3GPP TSG-RAN WG3 #112-e R3-212660

Online, 17 – 27 May 2021

Agenda Item: 10.2.1.4

Source: CATT (moderator)

Title: Offline Discussion on UE History Information in EN-DC

Document for: Approval

# Introduction

**CB: # 1204\_SONMDT\_UEHistory**

**- Topics to discuss:**

 **- Which node collects SN UHI**

 **- What information is contained in SN UHI**

 **- Which messages are used to exchange SN UHI information and how the information is encoded**

 **- Any other topics based on contributions submitted**

**- Start with summary of offline, proceed to TPs if there are agreements to capture**

(CATT - moderator)

Summary of offline disc [R3-212660](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Temp/360zip%24Temp/360%240/Inbox/R3-212660.zip)

# 2 For the Chairman’s Notes

Agreement for phase 1

**WA: SN is responsible for collecting the SN UHI; RAN3 should consider solutions which would not delay HO more than it would have been delayed without UHI**

**WA: Correlation of MN UHI and SN UHI could be realized via two-dimensional structure for UHI (PSCells history information are listed within each PCell in the UHI); it may not be feasible on all interfaces.**

**WA: At least include UHI in the SN addition, modification, change and release messages. Others are FFS. Specifically, include UHI in the following messages over Xn and X2:**

**- SN addition procedure (S-NODE ADDITION REQUEST, SGNB ADDITION REQUEST)**

**- SN Change procedure (S-NODE CHANGE REQUIRED, SGNB CHANGE REQUIRED)**

**- SN Modification procedure**

**-- MN-initiated: S-NODE MODIFICATION REQUEST ACKNOWLEDGE, SGNB MODIFICATION REQUEST ACKNOWLEDGE**

**- SN release procedure**

**-- MN-initiated: S-NODE RELEASE REQUEST ACKNOWLEDGE, SGNB RELEASE REQUEST ACKNOWLEDGE**

**-- SN-initiated: S-NODE RELEASE REQUIRED, SGNB RELEASE REQUIRED**

**Open issue**

**Issue 1: It is FFS on whether only SN UHI or correlated MN and SN UHI should be sent from SN to MN.**

**Issue 2: It is FFS whether Time spent in SCG should be introduced or not.**

**Issue 3: It is FFS for whether Cell Type should be introduced or not.**

**Issue 4: FFS whether the originating node of the PSCell change is included in the SCG UHI or not.**

**Issue 5: Whether the SCG UE History Information is to be encoded directly, or as a container to be passed as an OCTET STRING.**

**Issue 6: It is FFS whether to introduce one flag in SN Addition Response message to indicate whether MN should inform SN of the latest Pcell for every intra-MN PCell change.**

**To be continued…**

# Discussion (Phase 2)

## Usage of SN UHI

The summary of discussion in phase 1 is as below:

**Moderator’s summary**

 All companies believe SN UHI in MR-DC can reduce provide assistance information for Pscell change decision which help avoid the occurrence of pingpong. Additionally, 4 companies believe that it is also helpful for handover with/without SN change, DC setup etc.

Based on the discussion in phase 1,it is proposed to agree the following proposal：

**Proposal 1：SN UHI in MR-DC could at least reduce Pscell change ping-pong occurrence and other optimization based on SN UHI is not precluded which is NG-RAN node implementation.**

If there is different view, please provide your comments here.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | SN UHI in MR-DC could reduce Pscell change ping-pong occurrence.For the implementation stuff, we don’t need to have agreement here. Standard is not to cope with different implemenations.  |
| Nokia | Same as Samsung: optimization of the SCG mobility is the key purpose. Other usage is, as always, up to implementation. |
| Ericsson | It is probably too late to capture scenarios and possible implementation, now that we are far in stage-3 details |
| Qualcomm | Same view as Samsung and Nokia. Not sure the intention behind this agreement though – to capture in Chair notes and/or stage-2? Okay with both. |
| NEC | There is no different view. The purpose is to try to have a common understanding of the use case (if possible, limited use cases) first in place, then can design our stage 2/stage 3, to avoid very diverse discussion base on each company’s own understanding.This was actually raised in the paper [R3-204898](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_112-e/Docs/R3-204898.zip) from China Telecom in RAN3#109e (that was first meeting we discussed the “UE History Information in EN-DC”), but in that meeting we already entered the very detail stage 3 design discussion. But all in all, currently it seems there is no different view from companies. |
| ZTE | Share views as Samsung and Nokia. |
| KDDI | Share views as Samsung and Nokia. |

## UHI from MN to SN

The summary of discussion in phase 1 is as below:

**Moderator’s summary:**

* 8 companies believed a correlated MN and SN UHI shall be included for the messages direction from MN to SN
* 2 companies believe SN UHI is needed to SN, it may be beneficial to also include MN UHI
* 2 companies believed only SN UHI shall be included:

Based on the input from companies, it is proposed to follow the views from majority and agree the following proposal:

**Proposal2: Correlated MN and SN UHI is sent from MN to SN**

If there is different view, please provide your comments here.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | The information is not useful for the SN. Between MN and SN, only SN UHI is transmitted for both directions. This is clean and simple. |
| Nokia | For the time being, Samsung is right.However, it must also be considered, that if the PCell is included in the Addition/Modification, effectively, the SN has exactly the same information as when the MCG and SCG UHI is sent already combined.**>>> [QC]: PCell ID in SN Addition/Modification is optional right? Is it typically sent from MN to SN during SN addition/modification? Our thought was if we have both MN and SN UHI in the same place, it might be easy to combine.**BTW, does it mean we update the classic UHI (which includes also UTRAN cells) or do we create a 2nd UHI, where the LTE/NR part overlaps with the existing UHI? It would be simpler to have a separate SCG UHI and focus on mechanism allowing both, the MN and the SN to correlate these two whenever needed.**>>> [QC]: I think we would have to update the classic UHI with a sub list for SN UHI. Probably need to add note in semantics that SN UHI can’t be configured with UTRAN etc. or can be left to implementation.** |
| Huawei | Prefer sending correlated MN+SN UHI to SN and reporting back SN UHI to MN. We think MN anyway have to keep a correlated list so there is no cost in sending this to the SN.The information could show mobility on a higher level, e.g. whether this is a UE that is has been staying in the same PCell or different.  |
| Qualcomm | Similar view as Huawei. Also, some responses/follow up to Nokia’s questions above. |
| NEC | Follow Samsung view for now, for simplification reason, can have only SN-UHI for the time being. But still have a room to discuss to have the MN UHI correlation with SN-UHI, to see its benefit and further consequence.(just give an example, the moderator (CATT)’s paper [R3-211853](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_112-e/Docs/R3-211853.zip) is showing the benefit that can reduce ping-pong affect. If that is really beneficial, why not? But then also its consequence need to have further checking. E.g. need to have the PCell ID in SN Addition, which is currently optional and for different purpose (for PCI confusion).Therefore a proposal is to keep FFS for “**Correlated MN and SN UHI is sent from MN to SN**” and clearly show what is FFS. Example below:FFS for “Correlated MN and SN UHI is sent from MN to SN”, to have further discussion to reach common understanding its use case and benefit, and further discuss its consequence that may impact on existing function. |
| ZTE | Only recent SN UHI make sense to SN. SN does not need to aware for history of MN/SN experience. The extra information does help but expand signalling size.As compromise, allow only SN UHI to be send and retrieved from SN and FFS MN+ SN send to SN node. |
| KDDI | The benefit of sending correlated MN+SN UHI to SN is not so clear, and need to be identified. But, we also admit Huawei’s comment that there is no cost in sending this to the SN. So, we are fine to agree Proposal2. |

## Inter-MN handover case

3 options are raised as below**:**

**Opinion 1:** MN initiates SN modification procedures to retrieve SN UHI before handover

**Opinion 2:**  In order to avoid handover delays, the master node is always aware of the latest PSCell UE history information.

**Opinion 3:** use other messages to transfer UHI

Based on the input from companies, it is proposed to follow the views from majority and agree the following proposal:

The summary of discussion in phase 1 is as follows:

**Moderator’s summary**

The statistics is as below:

* 8 companies prefer Opinion 1, and one of them believe Opinion 2 as an implementation option.
* 1 companies prefer Opinion 2
* 1 companies prefer Opinion 3

Based on the input from companies, it is proposed to follow the views from majority and agree the following proposal:

**Proposal 7: Take option 1 i.e. MN initiates SN modification procedures to retrieve SN UHI before handover as baseline. RAN3 could consider solutions which would not delay HO more than it would have been delayed without UHI**

If there is different view, please provide your comments here.

|  |  |
| --- | --- |
| Company | Comment |
| Samsung | If the SN UHI is added in the S-NODE MODIFICATION REQUEST ACKNOWLEDGE, then whether the MN initiates the procedure or not before handover is implementation issue. We cannot mandate the MN to retrieve it before each handover.Currently, SN modification procedures is not always used. E.g. for full configuration, the query is not needed. The performance of handover is critical. It’s not logical to delay the handover just for the purpose to collect some SON information which is not time critical. **So the reasonable way forward is to have both option 1 and option 3. Option 1 is used in case SN modification procedure is needed without UHI. Option 3 is used in case SN modification procedure is not needed without UHI.** |
| Nokia | As already commented: the MN may need to fetch SCG config before a HO, so fetching SCG UHI at the same time is not extra delay. On the other hand, the MN may have enabled PSCell change reporting, as defined for LI purposes. Then, the MN does not need to fetch it.Let’s enable fetching the SCG UHI in the MN-initiated modification, as we did for the SCG config. Then, it is up to the MN and the circumstances to use it or not. |
| Huawei | We should start with agreeing option 1. If any further enhancement is needed, this can be discussed in the future. |
| Ericsson | The WA captured during the online session is enough. No need to capture this again. Solutions for not delaying HO will probably not be agreed in the remaining days. So let’s keep it for next meeting. |
| Qualcomm | We also think Option 1 can be agreed as baseline. Whether we need Option 2 or 3 in addition can be discussed in next meeting. |
| NEC | Remember that this SN-UHI is an assistant information only, even if it is not present, or the information is not up to date, it does not mind for the handover purpose in the target. So having the option 1 does not mean it always need to fetch, and indeed it is up to implementation to do. So we still think option 1 is enough. |
| ZTE | HO delay impact need to be taken into account , can be discussed in the next meeting. |
| KDDI | It’s better for everyone to have some time to evaluate candidate options and discuss in next meeting.  |

# Discussion(Phase 1)

## Which node (MN or SN) collects SN UHI (network side UHI)?

At last meeting, we have discussed this topic and did not achieve agreement. In this meeting, all companies provide views on this issue and the proposals are captured below:

**[1], Proposal 1:** SCG UHI is managed in the SN.

**[6], Proposal 1:** It is proposed for RAN3 to agree that SN collect SN UHI.

**[9], Proposal 1:** SN is responsible to collect SN UHI

**[10], Proposal 1:** SN collects UE’s UHI of S-NG-RAN node and the information saved by MN node.

  **Proposal 2:** SN is responsible for collecting SN UHI, SN sends SN UHI to MN when the SN is released by adding “UE history information” IE in the following SN Release messages over XnAP and X2AP

**[15], Proposal 1:** SN is responsible for collecting the SN UHI

**[18], Proposal 7:** When the UE is connected to a secondary node, the secondary node should be responsible for collecting the UE history information, and the master node should have the possibility to subscribe for information on any PSCell changes from the secondary node.

**[19], Proposal 1:** SN is responsible for collecting the SN UHI, but MN can fetch this information from SN whenever needed.

**[24], Proposal 2:** SN is responsible to collect SN UHI.

According to the above proposals in, it seems all companies believe that SN should be responsible for collecting SN UHI. So, we propose to have the following agreement:

**Agreement: SN is responsible for collection SN UHI.**

If there is different opinion, please provide your comments in the table below.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Agree that SN should be responsible for collecting the UHI if the MN have the possibility to subscribe for information on any PSCell changes from the SN (to avoid extra delay at handover). |
| KDDI | "**[18], Proposal 7**" is not so clear for us. Does it mean that SN can ask UE to report the SN UHI directly? Or does it mean that SN can ask UE to report the SN UHI via MN indirectly?[CATT]:Here we are discussing on network based UE history information,thereby no UE report is involved.My understandin g on this proposal is that it should be allowed for MN to drive the SN UHI any time. |
|   |  |

All company agreed that SN should be responbile for collection the SN UHI.One company think it should be allowed for MN to drive the Pscell change any time to avoid handover delay which is already supported from moderator’s point of view. So we have the following proposal:

**Proposal 1: SN is responsible for collecting the SN UHI.(Note it is already supported for MN to know the current Pscell any time).**

## Correlation of MN and SN UE history information

One FFS left for the information transferred in Handover Request message is as below:

MN and SN UHI shall be included in inter-MN handover message i.e. Handover Request message. It is FFS whether MN UHI and SN UHI will be separated IEs or a list of MN UHI containing a list of SN UHI.

There are 10 contributions which provide views on correlation of MN and SN UE history information and the summary is as below:

**Benefit on the correlation of MN UHI and SN UHI:**

* 9 contributions propose to have a correlated MN UHI and SN UHI while 1 contribution doesn’t see much benefit in correlating SN and MN UHI.

**How to correlate MN UHI and SN UHI:**

* 8 contributions propose to have a two dimension array i.e. a list of MN UHI containing a list of SN UHI, while one company propose to have separate IEs for MN UHI and SN UHI

Since it was already agreed that it is beneficial to correlate the UHI of MN and SN which is captured in the current chairman notes as follow:

It is beneficial if the MR-DC based UHI and the legacy UHI are correlated when received. Whether this is feasible and the details of the solution are FFS

Considering it is already an agreement that it is beneficial if the MR-DC based UHI and the legacy UHI are correlated and only one company challenges the agreement, we propose to not re-discuss whether it is beneficial to correlate MN UHI and SN UHI and only discuss the feasibility and solution on MN UHI and SN HUI correlation.

Please provide your views on the feasibility of correlation between MN UHI and SN UHI and your preferred solution i.e. two dimension or one dimension below:

|  |  |  |
| --- | --- | --- |
| Company | Whether it is feasible to correlate MN UHI and SN HUI | Solution on correlation between SN UHI and MN UHI |
| CATT | Feasible | Two dimension structure |
| Ericsson | Feasible | Two dimensions structure (nested PCell and PSCell history). All the information needs to be present at SN (e.g. PCell ID, cell type, HO cause). |
| ZTE | Feasible | Two dimension structure, in addition, SN UHI is not continuously compared to MN UHI. The structure should reflect the discontinuous situation.  |
| Qualcomm | Feasible | Two dimensional list (PSCell UHI list nested within PCell UHI). |
| NEC | May be |  |
| China Telecom | Feasible | Two dimension structure is preferred. |
| Nokia | Feasible | Time correlation based on the time the UE stayed in each PSCell (implementation of the MN, if needed). The lists of MCG and SCG UHI are kept separate so that the SN does not need to inform the MN about each PSCell change. |
| Samsung |  | The logic way is to firstly analyze how then conclude whether it is feasible. As all agreed in 3.1, SN is responsible for collection SN UHI.Pcell information is not always available in the SN. Pcell information is optional and defined for PCI confusion. The MN may not transmit the Pcell information to the SN. In this case, how to make the correlation is not clear. |
| Lenovo and Motorola Mobility | Feasible | Two dimension structure |
| KDDI | May be | Two dimension structure |
| CMCC | Feasible  | Two dimension structure |
| Huawei | Feasible | Agree the comments from ZTE. |

Moderator’s summary:

On the feasibility of corelation between MN and SN:

* 9 companies believed a correlated MN and SN UHI are feasible
* 2 companies think it maybe feasible to correlate MN and SN UHI
* 1 company believe correlated MN and SN UHI is NOT feasible because Pcell information is not always available in the SN

**Moderator’s comments:Current it is already supported to transfer Pcell information from MN to SN to resolve PCI confusion.There is no extra effort to let MN inform SN of the intra-MN Pcell change for SN UHI collection.**

Following the view of majority and also considering that the concern on the feasibility could be resolved,we have the following proposal

**Proposal 2: Correlation between MN UHI and SN UHI is feasible**

On the solutions for correlation:

* 9 companies support two dimension structure.
* 2 company prefer separate IE for MN and SN.

Considering that this issue has been discussed for several meetings,we propose to follow the view of majority to adopt two dimension structure option

**Proposal 3: Correlation of MN UHI and SN UHI could be realized via two-dimensional structure for UHI (PSCells history information are listed for each PCell in the UHI)**

## Which messages include UHI

At last RAN3 meeting, the agreement is as below.

MN and SN UHI shall be included in inter-MN handover message i.e. Handover Request message

Many companies propose to include UHI in other XN/X2 messages which are collected in the table below.

|  |  |  |
| --- | --- | --- |
| Number | Message  | Direction  |
| 1 | S-NODE ADDITION REQUESTSGNB ADDITION REQUEST | MN->SN |
| 2 | S-NODE ADDITION REQUEST ACKNOWLEDGESGNB ADDITION REQUEST ACKNOWLEDGE | SN->MN |
| 3 | S-NODE MODIFICATION REQUESTSGNB MODIFICATION REQUEST | MN->SN |
| 4 | S-NODE MODIFICATION REQUEST ACKNOWLEDGESGNB MODIFICATION REQUEST ACKNOWLEDGE | SN->MN |
| 5 | S-NODE MODIFICATION REQUIREDSGNB MODIFICATION REQUIRED | SN->MN |
| 6 | S-NODE MODIFICATION CONFIRMSGNB MODIFICATION CONFIRM | MN->SN |
| 7 | S-NODE RELEASE REQUESTSGNB RELEASE REQUEST | MN->SN |
| 8 | S-NODE RELEASE REQUEST ACKNOWLEDGESGNB RELEASE REQUEST ACKNOWLEDGE | SN->MN |
| 9 | S-NODE RELEASE REQUIREDSGNB RELEASE REQUIRED | SN->MN |
| 10 | S-NODE RELEASE CONFIRMSGNB RELEASE CONFIRM | MN->SN |
| 11 | S-NODE CHANGE REQUIREDSGNB CHANGE REQUIRED | SN->MN |
| 12 | S-NODE CHANGE CONFIRMSGNB CHANGE CONFIRM | MN->SN |
| 13 | S-NODE RECONFIGURATION COMPLETESGNB RECONFIGURATION COMPLETE | MN->SN |
| 14 | Access and Mobility Indication | MN->SNSN->MN |

Companies are kindly requested to provide views/comments on the messages in which UHI should be included.

|  |  |  |
| --- | --- | --- |
| Company | Number of messages in which UHI should be included | Comment |
| CATT | 1, 4, 5, 8, 9, 11 | Besides SN addition and SN change messages, it is proposed to include UHI from SN to MN during SN modification and release procedures. |
| Ericsson | 1, 8, 9, 11, 13 | In case PSCell change happens without MN involvement (UHI in MN is not up-to-date) the MN will receive the latest UHI in release request acknowledge (8), which can then be forwarded to the target SN in reconfiguration complete (13).3 and 4 could be used for fetching UHI if desired (compromise solution from last meeting). |
| ZTE | Not sure the assumption is transfer MN UHI+ SN UHI or MN UHI only or SN UHI onlyAt least 1,4,8,9,11 will be impact by SN UHIAnd which information carried should be identify. | 3 can be used for MN to send indication of fetching SN UHI. |
| Qualcomm | 1, 4, 5, 8, 9, 11(MN -> SN: 1SN -> MN: 4,5,8,9,11) | Also, okay to use 3 by MN for fetching SN UHI on a need-basis or during inter-MN handover without SN change.Regarding Ericsson’s comment, isn’t the procedure described SN change procedure (MN initiated) i.e. Figure 10.5.2-1 in TS 37.340? In our understanding, there can only be SN “Modification” without MN involvement i.e. Figure 10.3.2-3, 10.3.2-4 in TS 37.340. In that case, 13 is not needed right? |
| NEC | 1, 3, 4, 8, 9, 11. | 3 and 4 for fetching SN-UHI.13 can actually be used also. |
| China Telecom | 1, 4, 8, 9, 11 | 3 is used for MN to fetch the UHI, the UHI should be contained in 4;Moreover, the UHI should be transmitted from SN to MN when SN is changed or released (8,9,11). |
| Nokia | 1, 4, 5, 8, 9, 11 | In addition, the request to provide SCG UHI shall be enabled in 3 and 7.  |
| Samsung | 1, 8, 9, 11, 14 | For inter-MN handover, in order to avoid the handover delay by querying the SN UHI, a new message could be defined to transmit the UHI to the target.After detecting the ping-pong by the MN(or SN), the MN(or SN) should forward the information to the initiating SN (or MN) via 14 or new message. |
| Lenovo and Motorola Mobility | 1, 4, 8, 9, 11 | 3 can be used for MN to get SN UHI from SN. |
| CMCC | 1, 4, 5, 8, 9, 11 |  |
| Huawei | 1,4,8,9,11 | For the inter-MN mobility with SN change case, the SN sends the SN UHI to the MN in the SN modification request acknowledge.  |
|  |  |  |

The statistics of message number as below:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 　 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| CATT | √ | 　 | 　 | √ | √ | 　 | 　 | √ | √ | 　 | √ | 　 | 　 | 　 |
| Ericsson | √ | 　 | 　 | 　 | 　 | 　 | 　 | √ | √ | 　 | √ | 　 | √ | 　 |
| ZTE | √ | 　 | 　 | √ | 　 | 　 | 　 | √ | √ | 　 | √ | 　 | 　 | 　 |
| QC | √ | 　 | 　 | √ | √ | 　 | 　 | √ | √ | 　 | √ | 　 | 　 | 　 |
| NEC | √ | 　 | √ | √ | 　 | 　 | 　 | √ | √ | 　 | √ | 　 | 　 | 　 |
| CT | √ | 　 | 　 | √ | 　 | 　 | 　 | √ | √ | 　 | √ | 　 | 　 | 　 |
| NOKIA | √ | 　 | 　 | √ | √ | 　 | 　 | √ | √ | 　 | √ | 　 | 　 | 　 |
| Samsung | √ | 　 | 　 | 　 | 　 | 　 | 　 | √ | √ | 　 | √ | 　 | 　 | √ |
| Lenovo/Motorola Mobility | √ | 　 | 　 | √ | 　 | 　 | 　 | √ | √ | 　 | √ | 　 | 　 | 　 |
| CMCC | √ |  |  | √ | √ |  |  | √ | √ |  | √ |  |  |  |
| Huawei | √ |  |  | √ |  |  |  | √ | √ |  | √ |  |  |  |
| total:12 | 11 | 　 | 1 | 9 | 4 | 　 | 　 | 11 | 11 | 　 | 11 | 　 | 1 | 1 |

Based on the email discussion, Majority of the companies think UHI should be included in the following messages:

|  |  |  |  |
| --- | --- | --- | --- |
| Message | Direction | Reason | Number of support companies |
| S-NODE ADDITION REQUESTSGNB ADDITION REQUEST | MN->SN | The SN UHI list can help target SN for selecting better PSCell | 11 |
| S-NODE MODIFICATION REQUEST ACKNOWLEDGESGNB MODIFICATION REQUEST ACKNOWLEDGE | SN->MN | For MN initiated SN change procedure,MN would first ask for the UHI from SN via SN modification request procedure | 9 |
| S-NODE RELEASE REQUEST ACKNOWLEDGESGNB RELEASE REQUEST ACKNOWLEDGE | SN->MN | For MN initiated SN release procedure,SN should send its UHI to MN. | 11 |
| S-NODE RELEASE REQUIREDSGNB RELEASE REQUIRED | SN->MN | For SN initiated SN release procedure,SN should send its UHI to MN. | 11 |
| S-NODE CHANGE REQUIREDSGNB CHANGE REQUIRED | SN->MN | For SN initiated SN change procedure,SN should send its UHI to MN. | 11 |

**Proposal 3: Include UHI in the SN addition, modification, change and release messages. Specifically, include UHI in the following messages over Xn and X2:**

* SN addition procedure (S-NODE ADDITION REQUEST, SGNB ADDITION REQUEST)
* SN Change procedure (S-NODE CHANGE REQUIRED, SGNB CHANGE REQUIRED)
* SN Modification procedure
	+ **MN-initiated:** S-NODE MODIFICATION REQUEST ACKNOWLEDGE, SGNB MODIFICATION REQUEST ACKNOWLEDGE
* SN release procedure
	+ **MN-initiated:** S-NODE RELEASE REQUEST ACKNOWLEDGE, SGNB RELEASE REQUEST ACKNOWLEDGE
	+ **SN-initiated: S-NODE RELEASE REQUIRED, SGNB RELEASE REQUIRED**

## What type of UHI needs to be transferred in XN/X2 message

On the basis of subsection 3.3 in which messages to transfer UHI have been selected, here we further discuss the type of UHI in messages.

To be more specific, we discuss UHI type according to direction of message.

**Companies are requested to provide their views on the type of UHI for the messages direction from MN to SN.**

|  |  |  |
| --- | --- | --- |
| Company | Type of UHI (i.e.MN UHI,SN UHI or combination of MN and SN UHI) | Comment |
| CATT | Combination of MN and SN UHI | Since the history of Pscell list may be different when the UE is served by different Pcell, i.e. Pscell change ping-pong(A->B->A) may happen if UE is served by Pcell 1 while no Pscell change ping-pong if UE is served by Pcell 2,it is beneficial that combination of MN and SN UHI is provided to SN node. With the assistance of this information together with the current serving Pcell information, the SN node could make decision on Pscell selection which tries to avoid ping-ping. |
| Ericsson | Combination of MN and SN UHI | Combination of MN and SN UHI is the simplest way to achieve correlation, and as earlier concluded we think correlation is beneficial and feasible. |
| ZTE | SN UHI only | SN UHI is discontinuous in nature. Therefore, we don’t see much benefit for a SN when receiving all list of SN UHI. The last several visited SN UHI is good enough. We also not see much benefit for SN acquire MN UHI. |
| Qualcomm | Combination of MN and SN UHI | Although MN UHI by itself might not be directly useful at SN, having a single nested list (PSCell UHI within PCell UHI) is easy to maintain and achieve correlation. Also, this correlated list could be useful at SN as shown by CATT’s example |
| NEC | Basically only SN-UHI, may be also MN UHI. | Something more may be needed from MN to SN in order for the SN with consideration of MN Pcell to choose a Pscell that may reduce ping pong effect. |
| China Telecom | Combination of MN and SN UHI | Co-related MN and SN UHI facilitate the maintenance of lists between nodes. |
| Nokia | SCG UHI is obvious. MCG UHI may be provided too, should be FFS for the time being. | For possible SCG mobility issues the information about the current MN is enough – it can’t correct MCG mobility issues anyway. |
| Samsung | SN UHI only | MN UHI is not useful at SN. Some companies also acknowledge this (not useful) but think it is easy for maintenance if Combination of MN and SN UHI. Combination of MN and SN UHI just bring complexity for the SN unnecessarily. |
| KDDI | Combination of MN and SN UHI | We share the view with Qualcomm. |
| CMCC | Combination of MN and SN UHI | Similar view as CATT and Qualcomm |
| Huawei | Combination of MN and SN UHI | The SN may use the MN UHI and SN UHI to get the more accurate UE mobility state. We believe it is not problematic including both of them. |

**Moderator’s summary:**

* 8 companies believed a correlated MN and SN UHI shall be included for the messages direction from MN to SN
* 2 companies believe SN UHI is needed to SN, But for MN UHI, it is not sure.
* 2 companies believed only SN UHI shall be included:

We therefore propose to take the following as WA:

**WA: Correlated MN and SN UHI is sent from MN to SN.**

**Companies are requested to provide their views on the type of UHI for the messages direction from SN to MN.**

|  |  |  |
| --- | --- | --- |
| Company | Type of UHI(i.e.MN UHI,SN UHI or combination of MN and SN UHI) | Comment |
| CATT | Combination of MN and SN UHI is preferred | Since intra-MN handover without SN change may happen, it is not easy for MN to know the correlation between Pcell and Pscell list if SN only provides SN UHI when it is released.Either MN request for SN UHI on each Pcell change or SN provides combination of MN and SN UHI, we have the preference on the latter. |
| Ericsson | Combination of MN and SN UHI | Combination of MN and SN UHI is the simplest way to achieve correlation, and as earlier concluded we think correlation is beneficial and feasible. |
| ZTE | SN UHI only | If we agree SN takes the responsible for SN UHI and MN can do the correlation work, so why SN need to do the same work? |
| Qualcomm | Combination of MN and SN UHI | If a single list is maintained across MN and SN, this “single” list including the combination of MN and SN UHI needs to be sent from SN to MN. |
| NEC | SN-UHI only | If to send from SN to MN the combination of MN and SN UHI, it is only like to give back what the MN has given to SN, probably not so nice. |
| China Telecom | Combination of MN and SN UHI | Co-related MN and SN UHI facilitate the maintenance of lists between nodes. |
| Nokia | SCG UHI | The SN does not know MCG UHI – it could only copy of what has been provided before from the MN and that’s prone to errors (and illogical – the MN knows it better). |
| Samsung | SN-UHI only | The MN has MN UHI. The MN UHI in the SN is no up to date. |
| Lenovo and Motorola Mobility | SN UHI only | Same view as ZTE, it is MN rather than SN that can do the correlation work. |
| KDDI | Combination of MN and SN UHI | We think the same type as of UHI for the messages direction from MN to SN. |
| Huawei | SN UHI only | We think the MN can do the correlation work for the PSCell based on the timing of adding the SN. If the SN need send back the Combination of MN and SN UHI, the SN need to know the PCell change in order to set the combination of MN and SN UHI.  |

**Moderator’s summary**

* 5 companies believe a correlated MN and SN UHI shall be included for the messages direction from SN to MN
* 6 companies believe SN UHI shall be included:

We therefore propose to agree the following proposal:

**Proposal 5: It is FFS on whether only SN UHI or** correlated MN and SN UHI should be sent from SN to MN.

## The purpose of collection SN UHI

In [4],there is proposal to have a common understanding on the purpose of collecting SN UHI as below:

**Proposal 1:** it is proposed to have a common understanding that the purpose of the collecting SN UHI in MR-DC is to reduce ping-pong occurrence in the PScell selection.

Please provide views on the above proposal:

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| --- | --- | --- |
| Company | Is it agreeable that the usage of SN UHI is to provide assistant information on Pscell change decision which helps avoid the occurrence of ping-pong? | Comment |
| CATT | Yes. For example, if pingpong(A->B-A) Pscell change happened when UE is served by Pcell 1 according to UHI, Pscell change from cell A to cell B should be avoided in case the serving Pcell is cell 1. | Additionally if there is no ping-pong occurrence, SN UHI may also be used to select better PSCell which depends on implementation. |
| Ericsson | Yes, but not only. | Handover with/without SN change can also benefit from SN UHI. Dual connectivity decision, e.g. set up DC or not, can also benefit from having the SN UHI. |
| ZTE | Yes, in order to mitigate pingpong issue in Rel-17 |  |
| Qualcomm | Yes |  |
| NEC | Yes | Main purpose is to choose the appropriate PScell that may reducing the ping-pong occurrence. |
| China Telecom | Yes  | The SN UHI can reduce ping-pong occurrence, but it's not limited to this scenario,  |
| Nokia | Yes | DC information is orthogonal to resolving ping-pongs on the MCG.  |
| Samsung | Yes |  |
| Lenovo and Motorola Mobility | Yes |  |
| KDDI | Yes, but not only. | We share the view with Ericsson. |
| CMCC | Yes |  |
| Huawei | Yes, but not only. | We think the network also can use it to estimate the mobility state of the UE. |

**Moderator’s summary**

 All companies believe SN UHI in MR-DC can reduce provide assiatance information for Pscell change decision which help avoid the occurrence of pingpong. Additionally, 4 companies believe that it is also helpful for handover with/without SN change,DC setup etc.

We therefore propose to agree the following proposal:

**Proposal 6:** SN UHI in MR-DC can at least reduce ping-pong occurrence and other optimization based on SU UHI is not precluded which is NG-RAN node implementation.

## Inter-MN handover case

In the last meeting, RAN3 has agreed to add the MN/SN UHI in the handover request message. But the source MN sends the handover request message to the target MN before triggering the SN release procedure to the source SN. In order to retrieve SN UHI before handover, there are opinions as below:

**Opinion 1:** MN initiates SN modification procedures to retrieve SN UHI before handover.

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| --- |
| [10], **Proposal 6:** For MR-DC Inter-Master Node handover with/without Secondary Node change and Master Node to eNB/gNB Change procedure, Source MN needs to obtain SN UHI information through the MN-initiated SN Modification procedure before triggering the handover.[15], **Proposal 7:** In the inter-MN handover with/without SN change procedure, add the SN UHI in SN modification request acknowledge message, Handover request message and SN addition request message |

**Opinion 2:**  In order to avoid handover delays, the master node is always aware of the latest PSCell UE history information.

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| --- |
| [18], **Proposal 8:** Add a flag indicating subscription of PSCell changes to the SN addition request and SN modification request messages sent from the master node to the secondary node.**Proposal 9:** RAN2 to discuss and conclude on one of the two options to a) Introduce a new optional IE PSCell change information containing Global Cell ID of the new PSCell and cause value in the SN modification required message. b) Introduce a dedicated, mandatory class 2 procedure message PSCELL CHANGE INFORMATION including the Global Cell ID of the new PSCell. for signaling the PSCell changes to the master node subscribing for such information. |

**Opinion 3:** use other messages to transfer UHI

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| --- |
| [15], **Proposal 8**: In the inter-MN handover with/without SN change procedure, add the SN UHI in SN Release request acknowledge message and introduce one new message to inform the target MN/SN of the SN UHI[24], **Proposal 3:** SN UHI can be conveyed from source MN to target MN within a separate message like Access and Mobility Indication, after handover procedure is completed. |

**Companies are kindly requested to provide their view on inter-MN handover case.**

|  |  |  |
| --- | --- | --- |
| Company | opinion | Comment |
| CATT | 1 | MN has to initiate SN modification procedures to retrieve not only UHI but also UE SCG configuration, so mostly this procedure is unavoidable. |
| Ericsson | 2 | Related to option 1: SN modification procedure will delay handover and may lead to HO failure.Related to option 3: The target MN needs to receive the SN UHI in the HO request if it wants to take the right decision about keeping or changing the SN. |
| ZTE | 1 | Related to option 2: limited signalling.Related to option 3: The possible delay for new node to identify ping pong issue. |
| Qualcomm | 1 | Not sure about CATT’s comment that SN modification procedure is unavoidable during inter-MN handover. Figure 10.7.2-1 in TS 37.340 doesn’t show SN modification. This (option 1) however can be used to retrieve SN UHI before inter-MN handover although we incur a certain backhaul delay.Option 2 is also possible (this is similar to MN subscribing to location information reporting from SN). Question: Wouldn’t we incur delays here as well to receive PSCell change information via either options in Proposal 9?Option 3 is delayed update of SN UHI and might not optimal.  |
| NEC | 1 | Since the SN modification procedure is commonly used, and the SN-UHI is kind of sub function, not worth to introduce new dedicated procedure only for this purpose. |
| China Telecom | 1 | Agree with CATT, the MN also uses the modification procedure to query the current SCG configuration, e.g. when delta configuration is applied in an MN initiated SN change. Reuse MN-initiated modification procedure to fetch the UHI is a more suitable approach. |
| Nokia | 1 (2 only as an implementation option) | In case a HO may be time-critical, the MN may use CHO to have more time to fetch the SCG UHI.Technically, option 2 may be implemented in the MN even if option 1 is selected: if the MN requested SN to provide PSCell for e.g. LI purposes, it may build the SCG UHI on its own. In that case, fetching UHI from the SN is not necessary. This is up to the MN’s implementation, not a default solution. |
| Samsung | 3 | Option 1 bring handover delay. For full configuration, the query is not needed. RAN2 is discussing the enhanced solution to avoid the query. CHO may not be supported by some UEs.Option 2 bring too much signaling.Ping-pong detection is not time critical and it is based on statictics. |
| Lenovo and Motorola Mobility | 1 | Agree with ZTE. |
| Huawei | 1 | MN will initiate SN modification procedures to retrieve the SCG configuration in order to perform the delta configuration of SCG. Therefore we think RAN3 can use the SN modification procedures to retrieve the SN UHI collected by the source SN.  |

**Moderator’s summary**

The statistics is as below:

* 8 companies prefer Opinion 1, and one of them believe Opinion 2 as an implementation option.
* 1 companies prefer Opinion 2
* 1 companies prefer Opinion 3

Moderator’s comments:As commented by Nokia,by implementation,option 2 could be natural supported without extra IE introduced.Following the view of majority,we have the following proposal:

Proposal 7: MN initiates SN modification procedures to retrieve SN UHI before handover.

## Time spent without SCG

Most companies discuss this issue. The contributions which prefer to include this IE are captured as below:

[6], **Proposal 7:** It is proposed to record the time stamp in UHI when SN removed which is useful for detecting PSCell ping-pong.

 [9], **Proposal 7:** Include Time spent without SCG in UHI to gather information on SN coverage holes.

[15], **Proposal 14**: Add the stay time without PSCell to the MN+SN UHI

[18], **Proposal 5:** Time spent with no PSCell should be included in the UE history information.

The contribution which prefers to use Time stamp IE for SN UHI to deduce the time spent without SCG:

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| --- |
| [10], **Proposal 10:** Instead of “Time spent without SCG”, RAN3 to consider introduce Time stamp IE for SN UHI |

The contribution proposes to not include time spent without SCG IE is captured as below:

|  |
| --- |
| [5], **Proposal 4:** “Time spent without SCG” should not be included in SN UHI[24], **Proposal 6:** “Time spent without SCG” is not needed. |

**Companies are kindly requested to provide their views on whether the information is needed or not and how to indicate the time spent without SCG on the interface.**

|  |  |  |
| --- | --- | --- |
| Company | Whether the information on time spent without SCG is useful? | If the information is useful, which solution is preferred to carry this information, i.e. via an explicit IE or deduce from other IEs? |
| CATT | Yes | In my opinion, MN is responsible for correlating SN and MN UHI. When SN is absent, MN fill the time spent without SCG in correlated UHI. |
| Ericsson | Yes | Needed for the correlation and for Dual Connectivity decisions (e.g. setup DC or not). |
| ZTE | No | We prefer time stamp , detail can be found in [10].For Time spend without SCG, MN will have a timer and takes the responsible to collect SN UHI without record. Which seems object the principle “**SN is responsible for collection SN UHI**”.  |
| Qualcomm | Yes | Whether an explicit IE is needed or can be deduced from the nested list of PCell/PSCell UHI can be decided post agreements on sec 3.2 |
| China Telecom | No | If the UE has no SCG connection, it is a normal handover cases, and there is no PSCell related MRO issues. Moreover, whether the “Time spent without SCG” can help to setup DC needs FFS. |
| Nokia | No | SCG may be released also as a bearer option, so recording it does not help. |
| Samsung | No | If the UE has no SCG connection, it is a normal handover cases, and there is no PSCell related MRO issues.Also agree the comments from Nokia. |
| Lenovo and Motorola Mobility | No | Same view as China Telecom. |
| KDDI | Yes | We share the view with Ericsson. |
| Huawei | Yes | The time without SCG can indicate the PSCell discontinuous situation and can be used to identity the ping pong after the time without SCG. |

Moderator’s summary:

* 5 companies believed time spent without SCG is useful:
* 5 companies believed time spent without SCG is useless:

Proposal 8:It is FFS whether Time spent in SCG should be introduced or not.

## Whether to include Cell Type

At this meeting, some contributions discuss this issue:

 [1], **Proposal 4a:** Cell type is not included, or included optionally (up to the network configuration)

[5], **Proposal 5:** “Cell Type” should not be included in the SN UHI.

[9], **Proposal 8:** Whether an optional IE Cell Type can be included in UHI for mobility speed estimation can be discussed.

[10], **Proposal 9:**Cell type IE is not used for UE history information of S-Node

[15], **Proposal 15:**Add the cell type to the SN UHI

[18], **Proposal 16:**Introduce a new IE PCell handover information in the SN modification request, including Global Cell ID of the new cell, Cell Type of the new cell, and optionally HO cause

**Companies are kindly requested to provide their view on including cell type for SN UHI.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Ericsson | - | There is a dependency on the above discussed questions. Wait for further agreements. |
| ZTE | No | In general SN is quite smaller than cell in MN.We don’t see the necessary to introduce the information. |
| NEC | Yes | Together with time stay in a cell, this is an important information to know the UE movement, if cell type is large and time stay is short, then UE is moving faster, then may choose relatively larger cell for the UE. |
| China Telecom | No | Agree with ZTE, we do not see much benefit of introducing this information. |
| Nokia | No or optionally | Historically, it put a lot of burden to configure cell type. This could be an optional IE, to be used only in case an operator desires it. |
| Samsung |  | Ok to include cell type as optional. |
| Lenovo and Motorola Mobility | No | Same view as ZTE. |
| Huawei | Yes | We agree that the cell type IE can be included optionally  |
|  |  |  |

Moderator’s summary:

4 companies believed Cell Type is not needed, but one of them also believe it may be optional.

1 company propose to include cell type as optional.

2 companies believe it is needed.

Proposal 9:It is FFS for whether Cell Type should be introduced or not

## Other UHI related proposals

[1], **Proposal 4b:** The originating node of the PSCell change is included in the SCG UHI

[1], **Proposal 5:** RAN3 to consider if the SCG UE History Information is to be encoded directly, or as a container to be passed as an OCTET STRING

[6], **Proposal 5:** It is proposed to introduce one flag in SN Addition Response message to indicate whether to trigger MN-initiated SN Modification procedures and include current Pcell for every intra-MN PCell change.

**Companies are kindly requested to provide their view (if any) on the above UHI related proposals.**

|  |  |
| --- | --- |
| Company | Comment |
| CATT | It is proposed to discuss the proposals in 3.9 after there is conclusion on the issues in 3.1-3.8 |
| Ericsson | Agree with CATT |
| Nokia | Proposal 1 is a direct consequence of the understanding that SCG UHI is the help resolve issues with SCG mobility. But fine to postpone the decision, as proposed above. |
| Huawei | Agree with CATT. We need first focus to the essential issues. |

Moderator’s summary:

It seems companies are OK with postpone the discussion on other issue after there is conclusion for 3.1-3.8

Proposal 10:It is proposed to postpone the discussion after the issues 3.1-3.8.

# Conclusion, Recommendations [if needed]

If needed

# References

|  |  |  |
| --- | --- | --- |
| [1] | [R3-211551](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-211551.zip) | A compromise solution for handling of the SCG UE history information (Nokia, Nokia Shanghai Bell) |
| [2] | [R3-211552](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-211552.zip) | (TP to TS 38.423, NR\_ENDC\_SON\_MDT\_enh-Core) Enabling SCG UHI (Nokia, Nokia Shanghai Bell) |
| [3] | [R3-211553](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-211553.zip) | (TP to TS 36.423, NR\_ENDC\_SON\_MDT\_enh-Core) Enabling SCG UHI (Nokia, Nokia Shanghai Bell) |
| [4] | [R3-211674](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-211674.zip) | UE History Information (UHI) in MR-DC (NEC) |
| [5] | [R3-211717](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-211717.zip) | Discussion on UE history information (China Telecommunication) |
| [6] | [R3-211853](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-211853.zip) | Enhancement of UE history information in MR-DC scenario (CATT) |
| [7] | [R3-211854](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-211854.zip) | (TP on UE history information for 36.413) Addition of UE history information for SN (CATT) |
| [8] | [R3-211855](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-211855.zip) | (TP on UE history information for 36.423) Addition of UE history information for SN (CATT) |
| [9] | [R3-212123](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212123.zip) | UE History Information in MR-DC (Qualcomm Incorporated) |
| [10] | [R3-212134](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212134.zip) | UE History Information in MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [11] | [R3-212135](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212135.zip) | (TP for SON BL CR for TS 37.340) Introduce UHI of MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [12] | [R3-212136](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212136.zip) | (TP for SON BL CR for TS 36.423) Introduce UHI of MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [13] | [R3-212137](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212137.zip) | (TP for SON BL CR for TS 38.413) Introduce UHI of MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [14] | [R3-212138](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212138.zip) | (TP for SON BL CR for TS 38.423) Introduce UHI of MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [15] | [R3-212203](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212203.zip) | (TP for SON BLCR for 38.423) UE History Information in MR-DC (Huawei) |
| [16] | [R3-212204](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212204.zip) | (TP for SON BLCR for 38.413) UE History Information in MR-DC (Huawei) |
| [17] | [R3-212205](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212205.zip) | (TP for SON BLCR for 36.413 and 36.423) UE History Information in EN-DC (Huawei) |
| [18] | [R3-212251](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212251.zip) | (TP for SON BL CR for TS 38.423) UE History Information for Secondary Node (Ericsson) |
| [19] | [R3-212470](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212470.zip) | UE history information in MR-DC (CMCC) |
| [20 | [R3-212471](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212471.zip) | (TP to TS 36.413)UE history information in MR-DC (CMCC) |
| [21 | [R3-212472](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212472.zip) | (TP to TS 36.423)UE history information in MR-DC (CMCC) |
| [22 | [R3-212473](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212473.zip) | (TP to TS 38.413)UE history information in MR-DC (CMCC) |
| [23] | [R3-212474](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212474.zip) | (TP to TS 38.423)UE history information in MR-DC (CMCC) |
| [24] | [R3-212532](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212532.zip) | UE History Information in EN-DC (Samsung) |
| [25] | [R3-212533](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212533.zip) | TP for SON BLCR for 38.423: UE History Information in EN-DC (Samsung) |
| [26] | [R3-212534](https://www.3gpp.org/ftp/tsg_ran/liuaijuan/AppData/Local/Microsoft/Windows/#112DocsR3-212534.zip) | TP for SON BLCR for 36.423: UE History Information in EN-DC (Samsung) |

# Appendix