3GPP TSG-RAN WG3 #111-e R3-211166

Online, 25 January – 4 February 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: # 1003\_SONMDT\_UEHist**

**- SN maintains the UHI? MN maintains UHI when SN does not exist?**

**- Which messages (and how) are used: MN-initiated modification or release procedures, SN-initiated modification or release procedures, SN addition procedure, inter-MN handover with/without SN change procedure, MN to eNB/gNB change procedure, eNB/gNB to MN change procedure, etc.**

**- Access and Mobility Indication is used to transfer SN UHIs?**

**- Handover Report should be enhanced to indicate SN change PP to SN, including SN UHIs received by MN?**

**- Independent SN UHI vs. association between MN UHI and SN UHI (or merged MN and SN UHI)**

**- Whether to include Cell type**

**- Whether to include originating node of the PSCell**

**- Whether to include Time spent without SCG**

**- Whether to include PSCell history information with the list of visited PScells for each last visited PCell**

**- Whether to include time stamp in UE history information**

**- Encoding of UHI**

**- May also discuss other issues based on papers submitted**

**- Try to reach high-level agreements in the first phase, proceed to TPs in the second phase of the email discussion**

(CATT - moderator)

Summary of offline disc [R3-210991](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Inbox\R3-206880.zip)

# For the Chairman’s Notes

Propose the following to be agreed:

**SN is responsible for collecting the SN UHI.**

**Include UHI in the SN addition, modification, change and release procedure. 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**

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

**Correlation between MN UHI and SN UHI is feasible and beneficial.**

Open issue for further discussion:

It is FFS how to realize the correlation between MN UHI and SN UHI i.e. via two-dimensional structure for UHI (PSCells history information are listed for each PCell in the UHI) or a separate MN UHI and SN UHI.

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

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

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

It is FFS for whether Cell Type should be introduced or not.

The other enhancements or details could be discussed after we have conclusion on the basic features.

**Proposal on the work in phase 2:**

**1 The rapporteur of the baseline CR work on the corresponding TP based on the agreement reached above.**

**2 Continue the discussion on open issue 1 and open issue 2**

# Discussion for the second round

## Issue 1: Which node (MN or SN) collects SN UHI (network side UHI)?

In the first round of offline discussion, 10 companies propose to let SN collect SN UHI and 2 companies propose to let MN collect SN HUI. During the online session, the compromised proposal i.e. **SN is responsible for collecting the SN UHI, but MN may fetch this information from SN** is not agreed

**Question 1: After further consideration, if the above compromised solution is still not OK to you, please provide comments or further suggestion here**

|  |  |
| --- | --- |
| Company | Comments |
| Ericsson | Needs further study. Can wait next meeting with respect to progress at this meeting (e.g. acknowledgement that SN UHI can be useful in MN for mobility decisions) |
| Huawei | This is agreeable for us.  It would be important to get some progress here since this is blocking further progress. |
| CMCC | The compromise proposal is fine with us. We also agree with HW this blocking point has last long since Rel-16, we should make some progress |
| Samsung | We still don’t know the benefit to let MN knows each PScell change introduced by SN. The main argument is that for inter-MN handover, the source MN can transmit the SN UHI in handover request without query procedure which will reduce the handover latency. The MN can transmit what it has in Handover Request message to the target node. If the MN receives updated SN UHI in the release message from the SN, the source MN can update the target node with non-UE associated signaling because SN UHI is not time critical. |
| NEC | Need more understanding of the impact, difficulty, and other. |
| Qualcomm | We preferred MN to collect SN UHI to have a more central solution, to reduce signaling impact and to have ease of maintaining a single correlated UHI at both MN and SN.  The major opposition against MN collecting SN UHI is that MN might not be aware of intra-SN PSCell changes and reporting these PSCell changes is against “principle” although signaling support can be added for the same.  We request companies to consider the following 2 additional arguments as well:   1. RAN2 is yet to discuss UE History of SN from UE (UE collected UHI). If RAN2 supports this and no support for reporting via SRB3 exists, **MN would need to forward SN UHI from UE to SN** which will then use this along with SN collected SN UHI. This might be **forwarded back to MN** in case of PSCell change (so **ping-pong of SN UHI** between MN and SN happens 2. We agreed in CB#1005 for MRO for SN change failure that “**MN performs initial analysis to identify the node that caused the failure**”. Here we went for a centralized solution i.e. we made MN to identify the node that caused the SN change failure. Even here, we face the issue that MN can’t identify the node in case of intra-SN PSCell change. Why not consider a central solution for UHI as well then?   If companies still prefer SN to not report intra-SN PSCell changes due to the “principle” even though the alternative solution has more advantages, we are okay to go with majority and agree SN to be the node responsible for collecting SN UHI |
|  |  |

Since this issue has been discussed for several meetings and we are stuck now, to move forward,if we could not reach agreement on question 1, we have another alternative which enables both SN and MN to collect UHI as below:

**SN could be responsible for collecting the SN UHI and it is also allowed for SN to inform MN on every intra-SN Pscell change.**

**Question2: Whether the above compromised solution is OK to you or not, please provide comments or further suggestion here.**

|  |  |
| --- | --- |
| Company | Comment |
| CATT | OK |
| Ericsson | If SN informs the MN of each PSCell change, what is the benefit of maintaining the SN UHI in the SN, compare to having everything centralized in the MN? |
| Huawei | Assigning the role that collects the information is essential. If the roles are unclear both nodes have to support the functionality. |
| Samsung | As commented for Q1. |
| NEC | See comment in Q1. |
| Qualcomm | Adding on to Ericsson’s comments, so SN maintains SN UHI for its own optimization purposes but has to go through MN for every PSCell change. Centralized MN solution might be cleaner, but we are okay to go with SN based solution if companies still think otherwise |

## Other proposals made in the first round

The follows are proposed to be agreed based on the discuss in the first round

**Include UHI in the SN addition, modification, change and release procedure. 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**

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

**Correlation between MN UHI and SN UHI is feasible and beneficial.**

**Question3: If the above proposal is not OK to you, please provide comments or further suggestion here.**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Proposal 2 cannot be agreed before the is addressed  Proposal 3 is ok but might be reworded to reflect the fact that we do not know if MN UHI and SN UHI will be separated IEs or a list of MN UHI containing a list of SN UHI |
| Huawei | In principle, we are fine to agree all.  But the main question (who collects the history) is blocking the progress and should be decided first. If we have a decision there, it will be easier to get progress here. |
|  |  |

# Discussion for the first round

## 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 for SN to collect SN UHI are captured below:

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

**[4], Proposal 1:** SN collects UE history information of PSCell and forward it to MN during SN procedures

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

**[7], Proposal 1:** It is proposed that MN maintains UHI when SN does not exist and SN maintains the UHI when SN exists

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

**[14], Proposal1:** RAN3 to agree SN should be responsible for collecting UHI (network side) for SN

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

**[21], Proposal 1:** Agree SN to collect the SN UHI and could send it to MN for subsequent processing

Companies which propose to let MN collect SN UHI are captured below:

**[10], Proposal 2:** MN collects SN UHI and forwards it to target (or new SN) in case of SN addition/modification/change procedures.

**[20], Proposal 4:** The master node is responsible for keeping the UE history information (including master cell history and secondary cell history), and the UE history information collected by the master node should have precedence over any UE history information kept by the secondary node.

The main divergence for the two opinions is as follows:

1. It is already supported to enable SN node report the PScell to MN node for the purpose of location report. But it causes too much interaction in Xn/X2 and should be initiated by CN.
2. The MN does not need to know the intra-SN PSCell change.
3. Additional delays in inter-MN handover for SN to collect SN UHI.
4. PScell report from SN to MN is optional which relies on support of location report feature. If location report is not supported, then it is not feasible for MN to collect the UHI.

**Companies are requested to provide their views on this issue and discuss the pros/cons of MN vs. SN collecting the SN UHI.**

|  |  |  |
| --- | --- | --- |
| Company | Which node collects SN UHI? | Comment |
| CATT | SN | For the reason mentioned above, we prefer SN collects SN UHI. Before inter-MN handover, MN usually needs to retrieve SN configuration, not just SN UHI. So, the Additional delays in inter-MN handover are usually unavoidable. |
| ZTE | SN | Concern on interactive between MN and SN when PScell change in SN if MN takes the responsibility for SN UHI.  Even MN collects SN UHI, SN itself will also collects the same information for e.g. better HO decision. Therefore, redundant work exist for MN and SN. |
| Nokia | SN | The problem has two dimensions:  1) In cloud deployments of EN-DC, the MN may be overloaded with managing SCG UHI;  2) If the MN manages the SCG UHI, either the reporting of every PSCell change must be made mandatory, or the whole feature of SCG UHI is optional and dependent on location reporting. The first option breaks the principle that the MN should not be bothered with intra-SN mobility, while the other is questionable from the point of view of the feature. |
| Samsung | SN | MN may not know intra-SN PSCell change. PSCell in location report is triggered by the CN. |
| Qualcomm | Prefer MN | Before taking a decision, we should consider the following and try to answer the questions i) and ii) below:  If SN collects SN UHI, MN should collect SN UHI using SN Modification Request/Response before MN initiated SN change and inter-MN handover. This is a deviant from the procedures defined in 37.340 and adds more delay to the above 2 procedures. Also there are more signaling impacts if we choose MN to collect SN UHI (see section 3.2 for comparison)  **i) Are we okay with changing (delaying) the MN initiated SN change and inter-MN handover procedures from 37.340 and support additional signaling impact for sending UHI from SN->MN?**  If MN collects MN UHI. SN should inform MN about intra-SN changes either using SN Modification Required or Location Reporting. If companies don’t prefer Location Reporting due to reasons mentioned above, SN can use SN Modification Required to inform MN about intra-SN changes.  **ii) Is there a principle mentioned in specs that MN can’t be informed about intra-SN changes? If not, why can’t we use SN Modification Required to inform MN about intra-SN changes?**  Considering lesser signaling impact and a more central solution with MN collecting the SN UHI, we think it might be a better solution. |
| China Telecom | SN | We prefer SN to collect the SN UHI and forward it to the MN. And we also agree with CATT’s opinion, MN may retrieve SN configuration through Modification procedures before inter-MN handover, in this way, the X2/Xn delay is the same. |
| NEC | SN | For the SN addition the PSCell is selected by the SN based on the latest measurement result, and the selected PSCell is included in the NR RRCReconfiguration message which is transparent to the MN. Moreover, the PScell can be changed in the SN without MN knowing. Therefore it can be first to decide it is the SN collect the SN UHI.  It is also proposed the MN keep the list of SN UHI, update whenever it receive from SN. |
| Lenovo and Motorola Mobility | SN | SN is responsible to collect and manage SN UHI, and SN UHI can be transferred in SN addition, SN modification, SN release and SN change procedures. |
| Huawei | SN | We think it is the SN to collect based on the reason 2&4. For the reason 3, we agree the comments from CATT |
| CMCC | SN | Because of the reason 2/4, we support SN collects the SN UHI |
| NTTDOCOMO | SN | MN is transparent to the detail configuration of SN (e.g. PSCell CGI), it is natural to make SN to collect UHI in SN |
| Ericsson | MN | On HO: Agree with QC. MN does not need to always retrieve SN configuration. Therefore, this will delay HO in these cases. But this is not only about configuration retrieval. In case of intra-node HO, if UHI is updated by the SN, the MN will need to inform the SN of the new PCell, as it seems that correlation is needed between PCell and PSCell. This is also extra signaling. The MN will have use of more frequent updates of the UHI of the SN. This, together with the fact that the UHI should also register periods with no SN makes the MN more suitable for keeping track.  On the usage of the SN UHI in the MN: This is not only about avoiding ping-pong. Mobility decision can be taken by the MN can be improved if the MN is aware of the latest UHI all the time.  And centralized solution is key here. We will avoid desynchronization between MN and SN if only one node is in charge of UHI. It does not make change to have one node in charge of MN UHI, and another og SN SHI. If correlation is needed, there is only one UHI. |

Moderator’ Summary:10 companies prefer SN to be responsible for collecting the SN UHI, the reason is :

* + - 1. Avoid breaking the principle that the MN should not be bothered with intra-SN mobility.
      2. If MN collects SN UHI, SN itself will also collect. Redundant work exist for MN and SN.
      3. MN may be overloaded with managing SCG UHI.
      4. PScell report from SN to MN is optional.
      5. PSCell in location report is triggered by the CN
      6. No extra delay for inter-MN handover since MN may retrieve SN configuration through Modification procedures before inter-MN handover

2 companies prefer MN to collect SN UHI with the following reasons:

1 Centralized solution

2 Avoid delay

Following the view of majority,we have the following proposal:

**Proposal 1: SN is responsible for collecting the SN UHI.**

## Which messages include UHI

At last RAN3 meeting, it had been agreed to include UHI in SN addition and change messages with the detail FFS.

Include SN UHI in the SN addition and change messages (modification FFS); information flow in both directions is not precluded at this stage

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

|  |  |  |
| --- | --- | --- |
| Number | Message | Direction |
| 1 | S-NODE ADDITION REQUEST SGNB ADDITION REQUEST | MN->SN |
| 2 | S-NODE ADDITION REQUEST ACKNOWLEDGE SGNB ADDITION REQUEST ACKNOWLEDGE | SN->MN |
| 3 | S-NODE MODIFICATION REQUEST SGNB MODIFICATION REQUEST | MN->SN |
| 4 | S-NODE MODIFICATION REQUEST ACKNOWLEDGE SGNB MODIFICATION REQUEST ACKNOWLEDGE | SN->MN |
| 5 | S-NODE MODIFICATION REQUIRED SGNB MODIFICATION REQUIRED | SN->MN |
| 6 | S-NODE MODIFICATION CONFIRM SGNB MODIFICATION CONFIRM | MN->SN |
| 7 | S-NODE RELEASE REQUEST SGNB RELEASE REQUEST | MN->SN |
| 8 | S-NODE RELEASE REQUEST ACKNOWLEDGE SGNB RELEASE REQUEST ACKNOWLEDGE | SN->MN |
| 9 | S-NODE RELEASE REQUIRED SGNB RELEASE REQUIRED | SN->MN |
| 10 | S-NODE RELEASE CONFIRM SGNB RELEASE CONFIRM | MN->SN |
| 11 | S-NODE CHANGE REQUIRED SGNB CHANGE REQUIRED | SN->MN |
| 12 | S-NODE CHANGE CONFIRM SGNB CHANGE CONFIRM | MN->SN |
| 13 | HANDOVER REQUEST | inter-MN |
| 14 | Access and Mobility Indication | inter-MN |

**Companies are requested to list the number of messages in which UHI should be included and provide comments if any.**

|  |  |  |
| --- | --- | --- |
| Company | Number of messages in which UHI should be included | Comment |
| CATT | 1, 4, 8, 9, 11, 13 | Besides SN addition and SN change messages, it is proposed to include UHI from SN to MN during SN modification and release procedures. |
| ZTE | If UHI in this table refer to SN UHI:  1,3,4,8,11  If UHI in this table refer to MN UHI+ SN UHI :  13 |  |
| Nokia | SCG UHI: 1, 4, 5, 8, 9, 11, 13  Request to provide SCG UHI: 3, 7 |  |
| Samsung | 8, 9, 14 | Firstly, MN may not know intra-SN PSCell change, so SN can send SN UHI to MN during SN release procedure;  Secondly, SN UHI can be used for PSCell change issues detection like PSCell change PP during inter-MN handover, but it may be not a realtime optimization. It means it’s unnecessary to transfer SN UHI to the target node in Handover Request. Access and Mobility Indication can be used after source node retrieve SN UHI by SN release procedure. |
| Qualcomm | **If SN collects SN UHI: 1,4,5,8,9,11**  (MN -> SN: 1  SN -> MN: 4,5,8,9,11  Inter-MN: 13/14)  **If MN collects SN UHI: 1,5,13**  (MN->SN: 1  SN ->MN:5  Inter-MN:13) | If SN collects SN UHI, we need to transfer SN UHI in SN release, SN change and SN mod ack messages as well. |
| China Telecom | 1, 4, 5, 8, 9, 11, 13 |  |
| NEC | 1, 8, 9, 11, 13 | The SN UHI list can help target SN for selecting better PSCell, therefore 1.  Principle thinking that the SN give the SN UHI to the MN when the UE will leave the SN.  4 is not needed because the UE is still in SN.  The to be released SN give the latest SN UHI to the MN, so 8.  The release required SN give the latest SN UHI to the MN, so 9.  The change required SN give the latest SN UHI to the MN, so 11.  The source MN give the latest SN UHI list to the target MN, therefore 13. |
| Lenovo and Motorola Mobility | SN UHI can be included in 1,4,5,8,9,11.  Combination of MN and SN UHI can be included in 13. |  |
| Huawei | 1,4,8,9,11,13 | Agree the comments from CATT. |
| CMCC | 1,4,8,9,11,13 | Agree the comments from CATT. |
| NTTDOCOMO | 1,4,8,9,11,13 |  |
| Ericsson | 1, 13 | Very much depends on decisions for section 3.1 and 3.4 of this SoD.  Answer is assuming PCell/PSCell correlation and MN-managed UHI. This does not include signaling from SN to MN for PSCell change |

The statistics of message number as below:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| CATT | √ |  |  | √ |  |  |  | √ | √ |  | √ |  | √ |  |
| ZTE | √ |  | √ | √ |  |  |  | √ |  |  | √ |  | √ |  |
| NOKIA | √ |  | √ | √ | √ |  | √ | √ | √ |  | √ |  | √ |  |
| Samsung |  |  |  |  |  |  |  | √ | √ |  |  |  |  | √ |
| QC\_SN | √ |  |  | √ | √ |  |  | √ | √ |  | √ |  | √ | √ |
| CT | √ |  |  | √ | √ |  |  | √ | √ |  | √ |  | √ |  |
| NEC | √ |  |  |  |  |  |  | √ | √ |  | √ |  | √ |  |
| Lenovo and Motorola Mobility | √ |  |  | √ | √ |  |  | √ | √ |  | √ |  | √ |  |
| Huawei | √ |  |  | √ |  |  |  | √ | √ |  | √ |  | √ |  |
| CMCC | √ |  |  | √ |  |  |  | √ | √ |  | √ |  | √ |  |
| NTTDOCOMO | √ |  |  | √ |  |  |  | √ | √ |  | √ |  | √ |  |
| Ericsson | √ |  |  |  |  |  |  |  |  |  |  |  | √ |  |
| total:12 | 11 | 0 | 2 | 9 | 4 |  | 1 | 11 | 10 |  | 10 |  | 11 | 2 |

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 REQUEST SGNB ADDITION REQUEST | MN->SN | The SN UHI list can help target SN for selecting proper PSCell | 11 |
| S-NODE MODIFICATION REQUEST ACKNOWLEDGE SGNB 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 ACKNOWLEDGE SGNB RELEASE REQUEST ACKNOWLEDGE | SN->MN | For MN initiated SN release procedure,SN should send its UHI to MN. | 11 |
| S-NODE RELEASE REQUIRED SGNB RELEASE REQUIRED | SN->MN | For SN initiated SN release procedure,SN should send its UHI to MN. | 10 |
| S-NODE CHANGE REQUIRED SGNB CHANGE REQUIRED | SN->MN | For SN initiated SN change procedure,SN should send its UHI to MN. | 10 |
| HABDOVER REQUEST | inter-MN | During HO procedure,the UHI should be sent from source node to target node. | 11 |

**Proposal 2: 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 3.2 in which messages to transfer UHI have been selected, here we further discuss the type of UHI in messages.

The type may be SN UHI, MN UHI or combined SN and MN UHI to be transferred when correlated UHI is adopted as captured below:

[4], **Proposal 2:** Include SN UHI in the SN release and SN modification messages over X2/Xn interface:

[11], **Proposal 12:** We propose to define a new SN UHI and add this to the legacy UHI per visited Pcell

**Proposal 13:** We propose to define a new SN UHI (same as above) and send this from SN to MN

[15], **Proposal 5:** For XnAP and X2AP, only SN UHI information provide from MN to SN

[20], **Proposal 3**: The same UE history information should be available in both the primary and the secondary node

If separated UHI is adopted, only SN UHI may be needed to be transferred between MN and SN as below.

[10], **Proposal 2:** MN collects SN UHI and forwards it to target (or new SN) in case of SN addition/modification/change procedures.

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 | After MN sends combination of MN and SN UHI to SN in SN addition message, SN could use the information for the subsequence PScell change and continues to maintain SN parts of the correlated UHI in SN. |
| ZTE | Only SN UHI need to be transfer from MN to SN. |  |
| Nokia | Only SCG UHI is to be transferred |  |
| Samsung | SN UHI | SN can utilize SN UHI to optimize MRO issue during PSCell change, e.g. PSCell change PP. PSCell change PP could occur only if MN is not changed. So MN UHI is not needed by SN. |
| Qualcomm | Combination of MN and SN (if nested MN and SN UHI) | It is easier to signal and maintain the same correlated UHI information (MN+SN UHI) in both MN and SN rather than just exchanging only SN UHI between MN and SN and ask MN to correlate. |
| China Telecom | Combination of MN and SN UHI |  |
| NEC | SN UHI |  |
| Lenovo and Motorola Mobility | combination of MN and SN UHI, and/or, SN UHI |  |
| Huawei | combination of MN and SN UHI | The SN may benefit from having the MN UHI. |
| CMCC | Combination of MN and SN |  |
| NTTDOCOMO | Combination of MN and SN |  |
| Ericsson | Combination of MN and SN | See also response to 3.4 |

**Moderator’s summary:**

* 8 companies believed a correlated MN and SN UHI shall be included for the messages direction from MN to SN
* 4 companies believed SN UHI shall be included:
  + 1 company believes only SN part UHI of Combination of MN and SN UHI shall be included.
  + 3 companies believe separate SN UHI shall be included.

We therefore propose to agree the following proposal:

**Proposal 3: It is FFS on whether only SN UHI or** correlated MN and SN UHI should be 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 | Prefer to transfer combination of MN and SN UHI | SN sends combination of MN and SN UHI to MN before SN release and MN maintain the information. |
| ZTE | Only SN UHI need to be transfered from SN to MN |  |
| Nokia | Only SCG UHI is to be transferred |  |
| Samsung | SN UHI | Refer to our above reply. SN doesn’t need MN UHI so SN cannot send MN UHI to MN. |
| Qualcomm | Combination of MN and SN | Same as above (easier to signal one nested list rather than SN UHI separately). If MN has a more updated UHI, it can override it. |
| China Telecom | Combination of MN and SN UHI |  |
| NEC | SN UHI |  |
| Lenovo and Motorola Mobility | SN UHI |  |
| Huawei | Prefer only SN UHI | MN is in charge of MN hitsory  We think the MN can associate the SN UHI and MN UHI based on the time of SN addition and the time of SN release.  Therefore SN only need send the SN UHI to the MN |
| CMCC | Combination of MN and SN |  |
| NTTDOCOMO | Combination of MN and SN |  |
| Ericsson | SN UHI only |  |

**Moderator’s summary**

* 5 companies believe a correlated MN and SN UHI shall be included for the messages direction from SN to MN
* 7 companies believe SN UHI shall be included:
  + 4 companies believe SN UHI is sent to MN for Combining MN UHI with SN UHI.
  + 3 companies believe separate SN UHI shall be included.

We therefore propose to agree the following proposal:

**Proposal 4: It is FFS on whether only SN UHI or** correlated MN and SN UHI should be sent from SN to MN.

**Companies are requested to provide their views on the type of UHI for the inter-MN messages.**

|  |  |  |
| --- | --- | --- |
| 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 | With the information on combination of MN and SN UHI in handover request, the target MN could add a suitable SN node based on measurement report and history information. |
| ZTE | combination of MN and SN UHI |  |
| Nokia | Legacy UHI is already transferred. Thereforem SCG UHI shall be added separately. | MN may combine the legacy UHI with the SCG UHI internally, when needed. Instead of creating combined structures, RAN3 shall rather make sure the information provided enables such combining. |
| Samsung | Both, but they are separate. | We think only SN UHI related to the last MN is meaningful. Target MN doesn’t need SN UHIs related to older MN. |
| Qualcomm | Combination of MN and SN UHI |  |
| China Telecom | Combination of MN and SN UHI |  |
| NEC | Both, but they are separate. |  |
| Lenovo and Motorola Mobility | combination of MN and SN UHI |  |
| Huawei | combination of MN and SN UHI | The target MN/SN need use the previous UHI, therefore both MN and SN UHI should be included in the handover request message. Also the target MN/SN may use the relation between MN UHI and SN UHI to optimize the configuration for PSCell change. Therefore we think combination of MN and SN UHI is needed |
| CMCC | combination of MN and SN UHI | Same comments as HW |
| NTTDOCOMO | combination of MN and SN UHI |  |
| Ericsson | Combination of MN and SN | See also response to 3.4 |

Moderator’summary: Almost all the companies believe MN and SN UHI shall be included in inter-MN message. 9 companies which prefer correlated MN and SN UHI propose to include correlated MN and SN UHI in inter-MN message. 3 companies propose to include separate MN UHI and SN UHI since they prefer separate SN and MN UHI.

We therefore propose to agree the following proposal:

**Proposal 5: MN and SN UHI shall be included in inter-MN message and the structure of MN and SN UHI is up to 3.4.**

## Correlation of MN and SN UE history information

It was agreed that there are some benefits in correlating the MN UHI and SN UHI and the feasibility and details of such a solution was FFS.

**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.**

Out of the 10 contributions received this meeting,

* 8 contributions propose to have a correlated MN UHI and SN UHI solution and 7 contributions list PSCell as sub-list per PCell in the legacy list
* 2 contributions don’t see much benefit in correlating SN and MN UHI and prefer to have an independent SN UHI solution

Since it was already agreed that it is beneficial to correlate the UHI of MN and SN,we propose to discuss the feasibility of correlation between MN UHI and SN HUI. If it is feasible, please provide your preferred solution i.e. two dimension or one dimension

And if it is not feasible, please provide the reason.

|  |  |  |
| --- | --- | --- |
| Company | Is the correlation of MN UHI and SN UHI feasible or not? | Comment |
| CATT | Correlation of MN UHI and SN UHI is feasible | As in [7] subsection 2.4, an example has been given to prove the feasibility of correlation of MN UHI and SN UHI, i.e. using a two dimension array which list PSCell as sub-list per PCell in the legacy list. |
| ZTE | Correlation of MN UHI and SN UHI in MN node is feasible |  |
| Nokia | SCG UHI shall be a separate IE. However, collected information shall enable combining the legacy UHI and SCG UHI, if needed (internally, based on implementation). |  |
| Samsung | In general, we think correlation is not necessary.  If needed, implementation based method could be used as Nokia commented. | SN UHI can be used to solve the issue of PSCell change PP. It’s related to only the last MN. So it’s enough to store SN UHI separately. |
| Qualcomm | Correlation of MN UHI and SN UHI | Correlation achieved by using a nested list of MN and SN UHI and exchanged between MN and SN. |
| China Telecom | Correlation of MN UHI and SN UHI | We prefer two-dimensional structure, because it is clearer and easy for MN to maintain during MN/SN-initiated PScell Change procedures. |
| NEC | correlation in protocol level is not needed. | SN UHI is for the purpose to help SN to select the best PSCell that can help to reduce ping-pong effect. Correlation of MN UHI and SN UHI is not needed. |
| Lenovo and Motorola Mobility | Correlation of MN UHI and SN UHI is feasible. Two dimension solution is preferred. |  |
| Huawei | Correlation of MN UHI and SN UHI is feasible | Add the PSCell list to the legacy UHI per visited Pcell |
| CMCC | Correlation of MN UHI and SN UHI is feasible | As shown in our paper and TPs |
| NTTDOCOMO | Correlation of MN UHI and SN UHI is feasible |  |
| Ericsson | Correlation is needed and feasible | Having only one UHI (i.e. list of PSCells within a list of PCells) to “play with” makes things much simpler |

Moderator’s summary:

* 9 companies believed a correlated MN and SN UHI are feasible.
* 2 companies believed a correlated MN and SN UHI are feasible, but MN and SN UHI shall be a separate IE.
* 1 company believed a correlated MN and SN UHI is not needed.

Following the view of majority,we have the following proposal

**Proposal 6: Correlation between MN UHI and SN UHI is feasible.It could be realized via two-dimensional structure for UHI (PSCells history information are listed for each PCell in the UHI)**

## Time spent without SCG

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

[4], **Proposal 4:** “Time spent without SCG” should not be included in SN UHI.

[10], **Proposal 4:** Include “Time Spent without PSCell” in SN UHI.

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

[14], **Proposal 3:** Include time stamp in UE history information to help network to correlate the UHI (MN) and UHI (SN).

[20], **Proposal 7:** 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:

|  |
| --- |
| [16], **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 6:** “time spent without SCG” is unnecessary. It’s not expected to store SN UHI in MN when no SCG is configured. |

**Companies are 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 our opinion, MN is responsible for correlating SN and MN UHI. When SN is absent, MN fills the time spent without SCG in correlated UHI. |
| ZTE | Yes |  |
| Nokia | No | If DC is meant to be continued, this time shall be as short as possible. Hence, its duration does not help anything. |
| Samsung | No | Without SCG means no PScell related MRO issues. Therefore the information is not useful for MRO issues of PSCell change. |
| Qualcomm | Yes | Similar view as CATT. Useful to know the time without DC coverage for aiding future SN addition/changes. |
| China Telecom | No | The information of “Time spent without SCG” may not be used when deduce the failure reason for PScell change failure events, so we prefer to not include it in the UHI at this stage. |
| NEC | No | Time spent without SCG does not help SN to choose best PScell. |
| Lenovo and Motorola Mobility | Yes | Agree with CATT. |
| Huawei | Yes | As discussed in [11], the network should record the successive SN UHI and the time spent without SCG can be used to analyze the ping pang issue. |
| NTTDOCOMO | Yes | Include time stamp in UE history information to help network to correlate the UHI (MN) and UHI (SN). |
| Ericsson | Yes | For the receiving node to be able to correctly interpret the correlation of the MN part and the SN part of the UHI. This information can be useful to gather an understanding of the previous choices made for the UE in terms of DC connectivity. If for example a UE is moving at high speed, the UE may not be connected to SCGs. A node receiving this information may use it to quickly deduce that the UE is moving too fast to configure a reliable DC connection. |

Moderator’s summary:

* 7 companies believed time spent without SCG is useful for the follow reason:
  + MN knows the time without DC coverage for aiding future SN addition/changes.
  + MN can fill the time spent without SCG in correlated UHI.
  + Time spent without SCG can be used to analyze the ping pang issue
  + to help network to correlate the UHI (MN) and UHI (SN)
  + useful to gather an understanding of the previous choices made for the UE in terms of DC connectivity
* 4 companies believed time spent without SCG is useless:

Proposal: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)

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

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

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

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| ZTE | No |  |
| Nokia | No | Historically, it was mainly burden to configure cell type in every cell. But may be made optional (if configured for other purposes). |
| Qualcomm | No |  |
| China Telecom | No |  |
| NEC | yes | Together with time spent, the cell type can help the SN to choose best PScell, e.g. time spent long in small cell that mean at the moment the UE is moving slowly then SN may decide to choose small cell. |
| Lenovo and Motorola Mobility | No |  |
| Huawei | Yes | In some cases, the cell type is important. For example, the MN or SN may use the SN UHI to estimate the mobility speed. The cell type of SN may be small in FR2, be medium or large in FR1. It can be optional. |
| NTTDOCOMO | Yes | It is useful to estimate the mobility speed at SN side. |
| Ericsson | No, but | The usefulness very much depends on the agreements on other issues (e.g. 3.1). Ok to further discuss when more details on the full solution are known |

Moderator’s summary:

6 companies believed Cell Type is not needed while 3 companies believe it is needed.

Proposal :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

[5], **Proposal 3:** Handover Report should be enhanced to indicate SN change PP to SN, including SN UHIs received by MN.

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

|  |  |
| --- | --- |
| Company | Comment |
| Nokia | If the purpose of SCG UHI is to address mobility issues, then the information on the node the initiated the PSCell change is needed to enable that node to correct possible configuration errors. |
| Samsung | Yes for P3. MN can identify SN change issue like SN change PP. It is beneficial to indicate this to SN together with SN UHI to assist SN for further confirmation and optimization. If HO Report message cannot be agreed, other similar message could be considered. |
| Ericsson | Too early to discuss. We need to conclude on other issues first to understand how this can be achieved, and what for. |

Moderator’s summary:

No conclusion are made

Proposal :The other enahncements could be discussed after we have conclusion on the basic features.

# Conclusion, Recommendations [if needed]

If needed

# References

|  |  |  |
| --- | --- | --- |
| [1] | [R3-210079](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210079.zip) | Solution for handling of the SCG UE history information (Nokia, Nokia Shanghai Bell) |
| [2] | [R3-210080](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210080.zip) | (TP to TS 38.423, NR\_ENDC\_SON\_MDT\_enh-Core) Enabling SCG UHI (Nokia, Nokia Shanghai Bell) |
| [3] | [R3-210081](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210081.zip) | (TP to TS 36.423, NR\_ENDC\_SON\_MDT\_enh-Core) Enabling SCG UHI (Nokia, Nokia Shanghai Bell) |
| [4] | [R3-210109](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210109.zip) | Discussion on UE history information (China Telecommunication) |
| [5] | [R3-210264](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210264.zip) | TP for SON BLCR for 38.423: UE History Information in EN-DC (Samsung) |
| [6] | [R3-210265](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210265.zip) | TP for SON BLCR for 36.423: UE History Information in EN-DC (Samsung) |
| [7] | [R3-210297](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210297.zip) | Enhancement of UE history information in MR-DC scenario (CATT) |
| [8] | [R3-210298](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210298.zip) | (TP on UE history information for 36.413) Addition of UE history information for SN (CATT) |
| [9] | [R3-210299](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210299.zip) | (TP on UE history information for 36.423) Addition of UE history information for SN (CATT) |
| [10] | [R3-210344](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210344.zip) | UE History Information in MR-DC (Qualcomm Incorporated) |
| [11] | [R3-210391](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210391.zip) | (TP for SON BLCR for 38.423) UE History Information in MR-DC (Huawei) |
| [12] | [R3-210392](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210392.zip) | (TP for SON BLCR for 38.413) UE History Information in MR-DC (Huawei) |
| [13] | [R3-210393](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210393.zip) | (TP for SON BLCR for 36.413 and 36.423) UE History Information in EN-DC (Huawei) |
| [14] | [R3-210497](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210497.zip) | Discussion on collection of UE history information in EN-DC (NTT DOCOMO, INC.) |
| [15] | [R3-210560](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210560.zip) | UE History Information in MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [16] | [R3-210561](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210561.zip) | (TP for SON BL CR for TS 37.340) Introduce UHI of MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [17] | [R3-210562](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210562.zip) | (TP for SON BL CR for TS 36.423) Introduce UHI of MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [18] | [R3-210563](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210563.zip) | (TP for SON BL CR for TS 38.413) Introduce UHI of MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [19] | [R3-210564](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210564.zip) | (TP for SON BL CR for TS 38.423) Introduce UHI of MR-DC (ZTE, Lenovo, Motorola Mobility, China Unicom) |
| [20 | [R3-210673](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210673.zip) | (TP for SON BL CR for TS 36.413/38.413/36.423/38.423): UE History Information for Secondary Node (Ericsson) |
| [21 | [R3-210928](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210928.zip) | UE history information in MR-DC (CMCC) |
| [22 | [R3-210929](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210929.zip) | (TP to TS 36.413)UE history information in MR-DC (CMCC) |
| [23] | [R3-210930](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210930.zip) | (TP to TS 36.423)UE history information in MR-DC (CMCC) |
| [24] | [R3-210931](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210931.zip) | (TP to TS 38.413)UE history information in MR-DC (CMCC) |
| [25] | [R3-210932](file:///C:\Users\wangruiwei\AppData\Users\liuaijuan\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\JU4742V7\Docs\R3-210932.zip) | (TP to TS 38.423)UE history information in MR-DC (CMCC) |

# Appendix