**3GPP TSG-RAN2 #116bis-e R2-220xxxx**

**Electronic meeting, January 17th – 25th 12**

**Agenda item:**‎x.xx

**Source:** CATT

**Title:** Report of [Post116-e][088][UDC] UDC initial discussion (CATT)‎

**Document for:** Discussion and Decision

# 1 Introduction

This document is for the report of the following discussion

* [Post116-e][088][UDC] UDC initial discussion (CATT)

 Scope: To align companies’ understanding regarding which parts of the UDC functionality directly follows LTE mechanism, which parts shall be adapted based on NR characteristics (if any), and what is the target of each such adaptation (if any). The discussion may include stage-3 examples to illustrate the points discussed.

 Intended outcome: Report

 Deadline: Long

The reminder of this contribution is organized as the following.

* Section 2 provides Rapporteur’s general analysis on NR UDC functionality including potential issues to be discussed due to NR characteristics. Section 3 provides specification impact analysis and modification examples may be provided in later phase. Section 4 contains the summary.

The discussions are planned in two phases:

* In Phase 1, companies’ views/comments are collected, on the generally analysis and potential open issues in section 2 (i.e., do they agree to those issues or do they see any other issues that need to be discussed) and also on spec impact analysis in section 3. The deadline for Phase 1 is end of Dec. 8th, 2021, UTC time. Please find summary after each question and also an overall summary may have been added in the end of ph1 section.
* In Phase 2, companies’ views/comments are collected regarding how to address the issues that have been identified through Phase 1 discussions and how to modify the specifications. The deadline is end of Dec.16th, 2021, UTC time.

Participants are invited to leave their contact information in the table.

|  |  |  |
| --- | --- | --- |
| **Company name** | **Delegate name** | **Email address** |
| CATT | Erlin Zeng | erlin.zeng@catt.cn |
| LG | Geumsan Jo | Geumsan.jo@lge.com |
| Mediatek | Yuanyuan Zhang | Yuany.zhang@mediatek.com |
| Huawei, HiSilicon | Jun Chen | jun.chen@huawei.com |
| Apple | Ralf Rossbach | rrossbach@apple.com |
| OPPO | Zhe Fu | fuzhe@OPPO.com |
| Qualcomm | Ruiming Zheng | rzheng@qti.qualcomm.com |
| Intel | Yujian Zhang | yujian.zhang@intel.com |
| Samsung | Donggun Kim | s\_dg.kim@samsung.com |
| CMCC | Ningyu Chen | chenningyu@chinamobile.com |
| Ericsson | Ritesh Shreevastav | Ritesh.shreevastav@ericsson.com |
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# 2 General analysis on NR UDC Functionality

### Phase 1

The purpose of this section is to analyse from high level the NR UDC functionality, and identify

* which parts directly follow the LTE UDC mechanism, and
* which parts need further discussion and clarification.

The functionalities are divided as the following

1. PDCP aspects
2. UDC configuration
3. UDC operation in RRC re-establishment procedure
4. Release of UDC configuration in different cases
5. UDC operation in mobility procedure
6. Split Bearer
7. RAN3 impacts.
8. UE capability for UDC

In Table 1, some analysis in R2-2111067‎ is reused. In the table, the parts with TBD mean that some further discussions are needed (i.e. adaptation due to NR characteristics should be considered). Note that these points are not for the sake of optimization which does not belong to the WID scope, but it aims at clarification and easy inclusion of UDC to all the related NR specifications.

**Table 1 Functionality analysis**

|  |  |
| --- | --- |
| **parts of NR UDC functionality** | **Analysis** |
| PDCP aspects | * **UDC protocol**: defines the compression algorithm of UDC;
* **Configuration of UDC**: defines the configuration procedure for UDC as well as the initialization of the dictionary buffer of UDC;
* **UDC header**: defines the format of UDC header;
* **Pre-defined dictionary**: in UDC, pre-defined dictionary can be applied to improve the compression efficiency;
* **UDC buffer reset**: when the compression buffer and de-compression buffer are not synchronized, the compression buffer is reset for resynchronization;
* **UDC feedback procedure**: the network can figure out whether UDC decompression succeeds or not by checking UDC checksum error. Hence, UDC feedback procedure enables feedback, i.e. UDC feedback packet, from the network in case of the out of synchronization happens to trigger UDC buffer reset procedure;
* **UDC PDU format definitions**: defines the PDU format for UDC with 12 bits PDCP SN and 18 bits PDCP SN. In NR, SDAP is introduced for mapping between QoS flow and DRB. But it is TBD whether SDAP header and SDAP control PDU should be compressed by UDC;
* **PDCP reordering**: gNB implementation ensures that UDC decompression is after PDCP reordering.
* **UDC continuity** : whether support UDC continuity in NR which can follow ROHC continuity mechanism can be TBD.
* **Relationship with ROHC and EHC:** UDC is not configured simultaneously with ROHC or EHC for the same radio bearer.
 |
| UDC configuration | * For existing DRBs, UDC only is configured when reconfiguration with sync or the first *RRCReconfiguration* message after RRC connection re-establishment.
 |
| UDC operation when involving PDCP re-establishment procedure | * Reset compression buffer for UDC bearer.
 |
| Release of UDC configuration in different cases | * RRC reconfiguration with sync;
* RRC reestablishment procedure;
* Conditional reconfiguration with sync;
* RRC resume procedure;
 |
| UDC operation in mobility procedure | * **UDC in DAPS** (**TBD**): whether UDC can be used during DAPS HO in NR should be clarified. In LTE UDC, it is not applied for DAPS.
* **UDC in CHO:** UDC configuration is released when conditional reconfiguration with sync is executed.
 |
| Split bearer | * **UDC for split bearer** (**TBD**): it should be clarified whether UDC can be applied to split bearer.
 |
| RAN3 impacts | * **UDC impacts on E1** (**TBD**): if supporting CU-CP/UP splitting, E1 would be impacted to transmit UDC configuration from CP to UP.
 |
| UE capability for UDC | * Support UDC and pre-defined dictionary capabilities
 |

**Question 1-1: Do you agree the parts without TBD can easily follow the LTE mechanism?**

|  |  |  |
| --- | --- | --- |
|  Company | Yes or No | Comments if any |
| LG | Comments | It is difficult to say whether we can easily follow the LTE mechanism or not. Each function should be carefully checked whether it is supported for NR. |
| CATT | Yes | Intention is to check from high level which functionalities can follow those of LTE UDC, e.g., compression algorithm, checksum, pre-defined dictionary, handling for failure etc.. Detailed specification changes can be discussed in a later stage, once views have been aligned from high level.  |
| Mediatek | Yes | Except the aspects of TBD, we don't see any technical issue to follow the LTE mechanism.  |
| Huawei, HiSilicon | Yes with some clarifications | For UDC configuration, we understand that the network can configure UDC for a new DRB and the network can configure UDC for existing DRBs only by some means. So the following description can be improved:For existing DRBs, UDC only is configured when reconfiguration with sync or the first *RRCReconfiguration* message after RRC connection re-establishment.[Rapporteur]: Ok. Table 1 is updated.For release of UDC after a successful CHO, we understand that the UE shall release UDC configuration when the UE perfroms a successful CHO (i.e. after CHO execution), so the bullet “Conditional reconfiguration with sync;” could be improved to: after UE applying Conditional reconfiguration with sync.[Rapporteur]: We have the common understanding. Please note the current description is that UDC configuration is released when conditional reconfiguration with sync is executed.For UDC buffer reset, we think that when the compression buffer and de-compression buffer are not synchronized (indicated by gNB or identified by UE), the compression buffer is reset for resynchronization. This should be allowed by existing LTE UDC definition.[Rapporteur]: for UDC buffer reset, this aims reuse LTE UDC mechanism which has been supported. |
| Apple | Yes | We think that we can follow the high-level UDC functionality of LTE as a baseline and we also agree on the TBD aspects, detailed changes can be discussed in subsequent steps. |
| OPPO | See comment | We have several comments,1. Regarding UDC configuration, we prefer the following wording, since the current description in the Analysis part can not cover all cases, e.g. RRC resume case.

*The network reconfigures uplinkDataCompression only upon reconfiguration involving PDCP re-establishment…**(it can be modified if RAN2 achieves the agreement on the support of UDC continuity).*[Rapporteur]: We are confused for this comment. UDC is only configured when reconfiguration with sync or the first RRC Reconfiguration message after RRC connection re-establishment for existing DRBs and will be released in reconfiguration procedure involving PDCP re-establishment. If you mean UDC release procedure, we don’t think it is necessary to change the description since we have leave UDC continuity as TBD.1. Regarding UDC operation in RRC re-establishment procedure, we agree to reset the compression buffer for UDC if UDC continuity is not configured. But, we suggest to describe the case as “UDC operation when involving PDCP re-establishment procedure”, to align with current LTE text and cover more cases(e.g. HO)

[Rapporteur]: Ok. The corresponding part has been modified.1. Regarding the UDC support, we wonder whether UDC can be enabled for the DRB with RLC UM mode.

[Rapporteur]: Since LTE UDC could not be applied to RLC UM mode, it is also excluded in NR UDC WI. |
| Qualcomm | Yes | Except the TBD bullets, the high-level functionality can follow LTE UDC. The details and TBD can be discussed in the phase 2. |
| Intel | Yes |  |
| Samsung | Yes | TBD and possible issues can be discussed in the phase 2 and then we expect LTE UDC would be easily applicable to NR based on the results of Phase 2. |
| CMCC | Yes | LTE UDC should be reused as much as possible. And we are open with the TBD part. |
| Ericsson | Yes | We agree on high level the feature support for UDC in NR should be same as the LTE UDC |

**Summary for Q1-1:**

9 companies agree that the parts without TBD in Table 1 can easily follow LTE. 1 company suggest checking whether the functions are supported for NR carefully. And 2 companies give some details comments on the content in Table 1 which has been captured. 1 Company suggests clarifying whether UDC can be enabled for DRB with RLC UM mode. The rapporteur provides responses for some comments.

Since majority companies agree that the parts without TBS in Table 1 can follow LTE, the rapporteur proposes the following.

**Proposal 1 (9/11): The parts without TBD in Table 1 are assumed to directly follow LTE UDC mechanism.**

Some further clarifications on potential issues in table 1 (i.e. TBD) are discussed below.

**Issue 1: Whether UDC is applied to SDAP header and SDAP control PDU?**

In NR, SDAP has been introduced. There may be two types of SDAP PDUs, i.e. SDAP data PDU and SDAP Control PDU. It has specified that ciphering and header compression are not applied to SDAP header and SDAP control PDU (see TS 38.323). Whether UDC is applicable to SDAP header and SDAP control PDU should be discussed. If companies agree this is an issue to be discussed, two alternatives can be considered:

Alt 1: UDC is applicable to SDAP header and SDAP control PDU.

Alt 2: UDC is not applicable to SDAP header and SDAP control PDU.

The rapporteur prefers Alt2 which follow the existing mechanism that ciphering and header compression are not applied to SDAP header and SDAP control PDU.

**Question 1-2: Do you agree UDC is not applied to SDAP header and SDAP control PDU?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | New issues to be discussed if any |
| LG | Yes |  |
| CATT | Yes |  |
| Mediatek | Yes |  |
| Huawei, HiSilicon | Yes | We prefer alt2. At RAN2#107, we paper R2-1910523 discussed the issue. We think alt2 follows the principle of legacy ciphering and header compression definition, so the option should be easier than alt1. |
| Apple | Yes |  |
| OPPO | Yes | For simplicity. |
| Qualcomm | Yes | We prefer Alt 2. |
| Intel | Yes |  |
| Samsung | Yes |  |
| CMCC | Yes |  |
| Ericsson | Yes |  |

**Summary for Q1-2:**

All companies agree that UDC is not applied to the SDAP header and SDAP control PDU. Therefore, the following is proposed.

**Proposal 2 (11/11): UDC is not applied to the SDAP header and SDAP control PDU.**

**Issue 2: UDC PDU format**

Since SDAP is introduced in NR, its header location should be decided, i.e. whether it is located before or after UDC header should be discussed. Two formats can be considered:

Option 1: the SDAP header is located after UDC header which is illustrated as following:



Option 2: the UDC header is located after SDAP header which is illustrated as following:



 Note: this issue may be related to issue 3.3-1.

This issue is related to issue 1. If UDC is not applied to SDAP header, option 2 format can be used.

**Question 1-3: Do you agree option 2 is used as the UDC PDU format?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | New issues to be discussed if any |
| LG | Yes | Similar to ROHC and EHC header. |
| CATT | Yes |  |
| Mediatek | Yes |  |
| Huawei, HiSilicon | Yes | We prefer Option 2. At RAN2#107, we paper R2-1910523 discussed the issue, and Q1-3 is related to Q1-2. |
| Apple | Yes | Strongly prefer option 2. This also implies that the UDC header is ciphered as in LTE. In this case ciphering would apply to the UDC header, UDC data block, and MAC-I. And integrity protection would apply to PDCP header, SDAP header, UDC header, UDC data block, plus the addition of the MAC-I. |
| OPPO | Yes | It is related to the conclusion for Q1-2. If UDC is not applied to the SDAP header and SDAP control PDU, Option 2 is preferred.  |
| Qualcomm | Yes | We prefer Option 2. |
| Intel | Yes |  |
| Samsung | Yes | We can follow the same principle as that of EHC header for UDC header. |
| CMCC | Yes |  |
| Ericsson | Yes |  |

**Summary for Q1-3:**

All companies agree option 2 is used as UDC PDU format. Therefore, the following is proposed.

**Proposal 3 (11/11): The UDC header is located after SDAP header in the UDC PDU format.**

**Issue 3: UDC continuity**

In NR Rel-15, it has been agreed to support ROHC continuity in case of resuming an RRC connection or reconfiguration with sync, when the PDCP termination point is not changed and the *fullConfig* is not indicated (see TS 38.331). This is helpful to reduce the radio resource consumption. Although LTE UDC does not support continuity, some companies see the benefits of UDC continuity in NR. So it is suggested to discuss whether we can follow ROHC mechanism in NR UDC.

**Question 1-4: Do you agree to support UDC continuity in NR which reuses ROHC continuity mechanism?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | New issues to be discussed if any |
| LG | No | We want to keep the UDC simple to be aligned with allocated TU. |
| CATT | Yes | In our view, UDC continuity is beneficial to improve the resource efficiency. Since we follow the similar mechanism of ROHC continuity, we believe the work load is quite limited. We can check what the companies’ views are.  |
| Mediatek | Yes | We also think it’s beneficial to support UDC continuity. There is no much effort to support this, just following the same principle of ROHC continuity. Since UDC continuity is configurable, if the network can’t support UDC continuity, it can choose not to set the indication.  |
| Huawei, HiSilicon | Yes | We see the benefits of following RoHC continuity for NR UDC, and the specification impacts are limited, so we support it. |
| Apple | Yes | OK to reuse a mechanism similar to RoHC continuity for NR UDC. |
| OPPO | Yes | Suggest to follow the mechanism used in ROHC, i.e., “support UDC continuity in case of resuming an RRC connection or reconfiguration with sync, when the PDCP termination point is not changed and the fullConfig is not indicated” |
| Qualcomm | Comments | The scenario should be discussed first. It may be only beneficial for the intra-gNB-CU and inter-gNB-DU handover. |
| Intel | No strong view | There might not be much specification efforts to support UDC continuity. |
| Samsung | Yes, but | We should carefully review if any possible issue is foreseen when UDC context continues. |
| CMCC | Yes |  |
| Ericsson | No | We want to keep the UDC simple to be aligned with allocated TU. |

**Summary for Q1-4:**

7 companies agree to support UDC continuity in NR. While 2 companies want to keep UDC simple considering the allocated TU. 1 company wants to first discuss the scenario to apply UDC continuity. 1 company has no strong view.

The rapporteur thinks that if the mechanism of UDC continuity uses the same mechanism as ROHC continuity, the work load is quite limited. Therefore, rapporteur proposes that:

**Proposal 4 (7/11): Support UDC continuity in NR which reuses ROHC continuity mechanism.**

**Issue 4: Applicability of UDC in DAPS**

In LTE mobility enhancement WI, whether UDC is applied to DAPS was not discussed sufficiently but just shown hands to see companies’ views to save discussion time and suggested to consider it in NR UDC. So in LTE, UDC is not applied to DAPS. The simple way is follow LTE UDC that NR UDC is not applied to DAPS.

**Question 1-5: Do you agree NR UDC is not applied to DAPS like LTE UDC?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | New issues to be discussed if any |
| LG | Yes | We want to keep the UDC simple to be aligned with allocated TU. |
| CATT | Yes |  |
| Mediatek | No strong view | We don’t see the real technical issue to have it. But considering the time limitation, we are OK to leave it out.  |
| Huawei, HiSilicon | Yes | In LTE, if a DRB is configured with UDC, it can not be configured with DAPS. We think the LTE definition can be applied for NR UDC. |
| Apple | Yes |  |
| OPPO | No strong view | In NR, RoHC can be used for DAPS but EHC can not. If we follow the LTE UDC mechanism for DAPS, we only need to capture such configuration restrictions in NR spec. Otherwise, some change is needed (which should not be complicated either since there is a single UL in DAPS). We are fine to follow majorities. |
| Qualcomm | Yes | NR UDC is not applied to DAPS like LTE UDC |
| Intel | Yes | Discussion on UDC for DAPS might take non-negligible TU. |
| Samsung | Yes | Rel-16 DAPS handover already considered LTE UDC and thus we can keep the legacy principle. |
| CMCC | Yes |  |
| Ericsson | Yes |  |

**Summary for Q1-5:**

9 companies agree NR UDC is not applied to DAPS. And 2 companies show no strong view. Therefore, the following is proposed.

**Proposal 5 (9/11): UDC is not applied to DAPS in NR.**

**Issue 5: Applicability of UDC to split DRB**

In LTE UDC, the impact to 37.340 is not discussed and considered. But in NR, it should be checked. In 37.340, for ROHC, there is one clarification “In MR-DC, ROHC (as described in TS 36.323 [15] and TS 38.323 [16]) can be configured for all the bearer types.” In LTE, ROHC is not applied to split DRB and UDC followed the same as ROHC although UDC can be applied to split DRB from technical point of view. But in NR, ROHC is extended to apply to all bearer types. For NR UDC, it also can follow ROHC, i.e. UDC is extended to apply to all bearer types. Since it follows ROHC mechanism which is different in NR and LTE, it can be discussed as one open issue which belongs to the part of adaptation due to NR characteristics. So it is proposed to discuss whether to apply NR UDC to split DRB.

**Question 1-6: Do you agree NR UDC can be applied to split DRB?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | New issues to be discussed if any |
| LG | No | We want to keep the UDC simple to be aligned with allocated TU. |
| CATT | Yes | We think it beneficial to apply UDC to the split bearer. We can follow the mechanism of ROHC for split bearer. These might impact some specs but in our view the work load should be not too much.We can check what the companies’ views are. |
| Mediatek | Yes | For spit bearer, we have the common PDCP, where UDC/ROHC is performed. There is no technical concern to support UDC for split bearer. Considering split bearer is very common in NR, it is beneficial to support it to improve the resource efficiency generally.  |
| Huawei, HiSilicon | Yes | We see the benefits of allowing UDC for split DRB(s), and potential specifications impacts are:* RRC configuration restriction, e.g. network does not configure UDC when outOfOrderDelivery is configured
* Stage-2 impacts
* UE capability co-ordinations between network nodes, e.g. MN sends max UDC DRB number to SN. For RoHC for split DRB(s), the field maxNumberROHC-ContextSessionsSN can be exchanged between MN and SN

Generally the impacts are limited. |
| Apple | Yes | We see some benefits in applying UDC to split bearer scenario, which is common in NR. PDCP handles the reordering in NR, and we think NR UDC can follow NR ROHC in that it can be configured for any bearer type.  |
| OPPO | Yes | NR PDCP can support reordering.  |
| Qualcomm | Yes | Similar to NR RoHC, NR UDC can be applied to split DRB. Some spec. change should be further discussed. |
| Intel | No strong view | There might not be much specification efforts to support UDC on split DRB. |
| Samsung | Yes but | If we are going to apply UDC to split bearer, then possible technical issues should be considered and discussed in Phase 2. |
| CMCC | Yes |  |
| Ericsson | No | We would prefer to have same functionality as LTE |

**Summary for Q1-6:**

8 companies agree NR UDC can be applied to split bearer, similar as ROHC. 1 company wants to keep it simple considering the TU. 1 company prefers to have same functionality as LTE. One company has no strong view. Considering majority view, the rapporteur suggests that we can reuse the ROHC mechanism, i.e. UDC can be applied to split bearer.

**Proposal 6 (8/11): NR UDC can be applied to split DRB.**

**Issue 6: CU-CP and CU-UP splitting**

E1AP provides the signalling between gNB-CU-CP and gNB-CU-UP. And the Bearer Context Setup procedure is used to allow the gNB-CU-CP to establish a bearer context in the gNB-CU-UP. In the procedure, the gNB-CU-CP sends the BEARER CONTEXT SETUP REQUEST message to the gNB-CU-UP. Introduction of UDC configuration may require changes to E1 as well. This may need RAN3 further work. If companies think the scenario should be supported, LS can be sent to RAN3 when we identify parameters of UDC configuration.

**Question 1-7: Do you agree NR UDC is also applied to the scenario of CU-CP and CU-UP splitting, i.e. E1 interface should be involved?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed comments |
| LG | No |  We want to keep the UDC simple to be aligned with allocated TU. |
| CATT | Yes | CU-CP and CU-UP slitting scenario is one typical scenario in NR. Therefore, we think UDC should be supported in this scenario. We suggest to send LS to RAN3 after UDC configuration content is clear. |
| Mediatek | Yes | Agree with CATT.  |
| Huawei, HiSilicon | Yes | We share similar views as CATT. |
| Apple | Yes | Agree with CATT. |
| OPPO | Yes |  |
| Qualcomm | - | Should be discussed in RAN3 |
| Intel | No | Our understanding is that UDC is RAN2 only WI according to WID (e.g. from the listed impacted specifications). We would prefer to not involve RAN3 for UDC. |
| Samsung | - | We can leave it as FFS for now. LS would be helpful. |
| CMCC | Yes | We can focus on the RAN2 part, then send LS to RAN3 and let RAN3 to make the decision. |
| Ericsson | No | Agree with Intel |

**Summary for Q1-7:**

6 companies agree that NR UDC can be applied to the scenario of CU-CP and CU-UP splitting. 2 companies think UDC is RAN2 only and RAN3 is not involved. 1 company want to keep UDC simple to be aligned with allocated TU. 1 company thinks this should be discussed in RAN3. 1 company thinks this can be leave as FFS and LS is helpful and 5 companies think we can send LS to RAN3 after RAN2 has enough progress.

The rapporteur suggests stopping the discussion related to this issue for now, and can further discuss in the next RAN2 meeting.

**Other issues**

**Question 1-8: Do you see any further issues to be discussed for NR UDC? Please explain more about the identified issues.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Detailed comments |
| Apple | Yes | In LTE, UDC is not used for sidelink communication. RAN2 should discuss whether the same restriction can be carried forward to NR. |
| OPPO | Yes | Similar view as Apple. NR should also have restrictions on the UDC support for sidelink communication.  |
|  |  |  |
|  |  |  |
|  |  |  |

**Summary for Q1-8:**

2 companies suggest adding the restriction that UDC is not applied to sidelink communication. The rapporteur suggests the issue can be discussed in phase 2**.**

**Overall Summary of Phase 1**

11 companies joined in the discussion. The following proposals are proposed based on majority views.

**Proposal 1 (9/11): The parts without TBD in Table 1 are assumed to directly follow LTE UDC mechanism.**

**Proposal 2 (11/11): UDC is not applied to the SDAP header and SDAP control PDU.**

**Proposal 3 (11/11): The UDC header is located after SDAP header in the UDC PDU format.**

**Proposal 4 (7/11): Support UDC continuity in NR which reuses ROHC continuity mechanism.**

**Proposal 5 (9/11): UDC is not applied to DAPS in NR.**

**Proposal 6 (8/11): NR UDC can be applied to split DRB.**

To make further progress, the rapporteur suggests that draft CRs can be provided based on these proposals for further discussions in Ph2 on more detailed specification impacts.

### Phase 2

In phase 1, some companies propose to discuss whether NR UDC can be used for sidelink communication. Considering UDC is not applied to sidelink DRBs in LTE, the rapporteur suggests the same for NR, i.e., UDC is not applied to sidelink DRBs. Companies are invited to provide views on this issue.

**Question 2-1: Do you agree NR UDC is not applied to sidelink DRBs like for LTE UDC?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments if any |
| Huawei, HiSilicon | Yes | According to TS 38.331, SL-RLC-Config-r16 can be used to configure RLC AM or RLC UM DRBs, and it is a difference compared with LTE. The configurations of sidelink and Uu are independent, so it would introduce extra complexities for applying UDC to sidelink features.In general, we are fine to not support UDC for sidelink DRBs for the WI. |
| Apple | Yes |  |
| LG | Yes |  |
| Intel | Agree | NR UDC is not applied to sidelink DRBs. |
| OPPO | Yes |  |
| Qualcomm | Yes |  |
|  |  |  |

# 3 Specification impacts analysis

The purpose of this section is to align from high level companies’ views regarding which specifications are impacted and how.

## 3.1 TS 38.300

### Phase 1

Table 2 provides some analysis on the potential specification impacts to TS 38.300.

**Table 2 Spec impact analysis for 38.300**

|  |  |  |
| --- | --- | --- |
| Specification | Parts that follow the LTE mechanism | Additional impacted parts due to NR |
| TS 38.300 | * + Adding abbreviation of UDC;
	+ Adding UDC function in PDCP;
	+ Changing the protocol figures to allow UDC in uplink compression.
 | N.A. |

With the analysis, Rapporteur hasn’t seen any further impacts due to NR UDC to TS 38.300.

**Question 1-9: Do you agree with spec impact analysis in Table 2? Do you see any other impacts to TS 38.300?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional impacts if any |
| LG | Yes |  |
| CATT | Yes |  |
| Mediatek | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes | TS 38.300 should be extended to specify how UDC is handled for DAPS handover, as well as for the sidelink (see our response in question 1-8).[Rapporteur] In LTE, this is clarified in 36.331.  |
| OPPO | Yes, but | If RAN2 agrees on the support of UDC continuity, Stage-2 spec also needs to reflect such agreement.  |
| Qualcomm | Yes |  |
| Intel | Yes |  |
| Samsung  | Yes |  |
| CMCC | Yes |  |
| Ericsson | Yes |  |

Summary of Phase 1

All companies agree with impact analysis in Table 2.

1 company suggests to further specify how UDC is handled for DAPS handover and sidelink. 1 company suggest considering UDC continuity. The rapporteur thinks that we can take table 1 as baseline for now. Companies can provide further comments or suggestions during the phase 2 discussion or discussions in the next meeting.

**Proposal 7: Impact analysis in Table 2 is taken as baseline to develop draft CRs for review in the next step discussions.**

### Phase 2

In phase 2, a draft 38.300 CR is provided in the draft folder. Views and comments are collected, based on which the moderator may update the draft CR, as an input to the discussions in the next meeting.

**Question 2-2: Do you have any comments to the draft 38.300 CR (please focus on the changes, not coversheet)?**

|  |  |
| --- | --- |
| Company | Detailed comments to the draft CR |
| Huawei, HiSilicon | The following text may need some updates:*Only source and target PCell are used during DAPS handover. CA, DC, SUL, multi-TRP, EHC, CHO, NR sidelink configurations and V2X sidelink configurations are released by the source gNB before the handover command is sent to the UE and are not configured by the target gNB until the DAPS handover has completed (i.e. at earliest in the same message that releases the source PCell).* |
| Intel | The draft 38.300 CR looks fine. |
|  |  |
|  |  |
|  |  |
|  |  |

## 3.2 TS 38.306

### Phase 1

Table 3 provides some analysis on the potential specification impacts to TS 38.306.

**Table 3 Spec impact analysis for 38.306**

|  |  |  |
| --- | --- | --- |
| Specification | Parts that follow the LTE mechanism | Additional impacted parts due to NR |
| TS 38.306 | Adding UDC abbreviation and corresponding capability definition. | N.A. |

Rapporteur hasn’t seen any further impacts due to NR UDC to TS 38.306.

**Question 1-10: Do you agree with spec impact analysis in table 3? Do you see any other impacts to TS 38.306?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional impacts if any |
| LG | Yes |  |
| CATT | Yes |  |
| Mediatek | Yes |  |
| Huawei, HiSilicon | Yes | In LTE, the UE supporting UDC shall support up to 2 UDC DRBs, and it has been defined in TS 36.306.In NR, the UE will be more powerful, and it may happen that more than 2 DRBs can benefit from UDC. So we think that the UE capability can be enhanced, e.g. the UE can indicate whether it supports at most 3/4 UDC DRBs to the network. |
| Apple | Yes | We prefer to stay with 2 UDC DRBs to limit the demand on processing resources. |
| OPPO | Yes |  |
| Qualcomm | Yes with comments | Whether the additional capability is enhanced or added needs further discussion. |
| Intel | Yes |  |
| Samsung  | Yes |  |
| CMCC | Yes |  |
| Ericsson | Yes |  |

Summary of Phase 1

All companies agree with impact analysis in Table 3. While 1 company suggests extending the DRB number the UE supports for UDC. The rapporteur thinks that for phase 1, we can take LTE UDC capability as baseline and discuss whether the DRB number can be extended in phase 2.

**Proposal 8: Impact analysis in Table 3 is taken as baseline to develop draft CRs for review in the next step discussions.**

### Phase 2

In phase 2, a draft 38.306 CR is provided in the draft folder. Views and comments are collected, based on which the moderator may update the draft CR, as an input to the discussions in the next meeting. Please note extended DRB number is not covered in this version of the draft CR.

**Question 2-3: Do you have any comments to the draft 38.306 CR (please focus on the changes, not coversheet)?**

|  |  |
| --- | --- |
| Company | Detailed comments to the draft CR |
| Huawei, HiSilicon | No comments. |
| Apple | No comments. |
| Intel | The draft 38.306 CR looks fine. |
| OPPO | No comments. |
| Qualcomm | The parameter should be revised accordingly, if the change of the naming on 38.331 can be agreed. |
|  |  |

Besides the draft CR there is one more issue to discuss as the following.

Issue 3.2-1: extending the max number of UDC DRBs

In phase 1, one company suggests extending the max number for UDC DRBs that UE can support, e.g. to 3/4 DRBs. Here, companies are invited to give their views on whether to extend the max number of DRBs that can be configured UDC and if it is support, what is the preferred number?

**Question 2-4: Do you agree to extend the max number of UDC DRBs supporting by a UE? If yes, what number do you prefer to be the max number for UDC DRBs?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional comments if any |
| Huawei, HiSilicon | Yes | Proponent |
| Apple | No | We do not support extending the number of UDC DRBs beyond 2. |
| LG | No | We do not see the motivation for extending the number of UDC DRBs. |
| Intel | No | We think maximum 2 UDC DRBs are sufficient. |
| OPPO | No | We suggest to follow the restriction as LTE. |
| Qualcomm | Yes | If number of DRBs supporting is beyond 2, an additional capability is needed. |
|  |  |  |

## 3.3 TS 38.323

### Phase 1

Table 4 provides some analysis on the potential specification impacts to TS 38.323.

**Table 4 Spec impact analysis for 38.323**

|  |  |  |
| --- | --- | --- |
| Specification | Parts that follow the LTE mechanism | Additional impacted parts due to NR |
| TS 38.323 | Additions/changes related to the following* + UDC protocol.
	+ Configuration of UDC
	+ UDC header.
	+ Pre-defined dictionary.
	+ UDC buffer reset.
	+ UDC feedback procedure
	+ UDC function in RRC re-establishment procedure: reset compression buffer for RLC AM mode;
	+ ~~Configuration with ROHC and EHC: limitation that UDC is not configured simultaneously with ROHC or EHC for the same radio bearer.‎~~
	+ Clarification, if necessary, that gNB implementation ensures that UDC decompression is after PDCP reordering. ‎
 | * + Whether UDC is applied for SDAP header and SDAP control PDU
	+ UDC PDU format addressing SDAP header location
	+ UDC continuity if needed
 |

**Question 1-11: Do you agree with spec impact analysis in table 4? Do you see any other impacts to TS 38.323?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional impacts if any |
| LG | No | It is difficult to say whether we can easily follow the LTE mechanism or not. Each function should be carefully checked whether it is supported for NR.In addition, we think following two bullets are not relevant for PDCP specification.o Configuration with ROHC and EHC: limitation that UDC is not configured simultaneously with ROHC or EHC for the same radio bearer.‎ 🡪 The configuration limitation should be specified in RRC not in PDCP.o Clarification, if necessary, that gNB implementation ensures that UDC decompression is after PDCP reordering. ‎🡪 Network implementation should not be specified in PDCP specification. |
| CATT | Yes, and see comments | Firstly, we agree with LG’s comment about the limitation on configuration with ROHC and EHC. We’ve updated this part, so that this bullet is now move to 38.331 section (see highlighted modifications in the tables).Then, for LG’s comment on reordering related clarification, we can discuss if it is necessary to specify in the spec and if needed then consider where to capture it. |
| Mediatek | Yes | First of all, the intention is to clarify the difference between LTE and NR when UDC is supported. In LTE, PDCP reordering is optional. UDC still works even without it, since RLC can guarantee the in-sequence delivery. It’s network implementation to decide at which step to perform UDC decompression with/without PDCP reordering. But for NR, the case is different that PDCP reordering is mandatory. So network should perform UDC decompression after PDCP reordering. We agree that network implementation is not specified, but it would be good that the difference can be clarified somewhere.  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes | In addition to the changes in table 4, some general text may be needed to specify that operation with UDC is configurable for the PDCP entity (similar to what’s currently there in subclause 4.2.2 for RoHC/EHC). Further, we agree with MediaTek and LG that it might be good to clarify the UDC decompression order somewhere. |
| OPPO | See comment | Regarding UDC function in RRC re-establishment procedure, we agree to capture the impact on resetting compression buffer for UDC in PDCP spec, but it should be captured as the following, * When upper layers request a PDCP re-establishment, the UE shall: reset the compression buffer…

In our understanding, the mentioned RRC re-establishment procedure is one kind of CP procedure. Besides the RRC re-establishment procedure, other CP procedures, e.g. HO, can also trigger such UP function. In addition, Logically, if CP procedure triggers some UP function and if we want to explicitly indicate which CP procedure it is, such description should be captured in RRC spec, not PDCP spec.Also, more change requires if DAPS with UDC is supported.  |
| Qualcomm | Yes | UDC decompression after PDCP reordering should be clarified in somewhere. Regarding the reset the compression buffer, the LTE PDCP spec can be a reference,When upper layer request a PDCP re-establishment, the UE shall: reset the compression buffer to all zeros … … |
| Intel | See comments | Regarding “gNB implementation ensures that UDC decompression is after PDCP reordering”, we agree sensible gNB implementation should do so, but we’re not sure the necessity to specify gNB behavior. |
| Samsung  | Yes, but | We also think that we don’t need to capture the network behaviour, which can be up to network implementation. The details can be discussed in Phase 2. |
| CMCC | Yes |  |
| Ericsson | Yes, but | Same view as others that NW behaviour does not need to be specified |

Summary of Phase 1

8 companies agree with impact analysis in Table 4. Most companies agree that UDC decompression after PDCP reordering is NW implementation, but 4 companies express their concerns and would like to clarify the UDC decompression order in the specification. Regarding DAPS, we have agreed that UDC is not applied to DAPS in the previous discussions. The rapporteur thinks majority companies agree with the impacts analysis in Table 4 and we can leave the UDC decompression order issue to phase 2 discussions. In phase 1, we can capture that UDC decompression is performed after PDCP-re-ordering as the common understanding.

**Proposal 9 (8/11): Impact analysis in Table 4 is taken as baseline to develop draft CRs for review in the next step discussions. It is confirmed that UDC decompression should be performed after PDCP re-ordering, FFS whether this needs to be clarified in the specification.**

### Phase 2

In phase 2, a draft 38.323 CR is provided in the draft folder. Views and comments are collected, based on which the moderator may update the draft CR, as an input to the discussions in the next meeting.

**Question 2-5: Do you have any comments to the draft 38.323 CR (please focus on the changes, not coversheet)?**

|  |  |
| --- | --- |
| Company | Detailed comments to the draft CR |
| Huawei, HiSilicon | No comments. |
| LG | Figure 4.2.2-1 Header or Uplink Data Compression  Header or Uplink Data Decompression Section 4.4* uplink data compression and decompression using the UDC protocol using the UDC protocol;

Section 5.1.2* for AM DRBs, reset the UDC compression buffer to all zeros and prefill the dictionary as specified in TS 38.331 [3];

Section 5.2.1* perform uplink data compression of the PDCP SDU as specified in the subclause 5.X.4;

Section 5.X* The details of UDC operation should be moved to an Annex for UDC, similar to EHC protocol. In section 5.X, only general description (e.g. supported protocol, configuration, and protocol parameters) should be specified.

Section 6.3.X and 6.2.Y* We don’t think a new packet format is needed for UDC. UDC is performed for data part, and UDC header and UDC payload are included in the Data field. The legacy PDU format in 6.2.2.2 and 6.2.2.3 are still used for UDC, and no new PDU format is needed. The details of UDC header format should be specified in a UDC Annex.

Section 6.3.3* “Compressed PDCP SDU (user plane data only)” already covers UDC. New bullet for UDC is not needed.

Section 6.3.X, 6.3.Y, 6.3.Z, and 6.3.P* Those fields should be moved to a UDC Annex, together with the UDC header format.

Annex X* The details of UDC operation and UDC header format should be specified here.

  |
| Intel | Clause 4.2.2: sentence “UDC is not configured simultaneously with ROHC or EHC for the same radio bearer” is not needed as we have agreed to specify configuration restriction in 38.331 instead of 38.323.Figures 6.2.X.1 and 6.2.Y.1: the font in the figures should be “Arial” for consistency. |
| Qualcomm | 1. UDC is only for uplink data compression. For the Figure 4.2.2-1, right-side box, it cannot be written as NG-RAN/UE, it has to be NG-RAN. (Similar comment to the left-side box). UL Data de-compression happens on receive buffer, only if it is uplink instead of downlink. Should work for UE to network only.2. For 5.x.2, upon configuration of UDC, if dictionary is configured by upper layers, UE should first set the compression buffer to all zeros and then prefill the configured pre-defined dictionary in the compression buffer upon configuration of UDC.  |
|  |  |
|  |  |

Besides the draft CR, there is one more issue to discuss in the following.

Issue 3.3-1: re-ordering clarification

In phase 1, some companies would like to clarify that UDC decompression is performed after PDCP re-ordering in the spec, while some companies would not. In the draft CR to 38.323, the figure 4.2.2-1 is updated to add UDC related processing.



Figure 4.2.2-1: PDCP layer, functional view

It shows UDC decompression is after reordering function. Companies are invited to share their views on the following question.

**Question 2-6: With the updated Figure 4.2.2-1, do you agree that no need to further clarify UDC decompression being performed after PDCP re-ordering in the specification?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional comments if any |
| LG | Yes | We prefer to use the text “Header or Uplink Data Compression” instead of “Header Compression or u-plane uplink data compression”, as commented in Q2-5. |
| Intel | Agree | The figure is clear and there is no need to further clarify processing order in specification text. |
| OPPO | Yes | No need to further clarify |
| Qualcomm | Yes |  |
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|  |  |  |
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## 3.4 TS 38.331

### Phase 1

Table 5 provides some analysis on the potential specification impacts to TS 38.331.

**Table 5 Spec impact analysis for 38.331**

|  |  |  |
| --- | --- | --- |
| Specification | Parts that follow the LTE mechanism | Additional impacted parts due to NR |
| TS 38.331 | Additions/changes related to the following* + UDC configuration;
	+ Release UDC configuration in:
* RRC reconfiguration with sync;
* RRC reestablishment procedure;
* Conditional reconfiguration with sync;
* RRC resume;
	+ Configuration with ROHC and EHC: limitation that UDC is not configured simultaneously with ROHC or EHC for the same radio bearer.‎
 | Applicability of UDC in DAPS if neededUDC continuity if needed |

**Question 1-12: Do you agree with spec impact analysis in table 5? Do you see any other impacts to TS 38.331?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional impacts if any |
| LG | Yes |  |
| CATT | Yes | Adding the limitation on configuration with ROHC and EHC in the table. |
| Mediatek | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes |  |
| OPPO | Yes, but | Also indicate whether UDC can be applied to both RLC AM and RLC UM. |
| Qualcomm | Yes |  |
| Intel | Yes |  |
| Samsung  | Yes |  |
| CMCC | Yes |  |
| Ericsson | Yes |  |

Summary of Phase 1

All companies agree with impact analysis in Table 5. And one company suggests adding limitation on configuration with ROHC and EHC in the table (already added). One company indicates whether UDC can be applied to RLC UM (is not in the WI scope).

**Proposal 10 (11/11): Impact analysis in Table 5 is taken as baseline to develop draft CRs for review in the next step discussions.**

### Phase 2

In phase 2, a draft 38.331 CR is provided in the draft folder. Views and comments are collected, based on which the moderator may update the draft CR, as an input to the discussions in the next meeting.

**Question 2-7: Do you have any comments to the draft 38.331 CR (please focus on the changes, not coversheet)?**

|  |  |
| --- | --- |
| Company | Detailed comments to the draft CR |
| Huawei, HiSilicon | No comments. |
| Intel | The draft 38.331 CR looks fine. |
| OPPO | For UDC configuration, we suggest to use the following wording, which is more aligned with what we used to specific NR EHC/RoHC.*The network reconfigures uplinkDataCompression only upon reconfiguration involving PDCP re-establishment.*In other words, for the field description of uplinkDataCompression, we prefer to use “*The network reconfigures uplinkDataCompression only upon reconfiguration involving PDCP re-establishment*”, instead of “For existing DRBs, network can configure uplinkDataCompression when reconfiguration with sync or the first RRCReconfiguration message after RRC connection re-establishment.”In our understanding, using similar words for EHC/ROHC/UDC can avoid the potential misleading/misunderstanding to the implementors or the people who did not follow all discussions. In addition, such wording is more general to cover all cases, e.g. the RRC resume procedure. In practice, the gNB can reconfigure UDC when it wants(and if possible). Note that, even for EHC/RoHC, LTE RRC has detailed specified the cases for compression reconfiguration, while NR RRC has just captured a more general wording. In TS 38.331cid:image002.jpg@01D7F100.B2A87F00In TS 36.331cid:image006.jpg@01D7F100.B2A87F00Also, the explanation of Cond Rlc-AM should be updated accordingly. |
| Qualcomm | 1.Under the uplinkDataCompression-r17, the ellipsis should be removed.2.The capability naming is unusual. Suggest changingsupportedUDC-r17 -> udc-r17 (similar to ehc-r16 which is already in current NR spec)supportedStandardDic-r17 -> standardDictionary-r17 (because the only value is enumerated supported)supportedOperatorDic-r17 -> operatorDictionary-r17 |
|  |  |
|  |  |

## 3.5 TS 37.340

### Phase 1

Table 6 provides some analysis on the potential specification impacts to TS 37.340.

**Table 6 Spec impact analysis for 37.340**

|  |  |  |
| --- | --- | --- |
| Specification | Parts that follow the LTE mechanism | Additional impacted parts due to NR |
| TS 37.340 | N.A. | Applicability of UDC to split DRB if agreed |

**Question 1-13: Do you agree with spec impact analysis in table 6? Do you see any other impacts to TS 37.340?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional impacts if any |
| LG | No | We think UDC is not configured for split DRB. Then, there should be no specification impacts on 37.340. |
| CATT | Yes |  |
| Mediatek | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes | TS 37.340 should indicate the bearer types that can be supported with UDC (e.g., in section 6.3, regardless of whether or not the split bearer is included). |
| OPPO | Yes | We can have similar wording for UDC as the following in TS 37.340In MR-DC, RoHC and EHC (as described in TS 36.323 [15] and TS 38.323 [16]) can be configured for all the bearer types. |
| Qualcomm | Yes |  |
| Intel | Yes |  |
| Samsung  | Yes | The details can be discussed in Phase 2. |
| CMCC | Yes |  |
| Ericsson | No | We first need to decide whether this is supported |

Summary of Phase 1

9 companies agree with impact analysis in Table 6. And 2 companies suggest first studying whether split DRB is supported for UDC. In the previous discussion on Issue 5, we have the Proposal 6, i.e., **NR UDC can be applied to split DRB.** So rapporteur recommends that companies can take Table 6 as baseline and continue with the further discussions.

**Proposal 11 (9/11): Impact analysis in Table 6 is taken as baseline to develop draft CRs for review in the next step discussions.**

### Phase 2

In phase 2, a draft 37.340 CR is provided in the draft folder. Views and comments are collected, based on which the moderator may update the draft CR, as an input to the discussions in the next meeting.

**Question 2-8: Do you have any comments to the draft 37.340 CR (please focus on the changes, not coversheet)?**

|  |  |
| --- | --- |
| Company | Detailed comments to the draft CR |
| Huawei, HiSilicon | The latest CR has the following change:In MR-DC, RoHC and EHC (as described in TS 36.323 [15] and TS 38.323 [16]) can be configured for all the bearer types. In this release of specification, UDC can not be configured for any split bearer types.In the NR UDC WID, only NR SA scenario is mentioned, and we wonder whether the above text means: * (1) for non NR-DC, UDC can be configured
* **AND**, (2) for NR-DC, UDC can be configured only for non-split bearers
 |
| Intel | The proposed change is different from “Proposal 6 (8/11): NR UDC can be applied to split DRB.” |
| Qualcomm | The draft CR is not aligned with the proposal 6. |
|  |  |
|  |  |
|  |  |

## 3.6 TS 38.463

### Phase 1

Table 7 provides some analysis on the potential specification impacts to TS 38.463.

**Table 7 Spec impact analysis for 38.463**

|  |  |  |
| --- | --- | --- |
| Specification | Parts that follow the LTE mechanism | Additional impacted parts due to NR  |
| TS 38.463 | N.A. | Potential E1 impacts |

**Question 1-14: Do you agree with spec impact analysis in table 7?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional impacts if any |
| LG | No | We think UDC is not configured for CP/UP split case. Then, there should be no specification impacts on 38.463. |
| CATT | Yes |  |
| Mediatek | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes |  |
| OPPO |  | Leave it to RAN3 |
| Qualcomm | - | Should discuss in RAN3. |
| Intel | No | As in Q1-7, we don’t see it is necessary to introduce RAN3 impact. |
| Samsung  | - | FFS for now. |
| CMCC | Yes | We can inform RAN3 that E1 interface change may be needed. No matter RAN3 decide to do it or not, RAN2 CRs can be approved without waiting for RAN3 response. |
| Ericsson | No | Agree with Intel |

Summary of Phase 1

According to the previous discussion on Issue 6, it is suggested to stop the discussion for now. Whether to send LS to RAN3 can be decided in next RAN2 meeting.

### Phase 2

No discussions.

## 3.7 Other TS impacted if any

### Phase 1

**Question 1-15: Do you see any other specification impacted? If any, please provide more details.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Additional spec impacts if any |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

# 4. Conclusions

TBD

# References

[1] RP-211203, Revised WID: NR Uplink Data Compression (UDC)‎

[2] R2-2111067, Discussion on introduction of NR UDC CATT, CMCC, Huawei, HiSilicon, MediaTek