3GPP TSG-RAN WG2 Meeting #110-e R2-200xxxx

Elbonia, Online, 01 – 12 June 2020

**Agenda item: 6.7.6**

**Source: Nokia, Nokia Shanghai Bell**

**Title: E-mail discussion: [AT110e][048][IIOT] UE capabilities (Nokia)**

**WID/SID: NR\_IIOT - Release 16**

**Document for: Discussion and Decision**

# 1 Introduction

Section 2 and Section 3 of this document contain summary of company contributions [1] through [20] and are copied from a Tdoc summary document provided in R2-2004681 [21]:

* Contributions [1] through [15] were submitted to Agenda Item 6.7.6 UE capabilities
* Contributions [16] through [20] were submitted to other IIOT agenda items, but discuss capability related issues as well

Section 4 aims at gathering companies views within the Phase 1 of the following e-mail discussion:

* [AT110e][048][IIOT] UE capabilities (Nokia)

Scope: Treat R2-2004681, determine agreeable parts and and make agreements. Implement meeting agreements in updated CRs.

 Part 1: Agreements (rapporteur sets the deadline)

 Part 2: Endorsed CRs 38306 38331 36306 36331 (For merge, good Q cover sheet etc)

 Deadline: June 11 0700 UTC

# 2 Summary of Tdocs (as per R2-2004681 [21])

## 2.1 Relation between PHY-based prioritization and LCH-based prioritization

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| Company [Tdoc] | Proposal | Rationale from the Tdoc |
| vivo [3] | Proposal 2: The UE supporting the MAC priority shall also support the PHY priority. | If the UE supporting the MAC priority does not support the PHY priority, it is not clear how the PHY would handle the two MAC PDUs provided by the MAC. |
| LG Electronics Inc. [10] | Proposal: LCH-based prioritization and PHY-based prioritization are configured together. | Technically there is no issue with configuring only one prioritization function, but the usefulness of such configuration is questionable.  |
| Samsung [13] | Proposal 2. LCH based prioritization can be supported without PHY prioritization. | RAN1 and RAN2 have been discussing PHY-based prioritization and LCH-based prioritization independently and it is possible to configure them separately. |
| Nokia, Nokia Shanghai Bell [2] | Proposal 1: The UE supporting LCH based prioritization shall also support PHY based prioritization and vice versa. | Full advantages of the intra-UE prioritization can be exploited in case PHY-based prioritization and LCH-based prioritization are applied together. |
| Huawei, HiSilicon [20] | Proposal: RAN2 will not specify anything to support the case that only one of LCH-based prioritization and PHY-based prioritization is configured. | If PHY-based prioritization is not configured, it would be up to UE implementation which MAC PDU is transmitted if there are two overlapped MAC PDUs delivered to PHY, and this is conflicting with L2 decision.If PHY-based prioritization is configured but LCH-based prioritization is not configured, MAC will not deliver overlapped MAC PDUs to PHY, and this configuration would make PHY-based prioritization useless. |

Rapporteur summary:

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| 1 company suggests that LCH-based prioritization should be supported only together with PHY-based prioritization. 1 company indicates it should not be possible to configure two types of prioritization separately for highest gains and 1 copmany believes LCH-based prioritization and PHY-based prioritization should be typically configured together and RAN2 should not over-specify for the case that only of them is configured..1 company proposes that these capabilities should be independent.1 company proposes that the UE shall always support both types of prioritization.Based on the above, there is a tendency towards requiring the UE to always support both types of prioritization. However, since the similar discussion is ongoing in RAN1 at the moment and since the way configurability aspect is resolved impacts the dependency between PHY-based prioritzation and LCH-based prioritzation capabilities, it is proposed to wait for further RAN1 input on this matter before making the final decision in RAN2. **Proposal 1: Decide on the dependency between PHY-based prioritization and LCH-based prioritization capabilities after confirming whether they can be configured separately and after receiving further RAN1 input on IIOT capabilities.**  |

## 2.2 Joint EHC and RoHC operation

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| Company [Tdoc] | Proposal | Rationale from the Tdoc |
| vivo [3] | Proposal 1: The UE indicates whether it supports joint the ROHC and EHC operation. | Since the buffer for the compression context could be shared between ROHC and EHC, UE should be able to indicate it does not support joint EHC+RoHC operation while it still supports EHC and RoHC separately. |
| Ericsson [5] | Proposal 1 Capability indication for “joint EHC and ROHC operation” is not needed. | The operation of EHC and ROHC is very much independent, and also order of operation is up to UE implementation. Moreover, as a general rule, we should avoid feature-capability dependencies. |
| Intel [8] | Proposal 3: No need to introduce capability for joint EHC and ROHC operation. | EHC is mainly beneficial for small payload size, as captured in TR 38.825. Therefore, there might be no concern regarding large payload size / high data rate. In addition, EHC and ROHC are operated independently. Unless the processing power and/or memory for EHC and ROHC are shared in implementation, there is no need foreseen to introduce capability for joint EHC and ROHC operation. |
| LG Electronics Inc. [11] | Proposal 1. A capability signaling for joint EHC-ROHC operation is not needed.Proposal 2. The UE memory concern is well indicated by the maxNumberROHC-ContextSessions and maxNumberEHC-Contexts-r16, and no additional capability signaling is needed. | If the UE indicates that it can support the EHC, it means that the EHC is supported on top of the mandatory function, i.e. ROHC. It is not possible that the UE supports only EHC while not supporting ROHC. Thus, we don’t think a capability signaling for joint operation is needed.If the UE is able to allocate the memory dynamically to different header compression contexts (e.g. by removing oldest contexts when the memory overflows), the UE can set each parameter equal to the UE memory size.Else, if the UE is not able for dynamic memory allocation, the UE sets the parameters such that the sum of *maxNumberROHC-ContextSessions* and *maxNumberEHC-Contexts-r16* is equal to the UE memory size. |
| Samsung [13] | Proposal 3. No additional capability is needed for joint EHC and ROHC configurations. | EHC and RoHC compression do not require large computation power and there is no additional issue to configure them together. |
| NTT DOCOMO, INC. [14] | Proposal : Introduce a UE capability for supporting EHC and RoHC simultaneously | Mandating the simultaneous operation function is excessive implementation for the UE. Here are use cases where RoHC should be applied on one DRB and EHC should be applied on another DRB, but not necessarily both on one DRB. There is a concern that introducing any unnecessary function will lead to higher chip costs and there is a benefit that the UE can be cheaper by separating the capability and allowing the option not to implement the simultaneous operation function. |
| Nokia, Nokia Shanghai Bell [2] | Proposal 2: Do not introduce separate capability for joint EHC+RoHC operation. Clarify in TS 38.306 that the UE indicating support for EHC and for RoHC shall also support joint EHC+RoHC operation. Proposal 3: RAN2 to consider introduction of signaling of the number of the contexts supported by the UE altogether for EHC and ROHC. | It was agreed EHC and RoHC operate mostly independently, so there is no additional complexity of supporting them together. On the other hand the current signalling of maximum number of supported contexts for EHC and ROHC is independent and does not necessarily consider the joint configuration of EHC and RoHC. |
| ZTE Corporation, Sanechips [16] | Proposal 1: An additional UE capability about whether or not the UE supports simultaneous EHC and ROHC operations is needed.Proposal 1a: RAN2 further discuss the following possible definition ways for this additional UE capability:- Option1: A simple UE capability about supporting simultaneous EHC and ROHC operations, e.g., simultaneousROHCandEHC-r16. The value of TRUE means that the UE supports simultaneous EHC and ROHC operations on a DRB and also supports different compression schemes (either RoHC or EHC) on different DRBs at the same time. The value of FALSE or without this UE capability, it’s assumed that the UE cannot support any of the above processes, e.g., at any time the UE supports only one compression scheme operation for all the DRBs.- Option2: A UE capability about upper limitation on the total number of configured compression contexts for both RoHC and EHC, e.g., maxNumberROHCandEHC-Contexts-r16. | Simultaneous RoHC and EHC operations may require heavy UE processing load. If the issue is more related to UE memory constraints, then the capability could be expressed as a maximum number of sum of Ethernet header compression contexts and ROHC header compression contexts supported by the UE across all DRBs. |
| Huawei, HiSilicon [17] | Proposal 2: Introduce UE capability signalling to support RoHC and EHC simultaneously for a DRB in both NR and LTE specifications. | Supporting RoHC and EHC simultaneously for a DRB may impact the UE processing load and latency requirements fulfilment. For low cost/simpler UEs used in IIoT, it is important to have such capability signal. |
| OPPO [18] | Proposal 1 No need to introduce joint EHC and RoHC capability or related signalling. | If the memory buffer/processing rate is restricted in the UE, UE may modify the max number of supported contexts for RoHC and EHC, e.g. reducing the supported context number, and report the new number of supported contexts to the network. |

Rapporteur summary:

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| 4 companies think a capability to indicate support for simultaneous EHC and RoHC operation is needed.6 companies think a capability to indicate support for simultaneous EHC and RoHC operation is NOT needed.There is a slight majority towards not having a separate capability for this purpose. However, it seems it is also unclear whether the issue is with UE processing load or with UE’s memory constraints. If the issue is with the latter, then some companies indicated that one way to alleviate it could be to add signaling related to the joint number of EHC and RoHC contexts supported by the UE in case both are simultaneously enabled. This might also mitigate the processing load issue of the UE.**Proposal 2: Do not introduce a separate capability for simultaneous EHC and RoHC operation.** **Proposal 3: Discuss whether to introduce signaling of maximum number of EHC and RoHC contexts supported by the UE when EHC and RoHC are enabled together.** |

## 2.3 DRBs and RLC bearers limitations

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| Company [Tdoc] | Proposal | Rationale from the Tdoc |
| CATT [1] | Proposal 1: Not allow additional RLC entities to be configured for duplication without impacting the maximum number of DRBs in IIoT.Proposal 2: The minimum number of DRBs per MAC entity is 6 in Rel-16 IIoT. | Allowing additional RLC entities to be configured would be useful, but would also require further discussions and specifications work, which is challenging at the moment. The minimum number of DRBs that has to be supported by the UE with Rel-16 PDCP duplication is proposed to be six to account for LCIDs to be reserved for SRB1 and SRB2 duplication. |
| vivo [3] | Proposal 3: The UE indicates the maximum number (i.e. 4, 6 and 8) of the supported DRBs per MAC entity when the 4-leg duplication is configured. | It is considered that the Rel-15 UE buffer requirement (i.e. 16 RLC entities per MAC and 32 RLC entities per UE) for duplication can be kept, but for more flexible UE implementation, the UE should be allowed to indicate the support of more DRBs (e.g. up to 8 DRBs per MAC entity and up to 16 DRBs per UE) for the 4-leg duplication. |
| Apple [4] | Proposal 1: A DRB associated with multiple RLC entities is counted once per associated RLC bearer.Proposal 2: The supported DRB number is 16 per MAC entity and 32 per UE.Proposal 3: Confirm the cases in table-1. Table-1

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| Case  | DRB Type | Max DRB number for configuration of the DRB Type |
| 1 | 4-leg CA-duplicated DRB  | 4 per MAC entity |
| 2 | 4-leg DC-duplicated DRB  | 8 per UE |
| 3 | 2-leg CA-duplicated DRB | 8 per MAC entity |
| 4 | 2-leg DC-duplicated DRB | 16 per UE |
| 5 | Split DRB | 16 per UE |

 | With the Proposal 1, the number of RLC entities is the same as the number of DRBs. Therefore, the requirement in R15 could be updated as proposed by Proposal 2. |
| Huawei, HiSilicon [6] | Proposal 1: The number of logical channels for radio bearers will not be extended in Rel-16 for PDCP duplication enhancement.Proposal 2: The number of DRBs that can be configured with packet duplication is same as that in Rel-15, i.e. 8. It is up to network how many DRBs can be configured with Rel-16 duplication under the limitation of the number of logical channels. | In order to allow additional RLC entities, several issues need to be discussed and several specs will be affected, e.g. 38.306, 38.321, 38.331, which is not preferred in such a late stage.Rel-15 specifications support at most 8 DRBs configured with duplication, which is enough. There is no need to specify how many DRBs can be configured with Rel-16 duplication. |
| Lenovo, Motorola Mobility [7] | Proposal 1: Allocate a new range to the available logical channel ID besides the existing maxLC-ID to support the current maximum number of DRBs and to allow additional RLC entities to be configured.Proposal 2: The eLCID space can be used to identify more logical channel IDs when allocating a new range to the available logical channel ID should be noted.Proposal 3: Add a note to state that it is up to the NW to control the configuration of additional RLC entities without impacting the current maximum number of DRBs if it is not feasible to allocate a new range to the available logical channel ID besides the existing maxLC-ID. | The concern on the LCID space in Rel-15 has been alleviated with the introduction of eLCID. Therefore, it can work by allocating a new range to the available logical channel ID besides the existing maxLC-ID in order to allow the additional RLC entities to be configured. If there is the concern because of the insufficient time to check the details, simply add a note as a basic solution to state it is up to the NW to control the configuration of additional RLC entities without impacting the current maximum number of DRBs. |
| Intel [8] | Proposal 4: If RAN2 agrees that the number of RLC bearers associated with DRBs that a Rel-15 UE shall support is 16, UE capability of the support of additional number of RLC bearers can be introduced for Rel-16 UE supporting feature pdcp-DuplicationMoreThanTwoRLC-r16, with the signaled value range of {2, 4, 8, 16}.Proposal 5: If RAN2 agrees that there is no explicit limitation of the number of RLC bearers associated with DRBs that a Rel-15 UE shall support, then there is no need to introduce UE capability of the support of additional number of RLC bearer for Rel-16 UE supporting feature pdcp-DuplicationMoreThanTwoRLC-r16.  | The need to introduce the signalling of additional RLC bearers supported by the UE supporting Rel-16 PDCP duplication depends on how the current limitation should be interpreted. If the number of RLC bearers associated with DRBs that a UE shall support is 16, then the additional signalling is needed. If the number of RLC bearers is limited to 32, then the additional signalling is not needed. |
| OPPO [9] | Proposal 1: kindly asks RAN2 to agree that the UE capability constraints in terms of the number of RLC bearers (entities) that a UE shall support should be defined, or at least clarify the number of DRBs UE shall support depends on the number of associated RLC bearers. | Current capability related to the number of DRBs UE shall support is a capability requirement related to number of the RLC entities employed. It would be better to indicate the UE capability constraints in terms of the number of RLC bearers (entities) that a UE shall support, or at least clarify the number of DRBs UE shall support depends on the number of associated RLC bearers |
| LG Electronics Inc. [12] | Proposal 1: Confirm that the number of DRBs a UE must support in NR is 16 (split and duplicated DRBs count as 1 DRB).Proposal 2: Confirm that a maximum of 8 DRBs per MAC entity with duplication.Proposal 3: Confirm that additional RLC entities for Rel-16 PDCP duplication can be configured without impacting the maximum number of DRBs. | The minimum number of DRBs that the UE shall support should be same as legacy, i.e. 16. The number 16 was decided considering various aspects, e.g. UE processing complexity, traffic characteristics, etc. This number is not impacted by the PDCP duplication. Thus, we propose to confirm the previous agreement even in Rel-16.The minimum number of DRBs per MAC entity with duplication should be kept as 8, because support of diverse applications in the UE is needed, typically 2 RLC entities will be used at a time even with Rel-16 duplication and the maximum value of LCID is 32 already. |
| Nokia, Nokia Shanghai Bell [2] | Proposal 4: Allow additional RLC entities to be configured for duplication/DAPS beyond the minimum number of DRBs/RLC bearers the UE shall support.Proposal 5: Discuss the conditions allowing additional RLC entities to be configured to the UE (for duplication/DAPS) beyond the minimum number of bearers/RLC bearers. | If each RLC entity would count as a separate DRB and the current limitation of 16 DRBs would be kept the number of DRBs supported by the UE with Rel-16 PDCP duplication could be limited to 4. This is too restrictive so configuration of more RLC entities should be allowed. |

Rapporteur summary:

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| There are diverse proposals from the companies on the issue of the number of supported DRBs and RLC entities with Rel-16 PDCP duplication. The proposals often depend on the company’s interpretation of the current limitation, e.g. whether it limits the minimum number of DRBs only or also the minimum number of RLC bearers that a UE shall support. While it will be challenging to agree on the resolution of this issue before Rel-15 limitation is clarified, it seems agreeable that the intention is not to limit the number of supported DRBs or RLC bearers below what is possible with basic LCID space, i.e. up to 29 RLC bearers can be used. **Proposal 4: It should be possible to configure up to 29 RLC bearers in the Rel-16 UE.**Some companies indicate that with Rel-16 duplication activation MAC CE, there is no need to keep the limitation of the number of duplicated DRBs to 8. On the other hand, some companies indicate such limitation should be retained regardless of this. **Proposal 5: Discuss whether the limitation of the maximum of 8 DRBs with duplication per UE needs to be retained for the UE supporting Rel-16 duplication.** It is proposed to discuss any related signaling after the clarification of the limitation is agreed for Rel-15.**Proposal 6: Discuss any potentially required signaling for the number of supported RLC bearers and/or DRBs after the clarification of the limitation is agreed for Rel-15.** |

## 2.4 Reference time related capabilities

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| Company [Tdoc] | Proposal | Rationale from the Tdoc |
| vivo [3] | Proposal 4: One single bit is used to indicate the support of the reference time reception via broadcast and unicast and the support of the interest report of the reference time. | “As the UE is not able to know whether the network will use unicast or broadcast for the transmission of the reference time, the UE would anyway have to support the report of the reference time interest.” |
| Intel [8] | Proposal 1: Capabilities referenceTimeProvision-r16 and referenceTimeInd-r16 should be merged to a single capability. If RAN2 prefers having them as separate UE capabilities, the following dependency should be added “A UE supporting referenceTimeInd-r16 shall also support referenceTimeProvision-r16”. | The motivation of having a single capability is that the mechanism to request and provide via UE assistance information is specified at the same time, and the request part does not add major complexity on UE side from the implementation point of view. |
| Huawei, HiSilicon [19] | Proposal 4: ReferenceTimeProvision-r16 can be added as a pre-requisite for referenceTimeInd-r16 and those are two separate capabilities. | “It is possible that some UEs that are capable to receive accurate time info but not capable to require time info via UE assistance information. For example, simple industry processing machine without complex communication components or a receiving only machine with high precision clock that can receive accurate reference time information but don’t want to communicate with gNB.” |

Rapporteur summary:

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| Two companies which discussed this propose to merge referenceTimeProvision-r16 and referenceTimeInd-r16 capabilities. One company proposes that referenceTimeProvision-r16 should be a pre-requisite for referenceTimeInd-r16. The following propsal is brought up for discussion:**Proposal 7: Capabilities referenceTimeProvision-r16 and referenceTimeInd-r16 are merged to a single capability.** |

## 2.5 Other issues

Maximum number of contexts signalling for EHC

In [5], the following range of maxNumberEHC-Contexts is proposed: [2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536]. In the draft capabilities CR towards TS 28.331 in [15], the following range was proposed: {c2, c4, c8, c16, c24, c32, c64, c128, c256, c512, c1024, c16384, c32768, c65534, spare2, spare1}. The values could be much aligned in case spare values were used in Rel-16 already, so it is proposed to first discuss whether they are needed.

**Proposal 8: Decide whether spare values for maxNumberEHC-Contexts are needed.**

Support for CG periodicities of multiple of 2/7 symbols

In [8] and [13] it is proposed not to support CG periodicities of multiple of 2/7 symbols capability. However, this is not purely capability related discussion and there are numerous contributions on this topic submitted to AI 6.7.3.2. It is therefore proposed not to discuss this issue as part of the capabilities discussion at the moment.

PDCP related capabilities

In [2], it is indicated that currently the support for the PDCP duplication with more than two legs is independent from PDCP duplication with two legs. This may lead to a situation where the network has to configure three RLC entities to the UE even though it would be sufficient to use only two of them (it might also not be possible in case more than two cells are not available). Furthermore, for SRB, all three legs would also have to be active, even though only two could already meet the reliability/latency requirement. Based on that, the following proposal is made:

**Proposal 9: The UE supporting Rel-16 PDCP duplication (more than two legs per radio bearer) shall also support Rel-15 PDCP duplication (with only two legs per SRB/DRB).**

# 3 Conclusions from Tdoc summary (as per R2-2004681 [21])

Based on the summary presented in Section, the following proposals are made:

**Proposal 1: Decide on the dependency between PHY-based prioritization and LCH-based prioritization capabilities after confirming whether they can be configured separately and after receiving further RAN1 input on IIOT capabilities.**

**Proposal 2: Do not introduce a separate capability for simultaneous EHC and RoHC operation.**

**Proposal 3: Discuss whether to introduce signaling of maximum number of EHC and RoHC contexts supported by the UE when EHC and RoHC are enabled together.**

**Proposal 4: It should be possible to configure up to 29 RLC bearers in the Rel-16 UE.**

**Proposal 5: Discuss whether the limitation of the maximum of 8 DRBs with duplication per UE needs to be retained for the UE supporting Rel-16 duplication.**

**Proposal 6: Discuss any potentially required signaling for the number of supported RLC bearers and/or DRBs after the clarification of the limitation is agreed for Rel-15.**

**Proposal 7: Capabilities referenceTimeProvision-r16 and referenceTimeInd-r16 are merged to a single capability.**

**Proposal 8: Decide whether spare values for maxNumberEHC-Contexts are needed.**

**Proposal 9: The UE supporting Rel-16 PDCP duplication (more than two legs per radio bearer) shall also support Rel-15 PDCP duplication (with only two legs per SRB/DRB).**

# 4 E-mail discussion: [AT110e][048][IIOT] UE capabilities – Phase 1

As indicated in Section 2.1, the dependncy between PHY-based prioritization and LCH-based prioritization capabilities is dependent on the discussion of whether two features can be configured separately and how this is achieved. This aspect will be discussed as part of another e-mail discussion “[AT110e][043][IIOT] MAC (Samsung)”, so it is not part of Phase 1 of this e-mail discussion.

## 4.1 EHC related capabilities

Based on the summary in [21], the following two proposals were made:

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| **Proposal 2: Do not introduce a separate capability for simultaneous EHC and RoHC operation.** **Proposal 3: Discuss whether to introduce signaling of maximum number of EHC and RoHC contexts supported by the UE when EHC and RoHC are enabled together.** |

Companies are requested to provide their views on whether they agree with Proposal 2 and what their view on Proposal 3 is, i.e. whether introduction of signaling of maximum number of EHC and RoHC contexts supported by the UE when EHC and RoHC are enabled together is beneficial.

**Question 1: Please provide your views on Proposal 2 and Proposal 3 from [21].**

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| **Company** | **Do you agree with P2 (why/why not)?** | **Views on Proposal 3** |
| Qualcomm | No.EHC was introduced for Industrial IoT applications that typically do not use EtherType=IP. Irrespective of memory or processing capability, there is no reason for a UE supporting EHC for industrial IoT case to support RoHC. Further, such UEs are expected to be optimized in user-plane to achieve demanding IIoT latency requirements and supporting RoHC will compromise the optimizations. | Agree.It should be okay to have no linkage on the capabilities. Just have a Boolean linkage as discussed in P2.  |
| LG | Yes | We think the UE memory concern is well indicated by the *maxNumberROHC-ContextSessions* and *maxNumberEHC-Contexts-r16*, and no additional capability signaling is needed. |
| Ericsson | YesA capability indication for simultaneous operation is only useful when UE shares processing power/memory for EHC and ROHC, but Ericsson thinks the operation of EHC and ROHC is very much independent, | No need. UE can indicate max number independently for EHC and ROHC |
| Samsung | Yes | No need. Agree with LG and Ericsson |
| Huawei | NoAgree with Qualcomm on the performance perspective. For IIOT applications, the latency requirement needs to be fulfilled. Usually RoHC processing will introduce considerable latency. Indeed RoHC and EHC are independent features. However, unless their processing is parallel (most probably not), the introduced latency of one (de)compression will be added upon the latency of another (de)compression. The network might be able to configure only one feature according to the requirements of the application, it would be desirable to make the configuration decision based on capability signalling by the UE on whether or not the UE can handle simultaneous RoHC and EHC. This might be even more important for low cost/simpler UE which could be used based on the discussion around the minimum value of maxNumberEHC-Contexts during last meeting.  | Agree to discuss. However the joint max number of contexts might not be able to entirely solve the problem. Plus the joint capability signalling will cost merely 1 bit while joint max number of contexts will cost multiple bits.  |
| Intel | Yes, agree with P2. As discussed in our paper [8], EHC is mainly beneficial for small payload size, as captured in TR 38.825. Therefore, there might be no concern regarding large payload size / high data rate. In addition, EHC and ROHC are operated independently. Unless the processing power and/or memory for EHC and ROHC are shared in implementation, there is no need foreseen to introduce capability for joint EHC and ROHC operation. | No need. Same reason as in our reply to P2. |
| MediaTek | NoAgree with the points raised by QC and HW. For latency critical devices, it is important to keep the processing overhead in the UE to a minimum | Agree |
| OPPO | Yes | No need. We share the similar view as LG and Ericsson. |
| ZTE | Maybe No.We see some different views about UE capability, e.g., “*there is no reason for a UE supporting EHC for industrial IoT case to support RoHC*” or “*the EHC is supported on top of the mandatory function, i.e. ROHC. It is not possible that the UE supports only EHC while not supporting ROHC*”. But anyway, this can be handled by the existing separate UE capabilities.However, even the UE indicates support for both of these separate UE capabilities, the most general case is at one time only one compression scheme is enabled according to the service. There still exists ambiguity on whether the UE supports simultaneous EHC and ROHC operations on a DRB or whether UE supports different compression schemes (either RoHC or EHC) for different DRBs at the same time? This may further cause confusion on configuration. Therefore, we are fine to introduce an additional UE capability.A simple capability about whether or not UE supports simultaneous EHC and ROHC operations may be straightforward, but may be a little incomplete if further consider the context number. A simple assumption may be, if this new UE capability is set TRUE, both EHC Contexts and ROHC Contexts can be configured to their maximum numbers. If this cannot be confirmed, we think we’d better to go for P3. | Agree.We are not sure whether to modify the separate maximum number of supported contexts for RoHC or EHC would achieve the desired effect? For example, UE reports reduced max number of supported contexts for EHC, then even if only EHC is configured, at most this reduced maximum context can be allocated, cannot be more. We guess this is undesired?With introducing a new UE capability about the total number contexts for both RoHC and EHC, we assume the previous *maxNumberROHC-ContextSessions* and *maxNumberEHC-Contexts-r16* still can be reported with their original maximum values.More specifically, If UE indicates support for both of separate UE capabilities for EHC and RoHC, and such new UE capability, e.g, *maxNumberROHCandEHC-Contexts-r16* is absent, the gNB can assume there has no any restriction, e.g., the UE by default supports simultaneous EHC and ROHC operations on a DRB and also supports different compression schemes on different DRBs at the same time. And both EHC Contexts and ROHC Contexts can be configured to their maximum numbers. If such new UE capability is present, gNB can still assume that the UE supports simultaneous EHC and ROHC operations, but there has restriction that the total number of configured compression contexts for both RoHC and EHC should not be larger than *maxNumberROHCandEHC-Contexts-r16.* |
| CATT | No. We agree with QCOM and Huawei that for URLLC packets, supporting both ROHC and EHC processing may add a significant cost, either due to parallel processing to meet the latency requirements, or for over-dimensioned compression/decompression engines, when serialized, to minimize the latency penalty compared with when only one compression type is configured.  | We agree with LG.  |
| vivo | No. | No. We think that if the UE indicates the support the simultaneous operation of ROHC and EHC. Then this means that the buffer/processing capability for the EHC and the ROHC is shared. Then no more capability bit is needed. |
| DOCOMO | No.As explained in [14], despite it is unclear whether there is a case where this operation is used or not in a DRB, why does the joint operation need to be mandated when both EHC and RoHC are supported? | Slightly No but.As we have already agreed that EHC and RoHC are independent. I think it is applied to Capability aspect i.e. a UE has to have their memory size that it keeps both max number of the EHC contexts and the RoHC contexts. Their memory should not be shared between EHC and RoHC due to the agreement. Therefore, 1bit (whether it supports or not) is enough. |

With respect to the maximum number of contexts signalling for EHC, as indicated in section 2.5, two proposals were provided:

* Option 1: {2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536} (as per [5])
* Option 2: {c2, c4, c8, c16, c24, c32, c64, c128, c256, c512, c1024, c16384, c32768, c65534, spare2, spare1} (as per [15]).

Companies are invited to provide their views on this aspect, including whether there is a need for keeping some spare value(s) for maxNumberEHC-Contexts.

**Question 2: Please indicate your preferred value range for maxNumberEHC-Contexts, including whether the spare value(s) are needed.**

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| --- | --- | --- |
| **Company** | **Option 1/ Option 2 / another proposal** | **Comments** |
| Qualcomm | No manor concern between options 1 and 2.As commented during online 109bis-e, the numbers here 2, 4 etc are not enough. We need to be specific that 2 means 1+1 (UL and DL). |  |
| LG | Option 2 | It would be better to have some spare values for potential future extension. |
| Ericsson | Option 1 | No need for higher resolution in lower ranges in option 2, such as the one for 24. The value 16384 can be removed too, since it is maximum value from EHC.If there is a strong view, Ericsson is fine to have spare values and have coarser resolution in the lower ranges. It might be a good idea to let all companies be aware that the maximum value is 65534. Two of them are for CID=all zeros. This would be slightly different from the agreement in the last meeting  Maximum value of maxNumberEHC-Contexts that can be signalled is 65536 Minimum value of maxNumberEHC-Contexts that can be signalled is 2 |
| Samsung | Option 1 | But no strong view between them |
| Huawei | Option 1 | No strong view on spare values.  |
| Intel | Option 1 | We have slight preference for Option 1, which is a power of 2 series. As UE capability signaling can be extended in future release, our thinking is that there is not much need to have spare values at current release. |
| MediaTek | Option 1 | Slight preference for option 1 |
| OPPO | Option 1 | We slightly prefer option 1 |
| ZTE | Option 1/ Option 2 | We have no strong view and just want to clarify that, if the UE only supports uplink EHC, *maxNumberEHC-Contexts* indicates the maximum uplink CIDs. If the UE supports both uplink and downlink EHC, then *maxNumberEHC-Contexts* indicates the maximum total value of uplink and downlink CIDs, of which the maximum uplink CIDs and maximum downlink CIDs are same. |
| CATT | Option 1 | No strong view though. |
| vivo | Option 1 | It is not clear whether we will have any opportunity to use the spare values in the future. |
| DOCOMO | Option1 |  |

## 4.2 DRBs and RLC bearers limitations

With respect to the aspect of DRBs and RLC bearers limitations, the following three proposals were made based on Tdocs summary, as in section 2.3:

|  |
| --- |
| **Proposal 4: It should be possible to configure up to 29 RLC bearers in the Rel-16 UE.****Proposal 5: Discuss whether the limitation of the maximum of 8 DRBs with duplication per UE needs to be retained for the UE supporting Rel-16 duplication.** **Proposal 6: Discuss any potentially required signaling for the number of supported RLC bearers and/or DRBs after the clarification of the limitation is agreed for Rel-15.** |

For this aspect, there is a related e-mail discussion within Rel-15 corrections AI:

* [AT110e][017][NR15] UE cap Number of bearers (Qualcomm)

 Scope: Treat R2-2004441, R2-2005358, R2-2005359, R2-2004432, R2-2004433, R2-2005004, R2-2005580 (proponents are responsible to explain and drive)

 Part 1: Decision whether to make corrections or not, identify agreeable corrections. Deadline: June 4, 0700 UTC.

 Part 2: For agreeable parts, continuation to agree CRs. Deadline: June 10, 0700 UTC

Hence, Proposal 6 is not part of Phase 1 of this e-mail discussion and will be revisited once progress in [AT110e][017][NR15] is made. Nevertheless, Proposal 4 and Proposal 5 are rather independent and the companies are invited to provide their views on those.

**Question 3: Do you agree that it should be possible to configure up to 29 RLC bearers in the Rel-16 UE. (NOTE: This is not a question on the minimum/mandatory capability, which is to be decided by [AT110e][017][NR15])**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Justification** |
| Qualcomm | Yes | Good to have option for several RLC entities when 4-way duplication is used on a PDCP entity. |
| LG | Yes |  |
| Ericsson |  | Ericsson still has the view that a discussion without Rel-15 clarification will be confusing. Signalling-wise, RRC supports 32 RLC bearers in each CellGroupConfig. The email discussion [AT110e][017] would conclude on a minimum/mandatory capability of the number of RLC entities. The question here is, for IIoT WI, should RAN2 introduce a separate capability going beyond that? For this, Ericsson agrees that it can be helpful for IIoT. But going beyond the current addressable space of 32 per cell group is not well justified. A further explanation on the number 29 would be appreciated.  |
| Samsung | Yes |  |
| Huawei | Yes |  |
| Intel | Yes | It would be good to allow such configuration to support PDCP duplication of up to 4 RLC entities. |
| MediaTek | Yes |  |
| OPPO | Yes | We agree that the number of RLC bearers should be enlarged, but the number 29 needs further explanation |
| ZTE | Yes | Except the LCHs using for SRB#1,2,3, all the other LCHs can be used for DRB for duplication way.  |
| CATT | Yes | We understand the question is for RLC entities configured for DRBs and so share the same view as ZTE. Similar reasoning resulted in the same limitation on the maximum number of DRBs in Rel-15 considering the limitation of 32 LCIDs:maxDRB INTEGER ::= 29 -- Maximum number of DRBs (that can be added in DRB-ToAddModLIst).Anyways we are not sure of the purpose of the question. Per our answer to [AT110e][017A][NR15], we do not see the need to specify a capability for RLC bearers in Rel-15 or Rel-16.  |
| vivo | Yes |  |
| DOCOMO | Yes |  |

**Question 4: Do you think the limitation of the maximum of 8 DRBs with duplication per UE needs to be retained for the UE supporting Rel-16 duplication.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Justification** |
| Qualcomm | Yes | Only small number of bearers can be expected to justifiably use the overhead sustained by PDCP duplication. |
| LG |  | What should be retained is 8 DRBs with duplication per MAC entity, not per UE. |
| Ericsson | Yes | From the use-case point of view, no need to go beyond 8 |
| Samsung | Yes | 8 DRBs are sufficient. |
| Huawei | Yes | In most cases, few DRBs shall be configured with multiple legs PDCP duplication to serve traffic with extreme performance requirements. |
| Intel | Yes/No | Agree with LG. Our understanding is that Rel-15 limitation is that there can be up to 8 DRBs with duplication *per MAC entity*, due to the design of Duplication Activation/Deactivation MAC CE. We think the Rel-15 limitation can be kept. |
| MediaTek |  | We are ok to have 8 DRBs (or higher) for duplication, as long as the restriction on the maximum number of RLC entities per cell-group is respected.For example, it shouldn’t be possible to support 8 DRBs with 4-way CA duplication within a single cell group, as that will require 32 RLC entities for the cell group (and only 29 are available for DRBs). |
| OPPO | Yes | 8 per UE is enough. |
| ZTE | Yes | We can rely on NW implementation to set duplication status which will not go beyond 29 for one MAC entity. |
| CATT | Yes | As elaborated in R2-2004591, considering both maximum leg configuration in DRBs and SRBs and the limitation of 32 LCIDs yields 6 DRBs. But we are fine to follow majority to keep things simple. A minimum of 8 DRBs would not consider the full 4-leg configuration for each, but that is also acceptable. |
| vivo |  | We agree with MTK. |
| DOCOMO | Yes | We also think 8DRBs per MAC entity are sufficient since few DRBs shall be configured with multiple legs PDCP duplication.  |

## 4.3 Reference time information related capabilities

Based on the sumary in section 2.4, companies are invtied to provide their views on whether referenceTimeProvision-r16 and referenceTimeInd-r16 should be merged to a single capability.

**Question 5: Do you agree that referenceTimeProvision-r16 and referenceTimeInd-r16 should be merged to a single capability.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Justification** |
| Qualcomm | Yes |  |
| LG | Yes |  |
| Ericsson | Yes |  |
| Samsung | Yes |  |
| Huawei | No | We prefer to use separate capabilities for these two procedures. It is possible that some UEs that are capable to receive accurate time info but not capable to require time info via UE assistance information. For example, simple industry processing machine/tool without complex communication sub-system/components or a receiving-only machine/tool with high precision clock (no need to request extra accurate time info) etc.With two independent capabilities, it is quite simple to add one sentence description on their interdependence, i.e. UEs who support referenceTimeInd-r16 shall support referenceTimeProvision-r16.  |
| Intel | Yes | As discussed in our paper [8], the motivation of having a single capability is that the mechanism to request and provide via UE assistance information is specified at the same time, and the request part does not add major complexity on UE side from the implementation point of view.Regarding Huawei’s comment: “It is possible that some UEs that are capable to receive accurate time info but not capable to require time info via UE assistance information”, we’d like to note that we’re discussing UE capability sent by UE to gNB, and we think UEs which can send UE capability should be able to require reference time information. |
| SONY | Yes |  |
| MediaTek | No | As they are different procedures, it would be cleaner to have separate capabilities for them with the inter-dependency specified as suggested by Huawei. |
| OPPO | No | We agree that potentially there could be cost-sensitive UEs which is capable of data reception only for IIOT use cases.  |
| ZTE | Yes | Agree with Intel. |
| CATT | Yes |  |
| vivo | Yes |  |
| DOCOMO | Yes |  |

## 4.4 PDCP duplication related capabilities

Based on the sumary in section 2.5, companies are invtied to provide their views on whether the UE supporting Rel-16 PDCP duplication (more than two legs per radio bearer) shall also support Rel-15 PDCP duplication (with only two legs per SRB/DRB).

**Question 6: Do you agree that the UE supporting Rel-16 PDCP duplication (more than two legs per radio bearer) shall also support Rel-15 PDCP duplication (with only two legs per SRB/DRB).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Justification** |
| Qualcomm | Yes | Extra work for the UE seems minimal to support R15 variant if it already supported R16 variant. |
| LG | Yes |  |
| Ericsson | Yes | Ericsson’s understanding of the proposal is that if UE supports Rel-16 PDCP duplication, then it supports all the Rel-15 PDPC duplication functions indicated in *pdcp-DuplicationMCG-OrSCG-DRB, pdcp-DuplicationSplitDRB, pdcp-DuplicationSplitSRB, pdcp-DuplicationSRB*.  |
| Samsung | Yes |  |
| Huawei | Yes | Rel-16 PDCP duplication is an enhanced PDCP duplication function. So UE supporting Rel-16 PDCP duplication shall reasonably support Rel-15 PDCP duplication. |
| Intel | Yes | Basically Rel-16 PDCP duplication is an enhancement to Rel-15 duplication. |
| MediaTek | Yes |  |
| OPPO | Not sure | Although R16 duplication needs to configure UE with more than two secondary RLCs, but it allows only 1 secondary RLC legs to be activated for duplication, which is similar to the R15 duplication. |
| ZTE | Yes |  |
| CATT | Yes | We agree with Qualcomm on the minimal extra complexity. |
| vivo | No strong view | Supporting the Rel-16 duplication would also allow the UE to use two leg duplication with the Rel-16 duplication MAC CE. It seems that there is no need for the UE to support the Rel-15 MAC CE. |
| DOCOMO | Yes |  |

# References

1. R2-2004591 Capability constraints on the number of DRBs in IIoT CATT
2. R2-2004680 UE feature list and capabilities remaining issues Nokia, Nokia Shanghai Bell
3. R2-2004741 Remaining issues on the UE capability of IIOT vivo
4. R2-2004779 Supported Number of DRBs and RLC entities for R16 PDCP Duplication Enhancement Apple
5. R2-2004963 UE capability for IIoT Ericsson
6. R2-2005069 Discussion on requirements of the number of DRBs and RLC bearers Huawei, HiSilicon
7. R2-2005128 Configuration of the additional RLC entities Lenovo, Motorola Mobility
8. R2-2005301 Remaining issues in IIoT UE capability Intel Corporation
9. R2-2005341 Feasibility of additional RLC entities to be configured for duplication OPPO
10. R2-2005507 Relation between LCH-based and PHY-based prioritization LG Electronics Inc.
11. R2-2005508 Capability signaling for Joint EHC-ROHC operation LG Electronics Inc.
12. R2-2005509 Number of DRBs for duplication LG Electronics Inc.
13. R2-2005651 Remaining UE Capability Issues for IIOT Samsung
14. R2-2005679 Necessity of UE capability for simultaneous EHC and RoHC NTT DOCOMO INC.
15. R2-2004682 Draft CR for IIOT capabilities introduction to TS 38.331 Nokia, Nokia Shanghai Bell
16. R2-2005041 Remaining FFS for EHC in TSC ZTE Corporation, Sanechips
17. R2-2005154 Remaining issues about EHC Huawei, HiSilicon
18. R2-2005336 Open issues on EHC OPPO
19. R2-2005152 Request of accurate reference time delivery Huawei, HiSilicon
20. R2-2005070 Discussion on LCH-based prioritization and PHY-based prioritization Huawei, HiSilicon
21. R2-2004681 Summary of Tdocs on IIOT UE capabilities (AI 6.7.6) Nokia, Nokia Shanghai Bell