |
| 18-4a | SCell dormancy outside active time | Support for SCell dormancy indication sent outside the active time on PCell with DCI format 2\_6 | 19-1 |  |  |  | Per UE | No | No |  |  | Optional with capability signalling |
| 18-4b | SCell dormancy indication without data scheduling within active time | Support for SCell dormancy indication sent within the active time on PCell via DCI format 1\_1 without PDSCH scheduling |  |  | N/A |  | Per UE | No | No |  |  | Optional with capability signaling |

 |
| [4] | Intel Corporation | FG 18-4: There is no PDCCH/PDSCH transmission for a dormant BWP. A UE supporting one dormant BWP plus one non-dormant BWP is not equal to support two BWPs with PDCCH/PDSCH transmissions. Therefore, it is better to clarify that a prerequisite condition is UE capability of supporting at least 2 BWPs. Otherwise, it is not clear regarding the relation between SCell dormancy and multi-BWP operation. **Proposal 3: for SCell dormancy,** * **FG 18-2, component 3, to clarify that a prerequisite condition is UE capability of supporting at least 2 BWPs.**
 |
| [6] | Nokia, Nokia Shanghai Bell | **18-4:** * Should be clear that there are two cases, the DCI format scheduling PUSCH/PDSCH and the DCI format not scheduling PDSCH. We do not propose this to be split in separate capabilities but clarify that both cases are supported.

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| --- | --- | --- |
| 18-4 | SCell dormancy within active time | Support for SCell dormancy indication sent within the active time on PCell with DCI format 0\_1/1\_11. DCI format 1\_1 without scheduling PDSCH
2. DCI format 0\_1/1\_1 with scheduling PUSCH/PDSCH
 |

 |
| [7] | Qualcomm Incorporated | On FG 18-4 and 18-4a, there was a comment “Rapporteur: see comments above” to our previous proposal for email discussion. This comment seems to refer to a similar proposal form Huawei. However, there was no comments under Huawei’s proposal either. We prefer “per band combination” so that it provides more flexibility to UE to selectively support Scell dormancy. Besides we observed that most of the feature groups in MR/DC-CA enhancement are also “Per band combination” which is aligned with our proposal for Scell dormancy.

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| 18-4 | Scell dormancy within active time | Support for Scell dormancy indication sent within the active time on Pcell with DCI format 0\_1/1\_1 |  |  | N/A |  | Per band combination | No | No |  |  | Optional with capability signalling |
| 18-4a | Scell dormancy outside active time | Support for Scell dormancy indication sent outside the active time on Pcell with DCI format 2\_6 | [19-1] |  | N/A |  | Per band combination | No | No |  |  | Optional with capability signalling |

 |
| [8] | Huawei, HiSilicon | * **FG 18-4/4a**

FG 6-5/6-6 should be as pre-requisiteChange the reporting type from ‘per UE’ to ‘per BC’, and at this stage please put per UE in bracket. ***Proposal 5:*** *FG 6-5/6-6 should be as pre-requisite and Change the reporting type from ‘per UE’ to ‘per BC’ in FG 18-4/4a*

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18-4 | SCell dormancy within active time | Support for SCell dormancy indication sent within the active time on PCell with DCI format 0\_1/1\_1 | *FG 6-5/6-6* | *Per BC* | No | No |  | Optional with capability signalling |
| 18-4a | SCell dormancy outside active time | Support for SCell dormancy indication sent outside the active time on PCell with DCI format 2\_6 | [19-1] , *FG 6-5/6-6* | *Per BC* | No | No |  | Optional with capability signalling |

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**Based on above, following points should be discussed for FG18-4/4a.**

* **Whether new FG18-4b for “SCell dormancy indication without data scheduling within active time” is added or not**
* **Whether FG18-4/4a/[4b] are per band combination or per UE**
* **Whether/how to clarify some details for FG18-4/4a as below**
	+ **FG6-5/6-6 are prerequisite for 18-4/4a**
	+ **Clarify that a prerequisite condition is UE capability of supporting at least 2 BWPs**

# **18-5/[18-5a]: Cross-carrier scheduling with different SCS**

In [1], FG18-5 and [18-5a] are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 18. MR-DC/CA enhancement | 18-5 | Cross-carrier scheduling with different SCS | 1) The UE supports cross carrier scheduling for the different numerologies with carrier indicator field (CIF) in DL carrier aggregation where numerologies for the scheduling cell and scheduled cell are different[2) Processing up to X unicast DCI scheduling (DL and UL) per scheduled CC ][3 Default QCL assumption for cross-carrier scheduling with different SCS] |  |  | N/A |  | Per band combination | No | No |  | crossCarrierScheduling-OtherSCS 1) {Scheduling cell of lower SCS and scheduled cell of higher SCS, Scheduling cell of higher SCS and scheduled cell of lower SCS, both}[2) ]X is based on pair of (scheduling CC SCS, scheduled CC SCS):[4] for (15,120), (15,60), (30,120), [2] for (15,30), (30,60), (60,120 kHz), Note: This applies also to the case where there is a single span in the slot for the scheduling CC.In case UE supports 3-5b, the limits apply for each span for FDD scheduling cell and TDD scheduling cell. | Optional with capability signalling |
| [18-5a] | Default QCL assumption for cross-carrier scheduling  | Indicates whether the UE can be configured with *enabledDefaultBeamForCCS* for default QCL assumption for cross-carrier scheduling with same SCS. |  |  |  |  | Per band combination |  |  |  | FFS if this is needed or if it should cover also component 3 of 18-5 | Optional with capability signalling |

Following feedback is provided in a contribution for the RAN1#100bis-e meeting.

|  |  |  |
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| [2] | ZTE Corporation | According to RAN1#98bis meeting, UE vendors may have the concern that too many unicast DCIs are placed within one monitoring occasion if one scheduling cell cross-carrier schedules a large number of scheduled cells. In this case, the maximum number of unicast DCIs in one scheduling slot/span across all scheduled cells can be defined.***Proposal 1:*** *Increase the number of valid DCIs in a PDCCH monitoring occasion to at least 4;**Define the maximum number of unicast DCIs in one scheduling slot/span across all scheduled cells.*The current Rel-15 DAI counting mechanism assumes that only up to one unicast DL DCI is in each monitoring occasion for each scheduled cell, which doesn’t cover the case that more than one unicast DL DCI is received for the same scheduled cell. More than one unicast DL DCI for one scheduled cell is a typical case for cross-carrier scheduling with smaller SCS for the scheduling cell. For example, the scheduling cell is of 15 KHz SCS and the scheduled cell is of 120 KHz SCS, where one 15 KHz slot equals to 8 120 KHz slots. For full flexibility, up to 8 unicast DCIs may need to be transmitted within one MO. Thus, the new DAI counting order shall also take this case into account. For PDSCHs scheduled from the same MO for the same scheduled cell, the PDSCH starting time can be used for DAI counting. Combined with the Rel-15 DAI counting order, the new DAI counting order can be summarized as below:1. First in ascending order of PDSCH starting time;
2. Second in ascending order of serving cell index;
3. Third in ascending order of MO index.

***Proposal 2****: If the maximum number of unicast DCIs per MO is increased, the PDSCH starting time in addition to the existing MO and Cell index is introduced to order the HARQ-ACK feedback.***Figure 2.** DAI count order if more than one DCI is received within one MO. |
| [3] | MediaTek Inc. | For FG 18-5: Cross-carrier scheduling with different SCS, it is sufficient to reuse the Rel. 16 FG 3-5b PDCCH monitoring to have multiple DCIs in one slot of the scheduling cell with lower SCS than the scheduled cell. This has the benefit of avoiding introducing additional impact to the spec (e.g., new design for HARQ-ACK codebook). We think the value of X is not needed. Besices, it is recommended to add ‘Per band’ to support the feature for CA within certain bands or not. **Proposal 3: RAN1 agree to reuse the Rel. 16 FG 3-5b PDCCH monitoring to have multiple DCIs in one slot of the scheduling cell with lower SCS than the scheduled cell. Delete the descriptions related to value X. Add ‘Per band’ to FG 18-5 to support the feature for CA within certain bands or not.**For FG [18-5a]: Default QCL assumption for cross-carrier scheduling with same SCS, we support to keep this capability for better UE implementation flexibility.**Proposal 4: Keep “18-5a Default QCL assumption for cross-carrier scheduling with same SCS” in current RAN1 UE feature table.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18-5 | Cross-carrier scheduling with different SCS | 1) The UE supports cross carrier scheduling for the different numerologies with carrier indicator field (CIF) in DL carrier aggregation where numerologies for the scheduling cell and scheduled cell are different[2 Default QCL assumption for cross-carrier scheduling with different SCS] |  |  | N/A |  | Per band combination | No | No |  | crossCarrierScheduling-OtherSCS 1) {Scheduling cell of lower SCS and scheduled cell of higher SCS, Scheduling cell of higher SCS and scheduled cell of lower SCS, both} | Optional with capability signalling |
| 18-5a | Default QCL assumption for cross-carrier scheduling with same SCS | Indicates whether the UE can be configured with *enabledDefaultBeamForCCS* for default QCL assumption for cross-carrier scheduling with same SCS. | 6-10 |  |  |  | Per band combination |  |  |  |  | Optional with capability signalling |

 |
| [4] | Intel Corporation | FG 18-5 component 2): it is not clear which interpretation is correct.* Interpretation #1: X DL DCI + X UL DCI, i.e. gNB can transmit up to 2X DCI per scheduled cell
* Interpretation #2: totally X DCIs, i.e. gNB can transmit up to X DCI per scheduled cell

As discussed in [2], the main motivation for X>1 is for the case that the scheduling cell has a SCS shorter than scheduled cell. For better scheduling flexibility on the scheduled cell, the number of PDCCH detections needs to be increased. Another limitation is the maximum number of DL DCIs that schedule PDSCH on a same cell. If the maximum number is more than 4, it is not enough to rely on C-DAI as additional dimension in HARQ-ACK bit ordering for Type1 HARQ-ACK codebook. Some alternative options were proposed in early meetings. However, it is not likely to converge on any option. Therefore, we prefer to define $X=min\left(2^{u\_{PDSCH}-u\_{PDCCH}},4\right)$. The current value of X in [1] is OK. FG 18-5a: it could be a separate feature since all 3 components in FG 18-1 are related to cross-carrier scheduling with different SCS. **Proposal 4: for *Cross-carrier scheduling with different numerology,**** **FG 18-5 component 2): it is not clear which interpretation is correct.**
	+ **Interpretation #1: X DL DCI + X UL DCI, i.e. gNB can transmit up to 2X DCI per scheduled cell**
	+ **Interpretation #2: totally X DCIs, i.e. gNB can transmit up to X DCI per scheduled cell**
* **To confirm that**
	+ **X=4 for (15,120), (15,60), (30,120),**
	+ **X=2 for (15,30), (30,60), (60,120 kHz**),
* **FG 18-5a can be separate feature**
 |
| [5] | Ericsson | * Propose to add new FG 18-5b for UL CA with mixed numerologies
	+ The feature for cross-carrier scheduling with mixed numerology for uplink carrier aggregation is missing since 18-5 describes only DL CA. Introduce a new feature 18-5b for supporting UL CA, mirroring 18-5 with following changes:
		- * Change DL CA to UL CA in component 1)
			* Delete component 3)
* FG 18-5
	+ Regarding component 2
		- We propose to confirm the text in square brackets around component 2. For improved scheduling flexibility (e.g. contiguous scheduling) and efficient operation, especially in case of low SCS scheduling high SCS, it is desirable to allow increasing number of DCIs within a span.
	+ Regarding component 3
		- Propose to confirm the text in square brackets as default beam for different SCS case does not need separate capability.
* FG 18-5a
	+ Prefer to define this capability only for same SCS as different SCS can be handled by 18-5.
 |
| [6] | Nokia, Nokia Shanghai Bell | **18-5:** * Component 2: support the proposal where the X is based on the scheduling/scheduled carrier SCS combination as currently written in the table. The proposed values for X are reasonable. The component should be clarified that the X is defined per span.
* Component 3: This should be included as a basic component as always supported when UE indicates support for 18-5

**18-5a:** OK to have this new FG. Add pre-requisite 6-10 Cross carrier scheduling for the same numerology |
| [7] | Qualcomm Incorporated | On FG 18-5, we propose to add ‘Per band’ to selectively support the feature for CA within certain bands.On component 2 of FG 18-5, based on early RAN1 discussions, we observed that it is sufficient to use the Rel. 16 FG 3-5b PDCCH monitoring to have multiple DCIs in one slot of the scheduling cell with a lower SCS than the scheduled cell. There are discussions on whether a UE should support all components in an FG if the UE supports any. At least for FG 18-5, we think the UE should not be required to automatically support component 2 because the UE reports to support cross-carrier scheduling with different SCS as described by component 1.On component 3 of FG 18-5, similar to component 2, we would like to clarify whether a UE must support all components in an FG if the UE supports any.On FG 18-5a, we support to include this FG in the UE features. It can be further discussed whether 18-5a and 18-5 compnent 3 can be merged together. If they are merged together, compnent 3 of FG 18-5 is added to FG 18-5a, but not the other way round.~We can calrify more on our proposals. The intent is not to differentiate UE behaviours between DCI formats 0\_1/1\_1 and DCI formats 0\_2/1\_2 but to differentiate UE behaviours between eURLLC and eMBB. It is not clear to us how eURLLC benefits from the feature. It is also too restrictive if a UE must support cross-carrier scheduling with different SCS for both or neither of eMBB and eURLLC simultaneously. In the updated proposals below, DCI formats are removed from the “components” field.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18-5 | Cross-carrier scheduling with different SCS | 1) The UE supports cross carrier scheduling for the different numerologies with carrier indicator field (CIF) in DL carrier aggregation where numerologies for the scheduling cell and scheduled cell are different[2] Processing up to X unicast DCI scheduling (DL and UL) per scheduled CC ][3 Default QCL assumption for cross-carrier scheduling with different SCS] |  |  | N/A |  | Per band and per band combination | No | No |  | crossCarrierScheduling-OtherSCS 1) {Scheduling cell of lower SCS and scheduled cell of higher SCS, Scheduling cell of higher SCS and scheduled cell of lower SCS, both}[2] ]X is based on pair of (scheduling CC SCS, scheduled CC SCS):[4] for (15,120), (15,60), (30,120), [2] for (15,30), (30,60), (60,120 kHz), Note: This applies also to the case where there is a single span in the slot for the scheduling CC.In case UE supports 3-5b, the limits apply for each span for FDD scheduling cell and TDD scheduling cell. | Optional with capability signalling |
| [18-5a] | Default QCL assumption for cross-carrier scheduling  | Indicates whether the UE can be configured with *enabledDefaultBeamForCCS* for default QCL assumption for cross-carrier scheduling with same SCS. |  |  |  |  | Per band and per band combination |  |  |  | FFS if this is needed or if it should cover also component 3 of 18-5 | Optional with capability signalling |
| 18-5b | Cross-carrier scheduling with different SCS for URLLC | The UE supports cross-carrier scheduling with different SCS for URLLC |  | Yes | N/A |  | Per band and per band combination | No | No |  | 1) {Scheduling cell of lower SCS and scheduled cell of higher SCS, Scheduling cell of higher SCS and scheduled cell of lower SCS, both} | Optional with capability signalling |

 |

**Based on above, following points should be discussed for FG18-5/[5a].**

* **Confirm that FG[18-5a] for “Default QCL assumption for cross-carrier scheduling” is kept (i.e., remove bracket)**
	+ **It is clarified that FG18-5a is only for same SCS**
* **Whether new FG for “UL CA with mixed numerologies” is added or not**
* **Whether new FG for “Cross-carrier scheduling with different SCS for URLLC” is added or not**
* **Whether per band is added for FG18-5/[5a] or not**
* **Whether the component 2 of 18-5 “Processing up to X unicast DCI scheduling (DL and UL) per scheduled CC” is kept or removed**
* **Whether the component 3 of 18-5 is added to FG[18-5a] or not**
* **Whether or not to define the maximum number of unicast DCIs in one scheduling slot/span across all scheduled cells**

# **18-6/[18-6a]: Cross-carrier A-CSI RS triggering with different SCS**

In [1], FG18-6 and [18-6a] are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 18. MR-DC/CA enhancement | 18-6 | Cross-carrier A-CSI RS triggering with different SCS | Cross-carrier A-CSI RS triggering with different SCS | 2-33 |  | N/A |  | Per band combination | No | No |  | 1) {PDCCH cell of lower SCS and A-CSI RS cell of higher SCS, PDCCH cell of higher SCS and A-CSI-RS of lower SCS, both} .  | Optional with capability signalling |
| [18-6a] | Default QCL assumption for cross-carrier A-CSI-RS triggering | Indicates whether the UE can be configured with *enabledDefaultBeamForCCS* for default QCL assumption for cross-carrier A-CSI-RS triggering. |  |  |  |  | Per band combination |  |  |  | FFS if this is needed | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [3] | MediaTek Inc. | For FG [18-6a]: Default QCL assumption for cross-carrier A-CSI-RS triggering, we support to keep this capability for better UE implementation flexibility.**Proposal 5: Keep “18-6a Default QCL assumption for cross-carrier A-CSI-RS triggering” in current RAN1 UE feature table.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18-6a | Default QCL assumption for cross-carrier A-CSI-RS triggering | Indicates whether the UE can be configured with *enabledDefaultBeamForCCS* for default QCL assumption for cross-carrier A-CSI-RS triggering. |  |  |  |  | Per band combination |  |  |  |  | Optional with capability signalling |

 |
| [6] | Nokia, Nokia Shanghai Bell | **18-6a**: This should be made a mandatory component of 18.6. No need for a separate capability  |
| [7] | Qualcomm Incorporated | One FG 18-6* We propose to update feature type same as FG 18-5.
* Minor changes were made by adding “cell” and replaing a “-” with space for the second A-CSI RS to keep wording consistency.

On FG 18-6a, we propose to remove the FFS.~We can calrify more on our proposals. The intent is not to differentiate UE behaviours between DCI formats 0\_1/1\_1 and DCI formats 0\_2/1\_2 but to differentiate UE behaviours between eURLLC and eMBB. It is not clear to us how eURLLC benefits from the feature. It is also too restrictive if a UE must support cross-carrier scheduling with different SCS for both or neither of eMBB and eURLLC simultaneously. In the updated proposals below, DCI formats are removed from the “components” field.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18-6 | Cross-carrier A-CSI RS triggering with different SCS | Cross-carrier A-CSI RS triggering with different SCS | 2-33 |  | N/A |  | Per band and per combination | No | No |  | 1) {PDCCH cell of lower SCS and A-CSI RS cell of higher SCS, PDCCH cell of higher SCS and A-CSI RS cell of lower SCS, both} .  | Optional with capability signalling |
| [18-6a] | Default QCL assumption for cross-carrier A-CSI-RS triggering | Indicates whether the UE can be configured with *enabledDefaultBeamForCCS* for default QCL assumption for cross-carrier A-CSI-RS triggering. |  |  |  |  | Per band and per combination |  |  |  | FFS if this is needed | Optional with capability signalling |
| 18-6b | Cross-carrier A-CSI RS triggering with different SCS for URLLC | The UE supports cross-carrier A-CSI RS triggering with different SCS for URLLC  |  | Yes | N/A |  | Per band and per band combination | No | No |  | 1) {PDCCH cell of lower SCS and A-CSI RS cell of higher SCS, PDCCH cell of higher SCS and A-CSI-RS cell of lower SCS, both}.  | Optional with capability signalling |

 |

**Based on above, following points should be discussed for FG18-6/[6a].**

* **Whether FG[18-6a] for “Default QCL assumption for cross-carrier A-CSI-RS triggering” is kept (i.e., remove bracket) or removed (i.e., added in 18-6)**
* **Whether new FG for “Cross-carrier A-CSI-RS triggering with different SCS for URLLC” is added or not**
* **Whether per band is added for FG18-6/[6a] or not**

# **18-7: CA with non-aligned frame boundaries**

In [1], FG18-7 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 18. MR-DC/CA enhancement | 18-7 | CA with non-aligned frame boundaries | CA with non-aligned frame boundaries for inter-band CA |  |  | N/A |  | Per band combination | No | No |  | Defines whether the UE supports carrier aggregation operation where the frame boundaries of the PCell and the SCell are not aligned, while the slot boundaries are. | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [7] | Qualcomm Incorporated | * There should be a signaling structure recommended to RAN2, where the UE can indicate the grouping of cells across which the UE is capale of applying time offsets. For example, the UE can only apply offset between TDD bands but not between FDD bands, etc.
 |

**Based on above, following point should be discussed for FG18-7.**

* **Whether/how to define a signaling structure where the UE can indicate the grouping of cells across which the UE is capable of applying time offsets**

# **18-8: HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group**

In [1], FG18-8 is captured with bracket as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 18. MR-DC/CA enhancement | 18-8 | HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group | HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group | 6-7 |  | N/A |  | Per UE | No | No |  | Support HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group.Rel-15 had this per cell group | [Optional with capability signalling or Mandatory conditioned to support for multiple PUCCH groups 6-7] |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [3] | MediaTek Inc. | For FG 18-8: HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group, since this is a new Rel-16 feature, it should be optional with capability signaling.**Proposal 6: FG “18-8 HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group” should be optional with capability signaling.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18-8 | HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group | HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group | 6-7 |  | N/A |  | Per UE | No | No |  | Support HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group.Rel-15 had this per cell group | Optional with capability signalling |

 |
| [6] | Nokia, Nokia Shanghai Bell | **18-8**: Support that this is a mandatory feature for Rel-16 UEs supporting FG6-7 |
| [8] | Huawei, HiSilicon | * **FG 18-8**

There is no need to restrict to same SCS case only with only 6-7 as the pre-requisite, so 6-8 can also be pre-requisite FG and/or the condition for mandatory support.***Proposal 6:*** *There is no need to restrict to same SCS case only with only 6-7 as the pre-requisite in FG 18-8* |

**Based on above, following point should be discussed for FG18-8.**

* **Whether the FG18-8 is mandatory for Rel-16 UE supporting FG6-7 or optional**
* **Whether the FG6-8 is prerequisite for FG18-8 or not**

# **References**

[1] R1-2001484 RAN1 UE features list for Rel-16 NR after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001631 Discussion on UE feature for MR-DC CA ZTE

[3] R1-2001833 Views on Rel-16 UE features for MR-DC/CA MediaTek Inc.

[4] R1-2002024 UE feature for MR-DC Intel Corporation

[5] R1-2002426 Discussion on UE features for MR-DC Ericsson

[6] R1-2002477 On UE features for MR-DC/CA Nokia, Nokia Shanghai Bell

[7] R1-2002571 Discussion on UE features for MR-DC/CA Qualcomm Incorporated

[8] R1-2002595 Rel-16 UE features for MR-DC/CA Huawei, HiSilicon