**3GPP TSG-RAN WG2 Meeting #109bis-e *R2-200xxxx***

**Electronic meeting, 20 – 30 April 2020**

**Agenda item: 6.7.4.2**

**Source: Intel Corporation**

**Title: Report of email discussion [AT109bis-e][030][IIOT] Ethernet Header Compression (Intel)**

**Document for: Discussion and Decision**

# Introduction

The contribution is the report of following email discussion.

* [AT109bis-e][030][IIOT] Ethernet Header Compression (Intel)

Scope: Treat topics in 6.7.4.2, based on [R2-2003782](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_109bis-e\Docs\R2-2003782.zip) and comments.

Part 1: Determine which issues that need resolution, find agreeable proposals, can consider attempt to agree TP. Deadline: April 24 0700 UTC. Result to be merged to PDCP CRs.

# Discussion

## Whether to have reserved bit in EHC header

Terminology: to avoid confusion regarding reserved bit discussion, we’d like to emphasize that *EHC header* denotes the header in EHC full header format and/or EHC compressed header format in clause A.2.1.1 of TS 38.323 v16.0.0 [1], and *EHC* *feedback packet* is specified in clause A.2.1.2 of TS 38.323 v16.0.0 [1].

In RAN2#109-e meeting, following was agreed: “*EHC header only contains Context ID field, format indication bit, and reserved bit(s) if needed. The number of reserved bit(s) are FFS*”. Contributions R2-2002718 [4], R2-2002773 [6], and R2-2002973 [9] propose to have reserved bit/codepoint for future extensibility, e.g. when introducing profiles for EHC in future releases. On the other hand, contributions R2-2002712 [3], R2-2002758 [5], R2-2002936 [8], R2-2003171 [10], , R2-2003321 [13], and R2-2003755 [14] propose not to have reserved bit in EHC header, with the following reasons: 1) there is very little possibility to introduce a new packet format in future releases, because Ethernet header is long-existing format and difficult to be changed; 2) if there is a need to introduce new EHC profile in future releases, a new EHC header format can be introduced with RRC configuration; 3) the drawback of having reserved bit in EHC header is that the maximum number of EHC contexts is reduced to half; 4) potential future support for non-standard-Ethernet based protocols requires probably further changes in the EHC than using 1-2 bits.

One thing to note is that there are different options for companies proposing to have reserved bit/code point. R2-2002718 [4] proposes to have 1 reserved bit in EHC header, R2-2002773 [6] proposes to have 1 reserved code point, while R2-2002973 [9] proposes to have 1 and 3 reserved bits for 1 byte and 2 byte EHC header, respectively.

Given that there are majority views (6 out of 9 companies) to not have reserved bit/codepoint in EHC header, and agreeing on having reserved bits will take further discussion regarding reserved bit vs. reserved code point, and the number of reserved bits for 2 byte EHC header, following is proposed.

**Proposal 1**: There is no reserved bit/codepoint in EHC header.

**Question 1**: please provide your feedback on Proposal 1.

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| --- | --- | --- |
| **Company** | **Support Proposal 1 (Yes/No)** | **Comments** |
| LG | Yes |  |
| Ericsson | Yes |  |
| Futurewei | No | We are not sure there’d be need of a large number of CID in the first release of EHC application, and we see having a reserve bit would provide more flexibility for future extension, not only for possible new profiles, but also for new EHC header format in general.  We can, however, go with the majority, as this is not a critical issue. |
| Qualcomm | Yes |  |
| OPPO | No | We are also not sure whether we really need a larger number of CID in EHC than RoHC. In RoHC, the bit size of CID is 14 if large CID applies, whereas the bit size of CID is 4 if short CID applies. Thus, it is sufficient to set 14-bit CID for 2-byte header and 4-bit CID for 1-byte header.  However, we can accept the proposal since it is not a critical issue. |
| vivo | No |  |
| Samsung | Yes |  |
| Huawei | No | We share the view that there shall be possibility for future extension as RAN2 develop this first EHC version within a relatively short time. Using one reserve bit in 1 octet EHC header would not limit the available CID number as 2 octets EHC header can always be used where 14 bits would allow sufficiently large CID number. CID overwriting mechanism and “all-zeros” CID can be used if, however rarely, CID number is run out. |
| Nokia | Yes | This is not required for future extensibility while it limits the number of available contexts unnecessarily, especially the number of contexts in 1-byte header would be limited to 64 which may not be sufficient for IIOT. It is true that 2-byte header can be used, but in this case the compression efficiency deteriorates. |
| ZTE | No | We share the above comments for supporting to have spare bits. |
| CATT | Yes | If we think a large number of CIDs is not necessary, why we introduce two types of header size: 1byte and 2 bytes? At least 7 bits CID field is important to avoid unnecessary 1 more byte overhead. |
| Intel | Yes | There can be large number of CIDs since CID represents a unique combination of all compressed fields: DESTINATION ADDRESS, SOURCE ADDRESS, 802.1Q TAG, and LENGTH/TYPE. |
| DOCOMO | Partly Yes | According to 9 Annex A.1: Traffic model applied to example use cases in a White Paper "A 5G Traffic Model for Industrial Use Cases", some use cases are described. In the paper, the number of Ether devices is maximum 4 and it means that currently 7bits length is sufficient for the number of CIDs. Therefore, I think we can introduce R bit in the 2OCT format. https://www.5g-acia.org/fileadmin/5G-ACIA/Publikationen/5G-ACIA\_White\_Paper\_Traffic\_Model/WP\_5G\_5G\_Traffic\_Model\_for\_Industrial\_Use\_Cases\_22.10.19.pdf |

If there is no reserved bit in EHC header, contributions R2-2002712 [3], R2-2002758 [5], R2-2002936 [8], R2-2003171 [10], and R2-2003321 [13] propose that CID length is 7 or 15 bits, for 1 byte and 2 bytes EHC header, respectively. Note that this also applies to the case that there is one reserved code point in EHC header. On the other hand, with the assumption of have reserved bit, according to R2-2002718 [4], CID length is 6 or 14 bits, for 1 byte and 2 byte EHC header, respectively. According to R2-2002973 [9], CID length is 4 or 14 bits, for 1 byte and 2 bytes EHC header, respectively.

For consistency with Proposal 1, following is proposed:

**Proposal 2**: CID length is 7 or 15 bits, for 1 byte and 2 byte EHC header, respectively.

If Proposal 2 is agreed, then following Editor’s notes in TS 38.323 v16.0.0 can be removed:

* Clause A.2.1.1: *It is FFS whether and how many reserved bits are included in the EHC header*
* Clause A.2.2: *It is decided that 1 or 2 bytes are allocated for CID field. However, exact length of the CID field is not decided yet.*

**Question 2:** please provide your feedback on Proposal 2. Companies do not support the proposal are invited to provide their preference on CID length for 1 byte and 2 byte EHC header.

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| **Company** | **Support Proposal 2 (Yes/No)** | **Comments** |
| LG | Yes |  |
| Ericsson | Yes |  |
| Futurewei | Yes if Proposal 1 is taken |  |
| Qualcomm | Yes |  |
| OPPO | Yes if Proposal 1 is taken | As we mentioned in Q1, in EHC, it is sufficient to set 14-bit CID for 2-byte header and 4-bit CID for 1-byte header. However, if it is majority view, we are also ok |
| vivo | Yes if Proposal 1 is agreed |  |
| Samsung | Yes if Proposal 1 is agreed |  |
| Huawei |  | This would be straightforward if proposal 1 is agreed, though our preference is 6 bits/14bits CID for 1 octet/2 octets EHC header. |
| Nokia | Yes | As mentioned above, there is no need for reserved bits or for any other purpose, so we can use all the available bits for CID |
| ZTE | Yes if Proposal 1 is taken |  |
| CATT | Yes |  |
| Intel | Yes |  |
| DOCOMO | Yes if Proposal 1 is taken |  |

EHC feedback packet contains only CID field, and there is a related Editor’s note in TS 38.323 v16.0.0 [1]: “*It is FFS how many reserved bits are included in the EHC feedback packet*”. The specification assumes 1 reserved bit in EHC feedback packet since only CID field is included. If there is no reserved bit in EHC header, contributions R2-2002758 [5], R2-2003171 [10], and R2-2003321 [13] propose to confirm the EHC feedback packet format in PDCP running CR, i.e. there is 1 reserved bit in EHC feedback packet. Note that this also applies to the case that there is one reserved code point in EHC header. On the other hand, with the assumption of having reserved bit in EHC header, according to R2-2002718 [4], there should be 2 reserved bits in EHC feedback packet format, while according to R2-2002973 [9], there are 4 and 2 reserved bits in EHC feedback packet format, for 1 byte and 2 byte EHC header, respectively.

For consistency with Proposal 1, following is proposed:

**Proposal 3**: EHC feedback packet format in TS 38.323 v16.0.0 clause A2.1.2 can be confirmed, i.e. there is 1 reserved bit in EHC feedback packet.

If Proposal 3 is agreed, editor’s note “*It is FFS how many reserved bits are included in the EHC feedback packet*” in TS 38.323 v16.0.0 clause A.2.1.2 can be removed.

**Question 3:** please provide your feedback on Proposal 3. Companies do not support the proposal are invited to provide their preference on the number of reserved bits in EHC feedback packet.

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| **Company** | **Support Proposal 3 (Yes/No)** | **Comments** |
| LG | Yes |  |
| Ericsson | Yes |  |
| Futurewei | Yes if Proposal 1 is taken |  |
| Qualcomm | Yes |  |
| OPPO | Yes if Proposal 1 is taken |  |
| vivo | Yes if Proposal 1 is agreed |  |
| Samsung | Yes if Proposal 1 is agreed |  |
| Huawei |  | This would be straightforward if proposal 1 is agreed, though our preference is 2 reserve bits for EHC feedback. |
| Nokia | Yes | There is currently no use for this bit, so we can have it as reserved. If we do not have reserved bits in EHC header, then feedback cannot have more than 1 reserved bit. |
| ZTE | Yes if Proposal 1 is taken |  |
| CATT | Yes |  |
| Intel | Yes |  |
| DOCOMO | Yes if Proposal 1 is taken |  |

## Decompressor behavior when receiving unknow context ID

The issue was discussed in RAN2#109e-meeting without conclusion and was postpone to this meeting. R2-2002669 [2] proposes that decompressor should indicate to the compressor when receiving unknown context ID, R2-2003296 [12] suggest not to address this issue since this is an error case, and R2-2003758 [15] proposes to confirm that EHC feedback contains only CID, and further proposes to define compressor’s ehavior when overwriting a CID so that decompressor cannot receive unknow context IDs. In TS 38.323 v16.0.0 Annex A.1, it is specified that “*The EHC compressor keeps transmitting the FH packets until the EHC feedback is received from the EHC decompressor*…*After receiving the EHC feedback, the EHC compressor starts to transmit the CH packets to the EHC decompressor including the associated CID.*” It is understood that above specification text also applies to the case that compressor selects the CID which had already established (i.e. CID overwriting case), therefore there is no need to have further clarification.

Given that there is only 1 company proposing to specify decompressor behavior if it receives a compressed packet with an unknow context ID, and current feedback mechanism specified in TS 38.323 v16.0.0 prevents the problem of unknown context ID (compressor only sends compressed packet after receiving the feedback), it is proposed to not specify decompressor behavior when receiving unknown context ID.

**Proposal 4**: There is no need to specify decompressor behavior if it receives a compressed packet with an unknown context ID.

**Question 4:** please provide your feedback on Proposal 4.

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| **Company** | **Support Proposal 4 (Yes/No)** | **Comments** |
| LG | Yes |  |
| Ericssson | Yes |  |
| Futurewei | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| vivo | Yes |  |
| Samsung | Yes |  |
| Huawei | Yes |  |
| Nokia | Not entirely | It might be worth clarifying that decompressor discards such packets. |
| ZTE | Yes |  |
| CATT | Yes |  |
| Intel | Yes |  |
| DOCOMO | Yes but | I also think there is no need to specify decompressor behavior. However, I would like to confirm that the expression of the “ *keeps transmitting*” above means that the compressor shall not cancel to transmit the EHC header ( i.e. the CID OCT and the Ethernet full header) until the context is established even if it would like to use the CID in order to perform the overwrite procedure. |

## RRC parameter

Contribution R2-2002758 [5] and R2-2002936 [8] propose to replace parameter *ehc-HeaderSize*with *ehc-CIDLength*, to align between PDCP and RRC specification. R2-2002712 [3] proposes to keep *ehc-HeaderSize* and PDCP specification describes corresponding EHC header formats and therein clarifies to which CID the headers sizes belong to. R2-2003171 [10] proposes to introduce parameter *maxCID-EHC* and removes both *ehc-HeaderSize* and *ehc-CIDLength*, and R2-2003758 [15] also proposes to introduce MAX\_CID for EHC.

**Question 5:** please provide your preference on following options:

Option a: replace parameter *ehc-HeaderSize*with *ehc-CIDLength*

Option b: keep *ehc-HeaderSize*

Option c: introduce parameter *maxCID-EHC* and remove both *ehc-HeaderSize* and *ehc-CIDLength*

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| **Company** | **Preference (a/b/c)** | **Comments** |
| LG | a | Option b is not correct because; for the FH packet, the EHC header comprises bytes for CID field and Ethernet header, which would be much larger than 1 or 2 bytes.  Option c is used in ROHC to indicate three kinds of CID fields, i.e. small CID, 1 byte large CID and 2 bytes large CID. However, in EHC, there are only two kinds of CID fields, and there is no reason to introduce such parameter. |
| Ericsson | a | Option a is the most correct option. However also b would be acceptable when clearly described. |
| Futurewei | a | CID length is a DRB parameter, and it’d be better to clearly separate it from the max number of CID a UE can support.  Header size can be different between FH packet and compressed packet for the same length of CID. |
| Qualcomm | a |  |
| OPPO | a | Much explanation is needed for option b. |
| vivo | a |  |
| Samsung | a |  |
| Huawei | a | If in option b, “ehc-HeaderSize” means the size of EHC header, that could work as well. Anyway this is not critical issue. |
| Nokia | a | This should not be confused with maxCID though, which we think is needed anyway by the gNB to limit the number of contexts the UE may establishe in UL (as in ROHC). |
| ZTE | a | We assume *ehc-CIDLength* can indicate same thing as *maxCID-EHC*, e.g., maximum available CID, but needs much less bits.  The *maxCID-EHC* can be additionally used to limit the actually used CID number, especially when CID length is long. As we assume long CID length would only be allocated when it’s necessary, the *maxCID-EHC* may be not so useful and we are fine not to introduce *maxCID-EHC* in this release.  If proposal 1 is agreed, *ehc-HeaderSize* may be also fine as it may have less bits than *ehc-CIDLength* for indicating same thing. |
| CATT | a | It is a direct way and makes PDCP and RRC specifications aligned. |
| Intel | a | Using *ehc-CIDLength* is simple and straightforward compared with other options. |
| DOCOMO | a | I agree with Nokia. The maxCID is used for other purposes |

A related discussion is on how to handle clause “5.12.3 Protocol parameters” and its Editor’s Note: “*The need for configuration parameters is FFS.*” Contribution R2-2002758 [5] proposes to remove the clause since it is a copy of corresponding ROHC clause. R2-2002712 [3] proposes that RRC parameters can be described in this section. R2-2003171 [10] proposed to clarify that EHC header size and CID field length in EHC header are derived based on *maxCID-EHC*.

**Question 6:** please provide your preference on how to handle clause “5.12.3 Protocol parameters”.

Option a: Remove clause “5.12.3 Protocol parameters”.

Option b: Update clause “5.12.3 Protocol parameters” to document EHC parameters.

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| **Company** | **Preference (a/b)** | **Comments (including e.g. proposed text for clause “5.12.3 Protocol parameters”)** |
| LG | a | But we have to make VOID for this section instead of removing. |
| Ericsson | a |  |
| Futurewei | a | This section can be VOID’ed, as EHC is fully specified in PDCP. |
| Qualcomm | a | Agree with Futurewei explanation |
| OPPO | a |  |
| vivo | a |  |
| Samsung | a |  |
| Huawei | a |  |
| Nokia | b | It can be in another section, but we need to describe somewhere that RRC configures CID length (which then translates into the header structure the UE uses), and maxCID which denotes the maximum number of contexts the UE may establish in UL. |
| ZTE | a |  |
| CATT | a |  |
| Intel | a | The clause can be VOID’ed if Option a in Question 5 is agreed. |
| DOCOMO | b | Same as Nokia |

## Configuration

Reconfiguration involving PDCP re-establishment

R2-2002718 [4] and R2-2003171 [10] propose that network reconfigures *ethernetHeaderCompression* only upon reconfiguration involving PDCP re-establishment, similar to ROHC. In the email discussion in RAN2#109-e meeting, some companies indicated that this can be handled by the implementation and that such restriction is not required. From contributions submitted to this meeting, both companies prefer to capture the restriction.

**Proposal 5**: Network reconfigures *ethernetHeaderCompression* only upon reconfiguration involving PDCP re-establishment.

**Question 7:** please provide your feedback on Proposal 5.

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| **Company** | **Support Proposal 5 (Yes/No)** | **Comments** |
| LG | Yes |  |
| Ericsson | No | Can be handled by network implementation. |
| Futurewei | Yes | This avoid the context confusion (e.g., the CID length) when the reconfiguration message is received. |
| Qualcomm | Yes | We are open to discuss if there is any constraint placed on the network due to the “yes” answer. |
| OPPO | Yes |  |
| vivo | Yes |  |
| Samsung | Yes |  |
| Huawei | Yes |  |
| Nokia | Yes | If we do not agree this, there might be issues with proper handling of PDUs at PDCP layer. We are not sure how the UE side could be solved by network implementation. |
| ZTE | Yes | Agree with Futurewei. |
| CATT | Yes | It is consistent with the configuration of *headerCompression* for ROHC. It is a safe way for EHC configuration |
| Intel | Yes | This follows the principle in ROHC. |
| DOCOMO | Yes |  |

LTE EHC configuration

Contribution R2-2002908 [7] proposes that for LTE, EHC cannot be configured with UDC, following the same principle of not configuring ROHC and UDC together. Although it is only proposed by one company, the proposal is expected to be easily agreeable.

**Proposal 6**: For LTE, EHC cannot be configured together with UDC.

**Question 8:** please provide your feedback on Proposal 6.

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| **Company** | **Support Proposal 6 (Yes/No)** | **Comments** |
| LG | Yes |  |
| Ericsson | Yes |  |
| Futurewei | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| vivo | Yes |  |
| Huawei | Yes |  |
| Nokia | Yes |  |
| ZTE | Yes |  |
| CATT | Yes |  |
| Intel | Yes |  |
| DOCOMO | Yes |  |

## Other potential open issues

Differentiation between SDAP control and data PDUs

Contribution R2-2002908 [7] proposes to distinguish SDAP control PDU from SDAP Data PDU if both SDAP header and EHC are configured, since PDCP entity should generate EHC header for SDAP Data PDU while it should not generate EHC header for SDAP control PDU.

**Question 9:** please provide your preference on following options if both SDAP header and EHC are configured:

Option a: add clarification in PDCP specification to distinguish SDAP control PDU from SDAP Data PDU.

Option b: leave the handling to UE implementation.

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| **Company** | **Preference (a/b)** | **Comments** |
| LG | b | For ROHC, there is no special handling on distinguishing SDAP header. Thus, it should be also left up to UE implementation for EHC. |
| Ericsson | b |  |
| Futurewei | b | The compressor and decompressor can already distinguish SDAP data PDU and control PDU, and know that there is no thernet header in SDAP control PDU. |
| Qualcomm | b |  |
| OPPO | b |  |
| vivo | b |  |
| Samsung | a | Even for ROHC, it is not clear how to distinguish SDAP Control PDU from SDAP Data PDU even though implementation can distinguish one from the other. ROHC is a implementation-specific solution and thus it was left as it was.  However, EHC is a standardized solution and has different handling for SDAP Control PDU and SDAP Data PDU, which requires further clarification unlike ROHC. |
| Huawei | b | We do not see any problem that SDAP control PDUs are distinguished from SDAP data PDUs by UE implementation. Nothing needs to be specified. |
| Nokia | b | We also do not see why anything would have to be specified here. |
| ZTE | b | Agree with LG. |
| CATT | b |  |
| Intel | b |  |
| DOCOMO | b | This is about the compressor’s internal behavior, so there is no problem even if it is handled by the implementation. |

Ethernet frame handling by EHC

R2-2003172 [11] proposes to adopt a TP regarding detailed example of operation on different Ethernet header structures as informative text.

**Question 10:** please provide your preference on whether to capture example of operation on different Ethernet header structures as informative text.:

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| --- | --- | --- |
| **Company** | **Whether to capture an informative text (Yes/No)** | **Comments (including proposed changes to the TP if any)** |
| LG | No | We don’t see any clear reason to include such informative example. |
| Ericsson | No |  |
| Futurewei | Yes | An informative section (e.g., an annex) can be helpful. |
| Qualcomm | Yes | Not a strong view though |
| OPPO | No |  |
| vivo |  | No strong view. The informative text could be helpful for the readers. |
| Samsung | No |  |
| Huawei | No | Agree with LG |
| Nokia | Yes | We can of course discuss the exact form of the TP and we think it is OK to have this as informative Annex. The reason is simple – we believe the way EHC is currently described will not be sufficiently clear to people implementing the feature even if it is clear to us at the moment. For example, the level of detail as compared to how RoHC is described by IETF is much much lower, even when we consider that EHC is simpler in general. |
| ZTE | Yes | Such example would be helpful for understanding EHC. |
| CATT | - | No strong view |
| Intel | No | We don’t think Ethernet frame handling details should be captured in PDCP specification. If the example is captured, RAN2 needs to maintain it if any update of Ethernet specifications results in updated operation on Ethernet header handling in EHC. |
| DOCOMO | No | Agree with Intel. We need to maintain it once we introduce it. |

# Conclusion

**[To be provided at the end of email discussion]**

# References

[1] 3GPP TS 38.323 v16.0.0, "NR; Packet Data Convergence Protocol (PDCP) specification"

[2] R2-2002669, Sony, “EHC absence of Q-Tags and NACK feedback”

[3] R2-2002712, Ericsson, “Remaining EHC issues”

[4] R2-2002718, Huawei, HiSilicon “Discussion about remaining issues of EHC”

[5] R2-2002758, CATT, “The Remaining Issues on EHC”

[6] R2-2002773, vivo, “Reserved value in the EHC header”

[7] R2-2002908, Samsung, “Leftover issues for EHC”

[8] R2-2002936, LG Electronics Inc., “Length of CID field in EHC header”

[9] R2-2002973, OPPO, “Discussion on EHC format ”

[10] R2-2003171, Nokia, Nokia Shanghai Bell, “EHC remaining issues”

[11] R2-2003172, Nokia, Nokia Shanghai Bell, “Clarification on Ethernet frame handling by EHC”

[12] R2-2003296, ZTE Corporation, Sanechips, “Remaining issues for EHC in TSC”

[13] R2-2003321, Intel Corporation, “Remaining issues in Ethernet header compression”

[14] R2-2003755, Qualcomm Inc, “On reserved bit in EHC header”

[15] R2-2003758, NTT DOCOMO INC., “Remaining issue for EHC”