Fro submission

Variant of [RAN93e-R18Prep-03] Mobility Enhancements Version 0.0.5

RAN

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Source:

Title: **Moderator's summary for discussion [RAN93e-R18Prep-3] Mobility enhancements**

Agenda item: **9.0.1**

Document for: **Discussion and decision**

1 Introduction

Proposals on various mobility enhancements were provided to the 3GPP RAN Rel-18 workshop in June 2021. Mobility enhancements was identified as a topic for further email discussions as in RWS-210659:

Mobility enhancements, with the following example areas:

- Layer 1/layer 2 based inter cell mobility
- DAPS (Dual Active Protocol Stack)/CHO (Conditional HandOver) related improvements
- FR2 (frequency range 2)-specific enhancements

The email discussion aims at reaching common understanding on a set of areas with high-level description, which could help RAN to converge on a reasonable scope for mobility enhancements in Rel-18. This high-level description is not a draft WI/SI, and it is a list of targeting bullets for each area. The potential impacted WGs and leading WG can also be discussed in this email discussion.

Please provide your proposals/comments with sufficient motivation assessment, and avoid inputs simply indicating "support/not support".

2 Initial Phase

The goal for initial round is to collect proposals from companies for each area, which can be used for potential areas convergence in the intermediate round.

2.1 General comments

Companies are invited to provide general comments on the interested areas for mobility enhancements.

Feedback Form 1: General comments

1 – Qualcomm CDMA Technologies

The WI scope should be realistic considering the amount of time spent and several rounds of down-scoping needed in Rel-16. The priority for Rel-16 enhancements should be for features which have seen some interest/traction already.

2 – Futurewei Technologies

Mobility enhancement in Rel-18 should focus on maintaining user experience during mobility events, especially for FR2 considering its volatile channel conditions.

Avoiding invoking L3 handover procedure (for security key/context change and PDCP entity re-establishment) is more effective than reducing transition time of L3 handover procedure, when it comes to maintaining user experience. CA/DC enhancement for FR2 with multiple configured, fast activated/switched connections should also be considered for mobility enhancement.

3 – InterDigital France R&D

Considering the wide range of proposals for mobility enhancements, the WI scope should prioritize enhancements which have were initially considered for previous releases (i.e. Rel16/17), or which were discussed during the design of Rel16/17 features (e.g. CHO), but were excluded due to time constraints.

4 – China Telecommunications

In our view, mobility enhancement is one of the essential topics for Rel-18 and should be handled with high priority. It is crucial to enhance current mobility procedures to provide consistent high data rate with low latency performance.

5 – vivo Mobile Communication Co.

Considering multiple mobility mechanisms have been specified in Rel-15/16/17 and the deployment timeline for Rel-18, Mobility enhancement in Rel-18 should focus on the issues in real 5G deployment, e.g. mobility performance enhancement for dense network like in FR2.

6 – MediaTek Inc.

In Rel-18, we may **focus on mobility in FR2, but define generic enhancements**. We believe that the main goal for mobility enhancement is to **reduce latency and interruption in mobility procedures**, which become more significant issues in FR2, where more frequent and unreliable mobility events are expected. The latency and interruption may be contributed by target cell preparation, time tracking for target cell/TRP, RACH, etc. Mobility failure also introduces long interruption. Different mobility enhancements may be introduced to reduce each of these factors.

7 – Samsung Research America

For Rel-18 mobility enhancements, we agree to prioritize the three interested areas introduced in the clause 2.2, 2.3 and 2.4.

We have assumed that the L1/L2 mobility enhancements are required to extend the L1/L2 inter-cell beam management from Rel-17 NR feMIMO.

Hence, we may need to discuss whether to have two separate WIs on L1/L2 mobility enhancements and others (i.e. DAPS/CHO enhancements & FR2 specific enhancements), respectively.

8 – HuaWei Technologies Co.

There are various aspects proposed in mobility area, in general we see mobility is one important topic worth further enhancements in Rel-18, but on the other hand we also think that the scope should not be expanded too much. Our main interested areas are:

- L1/L2 mobility for standalone and multi-carrier deployment

- limited enhancements for DAPS/CHO improvements, which is seen essential.

9 – SoftBank Corp.

Generally speaking, we appreciate the activities to make FR2 more useful, and mobility issue as well

10 – Intel Corporation (UK) Ltd

In Rel-16, to reduce the latency and improve the reliability during mobility, DAPS handover and Conditional PCell/PScell change were introduced. However there are some limitations:

- For new services, e.g. XR, 4K/8K video and cloud gaming, etc, the packet delay, throughput requirement is stringent. The network needs to guarantee the low interruption and high data rate even for handover case in order ensure the good user experience. Normally CA/DC and high frequency are deployed to provide additional capacity. Therefore low interruption handover is important for CA/DC and high frequency scenario. However:

o Rel-16 DAPS handover requires simultaneous operation between source and target cell which is quite challenging in implementation and not feasible for FR2-FR2;

o Rel-16 DAPS handover cannot support consistent data rate with low interruption (e.g. XR requirement): Data rate is decreased during DAPS handover due to release of CA, DC and without simultaneous UL data transmission;

o Handover Failure Ratio may be increased since Rel-16 DAPS cannot work together with CA, DC, EHC, UDC, and CHO/CPC and the source has to release the configuration, introducing additional delay, before sending HO command;

o There is currently no solution to reduce the interruption caused by the switching of SCG, or between MCG and SCG since Rel-16 DAPS is not applied for it;

- to support URLLC services, low interruption and high reliability handover is need. However:

o In Rel-16 DAPS can only reduce the interruption, and CHO can only improve the reliability;

- In addition, “handover between nodes with different releases” will be more popular when NPN is used widely. However:

o Lossless handover cannot be guaranteed for the handover between the nodes with different release;

We consider following scenarios are important and should be considered in Rel-18:

- Scenario 1: Mobility enhancements on FR2, especially to enable low interruption for XR, 4k/8k, cloud gaming, etc new services;

- Scenario 2: To support consistent data rate with low interruption during handover for XR, 4k/8k, cloud gaming, etc new services;

- Scenario 3: To support low interruption + reliability simultaneously during handover for URLLC services;
- Scenario 4: Low interruption upon switching of SCG, switching between MCG and SCG, etc for XR, 4k/8k, cloud gaming, etc new services;
- Scenario 5: support lossless HO and delta signalling for HO between nodes with different releases, especially for NPN scenarios;

11 – Guangdong OPPO Mobile Telecom.

For R18 mobility enhancement work, the WI scope should focus on improving mobility efficiency especially in FR2 deployments by studying the L1/L2 mobility. And the RACH-less HO as well as MBB for interruption time reduction can also be considered for FR2 case.

12 – China Mobile Com. Corporation

Mobility enhancement is one of essential aspects in Rel-18. Although lots of potential topics are identified, this WI should focus on some selected topics to provide high reliability as well as low interruption. Considering the potential commercial deployment, we should prioritize features with less UE complexity.

13 – NEC Corporation

Mobility performance improvement is essential for many 5G services and scenarios, and in Rel-16/Rel-17 discussion, there were initial some discussion on this already. We support to consider high priority for this topic.

14 – Beijing Xiaomi Mobile Software

Mobility is one of the key performance in NR. We agree further enhancement is needed. However, we think the scope should be well discussed. Enhancement based on R17 features should be prioritized, e.g. CHO, DAPS, L1/L2. Any new solution should be justified with essential requirement.

15 – Lenovo (Beijing) Ltd

According to the contribution for mobility submitted for RWS for Rel-18, there are main impacts on RAN2. Therefore, this topic can be led by RAN2. and other group e.g RAN1, RAN3, RAN4 should be involved as well. We have interests in L1/L2 mobility enhancements, DAPS/CHO/CPAC enhancement and FR2 specific enhancement.

16 – ZTE Corporation

Mobility is one of the most important topics in wireless communication system. Although we have enhancement on mobility aspect every release, new requirements and challenges can always be seen from the market. In Rel-18, we think further enhancement on mobility is still needed, and we should mainly focus on the challenges from FR2 (e.g. improve robustness and interruption in FR2 mobility) and new services (AR/VR) (e.g. avoid throughput gap during mobility).

17 – KDDI Corporation

1. We are supportive to enhance L1/L2 mobility from Rel-17 to reduce L3 mobility and RRC signaling.
2. We think it's better to focus solutions work for FR2 secondary cell mobility rather than Primary cell mobility. We also think that those solutions beneficial for Secondary cell are not DAPS/CHO enhancement but DC/CA enhancement.

18 – Spreadtrum Communications

In the topic of mobility enhancement, the Rel-18 scope should prioritize enhancements on the leftover of the previous release, such as DAPS for FR2 to FR2, L1L2 based inter cell mobility, combination of DAPS and CHO.

19 – China Unicom

In general, we think FR2 band is critical for operator for commercial 5G advanced network. When considering the potential objectives, we prioritized the following topics:

- L1/L2 mobility for FR1 and FR2 MR-CA scenario
- CHO and DAPS enhancement
- Others mobility enhancement, we highlight mobility enhancement for 5G RAN sharing

20 – VODAFONE Group Plc

We are supportive of improvements e.g. that allow Guaranteed Bit Rate services or ”bounded low latency” services to be delivered consistently at cell and beam change.

There appear to be many candidate features, many of which have been studied in earlier releases but which have run out of time to specify. Selecting promising features from those that have already been studied may be a way to optimise use of R18 time.

21 – LG Electronics France

We think mobility enhancement is one of key enhancements for Rel-18, given increasingly stringent mobility requirements due to XR use cases and FR2 deployments. The three enhancement areas as suggested in this agenda (2.2 to 2.4) can be one potential categorization we can take as baseline.

22 – FGI

We support the mobility enhancement to be studied in Rel-18. The objective including 0 ms interruption and reliability are essential, which is also beneficial for new applications such as XR. We can consider to study the leftover from Rel-15/16/17, L1/L2 inter-cell mobility, DAPS/CHO enhancement, and FR2 enhancement.

2.2 L1/L2 mobility enhancements

Companies are invited to provide your detailed proposals on the main targets and motivation to support L1/L2 mobility.

Feedback Form 2: Detailed proposals on the main targets and motivation to support L1/L2 mobility

1 – Ericsson LM

We support this objective and think this is the most important objective in the mobility area. It was part of the Rel-17 MIMO WI but due to lack of time it was down-scoped. We think we should have this objective:

Introduce L1/L2-centric mobility to trigger serving cell change (among preconfigured serving cells) and reduce the need for L3 mobility (RAN2, RAN1, RAN3,RAN4)

2 – Qualcomm CDMA Technologies

We also support this objective and consider it a high priority. It should be applicable to change of any SpCell and SCell.

3 – Futurewei Technologies

L1/L2 mobility should target at scenarios where security key/context update is not needed. It is more suitable for intra-CU cell change, inter-cell mTRP change, or fast activation/switch among multiple configured cells for CA/DC deployment in FR2.

4 – InterDigital France R&D

L1/L2 based mobility should be supported, since this was initially part of Rel17 MIMO WI but was not included as part of Rel17 finally.

5 – Apple Hungary Kft.

We see that L1/L2 mobility as the key component of the mobility enhancements for Rel-18. FR2 enhancements (which are also under discussion in this same item) in mobility have the potential to be heavily beam based and for us it's logical next step to design "beam-based" mobility and L2/L1 would be a better place to handle such. We also see that the Rel-18 FeMIMO would feed into this from RAN1 and a good level of inter/intra-node (CU/DU) signaling co-ordination would be required from RAN3. We see RAN2 driving this topic with requests to RAN1/3/4 for their in-feeds to make a set of mobility enhancements that close in towards a full-fledged 0ms interruption in mobility in FR2. We also see that the same framework would be used for FR1 as well.

6 – China Telecommunications

We support this objective, and we propose to specify L1/L2 based inter-cell mobility solutions for intra-DU and inter-DU(intra-CU) cases in multiple scenarios, such as NR SA, CA and MR-DC. For inter-CU use case, as there may be the impact of inter-cell asynchrony, it can be considered as low priority in R18.

7 – vivo Mobile Communication Co.

We also support this objective and consider it should be high priority. L1/L2 based mobility with serving cell change, which was down scoped during Rel-17 should be considered here. Meanwhile, we think mobility based on DL-centric and UL-centric measurement, measurement and corresponding report for both synchronized and non-synchronized scenarios should be considered. Regarding scenarios, we could firstly focus on intra-DU case, inter-/intra-frequency.

8 – MediaTek Inc.

For L1/L2 mobility enhancements, we have the following proposals:

- **Extended scenarios for (Rel-17) inter-cell beam management:** Extend inter-cell indication based on Rel-17 unified TCI framework to allowing UE to transmit or receive non-UE-dedicated channels/signals of non-serving cell, and enhancement to beam measurement/reporting on non-serving cell. Inter-frequency scenario for inter-cell BM should be also considered. We may also investigate the interaction of inter-cell BM and RRC-based handover.

- **UE-initiated beam selection:** For L1/L2 mobility across TRPs, mobility failure may happen due to failed beam report/indication to/from serving TRP. This proposal allows UE to indicate its preferred beam towards a (good) neighbor TRP, so as to resolve the robustness issue.

- If L1/L2 mobility beyond multi-TRP scenario is to be supported, two additional proposals may also be considered: **mobility between configured cells** and **TA acquisition optimization**. We think these proposals also work for RRC-based mobility; please see descriptions in Sec. 2.5.

9 – Samsung Research America

We would like to propose with the detailed motivation:

1) Specify the L1/L2 based inter-cell mobility framework to be supported in inter-gNB as well as intra-gNB intra-/inter-DU deployments

User plane data handling and inter-node/ F1 and Xn signaling for L1/L2 based inter-cell mobility considering each DU has own layer 2 protocol stack. Reducing the interruption time when the random access toward the target cell upon L1/L2 based inter-cell mobility is required.

2) Identify and Specify features to facilitate L1 measurement/ reporting and triggering of L1/L2 based inter-cell mobility

L1 measurement/ reporting mechanism for inter-cell mTRP is the baseline with enhancements to support inter-frequency operation e.g. measurement gap, etc.

Identify and specify features to facility beam indication for L1/L2 based inter-cell mobility based on the unified TCI framework introduced in Rel-17, and including support of multiple TA values

10 – ZTE Corporation

In L3 triggered handover, the “timer to trigger” and “hysteresis” will be used to delay the triggering of measurement report and avoid the ping-pong HO. However, in FR2, since the radio condition may change rapidly, the L3 triggered HO seems too slow for FR2 mobility in some cases. Therefore, to improve the mobility performance in FR2, L1/L2 triggered mobility seems helpful as a complementary feature to the normal HO. However, considering the requirement to act fast on the L1/L2 triggered mobility and the potential ping-pong issue, the study on L1/L2 triggered HO should focus on the scenarios where only the change of L1/L2-low configuration (i.e. PHY, MAC, FFS on RLC) is required during the mobility. For example, for the mobility within one DU or CU, where security key change is not needed, radio bearer level configuration can be reused, path switch and data forwarding are not required.

Then, regarding RAN1-related aspect, we identify that there may be some leftover issues of Scenario-1 (inter-cell beam management) from Rel-17, like UE-initialized L1/L2 reporting/handover, flexible measurement (e.g., for aperiodic RS), and increase number of Tx beam to be reported and number of one TRPs with different PCIs to be measured.

11 – Guangdong OPPO Mobile Telecom.

For L1/L2 mobility, the inter-cell mTRP scenario should be studied in R18 mobility enhancement to extend the work of R17 inter-cell beam management.

12 – Intel Corporation (UK) Ltd

In our view it would be beneficial to develop a more general framework for fast and low interruption mobility that is based on the UE being provided with a preconfigured target/candidate cell (group) configuration, and then the UE will do the switching (e.g. bi-direction) based on network request (e.g. L1, L2 or RRC signalling) or a preconfigured condition. It can reduce the latency, and also improve the reliability.

It would be good to use this framework to cover multiple scenarios. The scenarios we think should be addressed in Rel-18 are scenario 1 and scenario 4 listed above, to be specific:

- Scenario 1: mobility enhancements on FR2, including intra-DU, inter-DU case;
- Scenario 4: Low interruption upon switching of PCell, switching of PSCell, switching between sPCell and Scell, switching between Pcell and PSCell, etc;

The name of "L1/L2 based mobility" is too limited, and implies the solution discussed in Rel-17 under FeMIMO. We would prefer to have a more general name "fast cell group switching" for the discussion in Rel-18 to enable a more open discussion of potential solutions. We suggest the following objectives:

- **Objective:**
- **Specify solution for fast cell group switching (L1/L2 or L3) without the need of simultaneous transmission/reception on the 2 cell groups, i.e. only one cell group activated at a time;**
- **Following scenarios are considered:**
  - **Switching of PCell;**
  - **Switching of PSCell;**
  - **Switching between sPCell and SCell;**
  - **Switching between PCell and PSCell;**
  - **Intra/inter-DU;**
  - **More than two cell groups, e.g. three;**

13 – SHARP Corporation

We are supportive of working on L1/L2 mobility in Rel-18 which was deprioritized from Rel-17 due to the lack of time. The objectives in Rel-17 FeMIMO WI could be the starting point when drafting WID.

14 – HuaWei Technologies Co.

We think this is a leftover from Rel-17 due to time limitation, and we support this direction in general. The L1/L2 mobility can satisfy smooth experience in terms of high data rate and very low interruption, and it does not require higher RF UE capabilities. DAPS with CA may also achieve 0 ms, but it requires much higher RF UE capabilities up to 4 legs. Thus we think L1/L2 mobility is a more practical direction for regular UEs with only 2Tx.

In addition we also think this solution is applicable for both standalone and multi-carrier deployment including inter-frequency case, targeting on intra-DU and intra-CU inter-DU cases. We also think this applies to both FR1 and FR2, and thus there is also a need to enhance the beam management.

In summary we think to specify the L1/L2 mobility, we should discuss the following for the above scenarios:

- **Pre-configuration and maintenance of configuration for candidate serving cells;**
- **Dynamic switch mechanism among the cells;**
- **L1 measurement and beam management enhancements.**

15 – ASUSTEK COMPUTER (SHANGHAI)

We also support L1/L2-centric mobility enhancements at least for PSCell change and think intra-DU, inter-DU, synchronized, and non-synchronized cases should be studied.

16 – China Mobile Com. Corporation

We in general support L1/L2 mobility for pre-configured cells which is a key topic for Rel-18 Mobility enhancement. Considering the time limit, RAN2 firstly focuses on scenarios like inter-DU intra-CU and intra DU for both FR1 and FR2.

17 – NEC Corporation

For this objective, the remaining issues from Rel-17 MIMO need to be handled. In our understanding, the following objectives can be considered:

1. Support serving cell change as a result of beam indication of a neighboring cell beam
2. Support Inter-DU operations for L1/L2 mobility enhancements in RAN3

18 – Beijing Xiaomi Mobile Software

While using the Rel-17 work as the bases, the Rel-18 scope of "Layer 1/layer 2 based inter cell mobility" should include more scenarios as follows:

Ø To support Scenario 2: L1L2 mobility model (i.e. with serving cell change) as defined in RAN2#114e

o Support both intra-DU and inter-DU

o Support both intra-frequency and inter-frequency

Ø To extend the use cases of Scenario 1: Inter-cell multi-TRP-like model as defined in RAN2#114e

o Support inter-DU

o Support inter-frequency

19 – NTT DOCOMO INC.

We support L1/L2 inter-cell mobility with serving cell change based on Rel-17 progress. More realistic assumption should be considered, e.g., different TA assumption for different PCIs for inter cell mobility. To realize such mobility, RRC pre-configuration of multiple intra-frequency candidate cells' ServingCell-Config configurations with different PCIs should be supported at least for SpCell. And SpCell change to a candidate cell with different PCI can be performed via L1/L2 signaling. To avoid ping-pong effect brought by L1/L2 signaling mobility, the enhanced beam measurement/reporting method considering L3 measurements can be discussed.

20 – Lenovo (Beijing) Ltd

The scenario for L1/L2 mobility model with serving cell change is not supported in Rel-17 because of the limited time. L1/L2 based serving cell change can reduce the mobility latency, especially for FR2. Therefore, L1/L2 centric inter-cell mobility should be specified in Rel-18. In addition, Intra-DU can be prioritized over Inter-DU with Intra-CU. Intra-frequency can be prioritized over Inter-frequency.

21 – CATT

We support this area. In Rel-17 we are specifying L1/L2 mobility with some restriction to applicable scenarios. In Rel-18 we should extend it. For example, to allow serving cell change is one of the important extra here. Depending on what's finally done in R17, we could also further work on aspects such as beam measurement and report, timing management, or other aspects.

22 – KDDI Corporation

In general, we have similar views as above companies, specifically we have the following views.

1. Introduce L1/L2-centric mobility to trigger serving cell change
2. L1/L2-centric mobility can be applied to also inter-gNB as well as intra gNB intra-/inter-DU deployments
3. Potential enhancement for conditional L1/L2 mobility

23 – Nokia Corporation

We see benefits from having robust L1/L2 mobility with low latency and interruption time considering both mTRP operation and serving cell change in intra-DU and inter-DU scenarios. L1 mobility can provide low latency and interruption time and improved robustness via UE measurement assistance to provide overall system gains. This likely requires work across all WGs, especially in RAN2 and RAN4. If needed, a study phase could be considered for the work to focus the work on most relevant scenarios.

24 – Spreadtrum Communications

Since L1/L2 based inter-cell mobility in mobility scenario is the leftover of Rel-17 and it is beneficial to achieve fast cell change, it should be highly prioritized for Rel-18. It should consider to be limited to the scenario without the issue of security key update, such as intra-CU scenario. In order to maximize the gain of L1/L2 based inter-cell mobility, RACH-less should be supported at the same time.

25 – China Unicom

L1/L2 mobility is a high priority objective for R18. When considering the specification complexity and realistic network requirements, we think intra-CU L1/L2 mobility enhancement in R18 is sufficient for most scenarios, and CA scenarios can be taken high priority. Thus we suggest to have the below objectives:

Specific L1/L2 mobility in NR-CA scenarios with intra-CU (inter/intra-DU) cell changing.

- Preconfigured configurations of candidate cells by L3 signalling

- L1/L2 or L3 measurement

- L1/L2 dynamic downlink/uplink switching with signalling like SSB or CSI-RS signaling

- Dynamic switching between Pcell and Scell in NR-CA

- Aligning with conventional L3 handover procedures if time allows, e.g. RRM and RLF.

26 – LG Electronics France

We support this direction of enhancements. We understand that enhancement is starting from the objective excluded from Rel-17 feMIMO.

For this direction, we can consider the following enhancements:

- Dynamic mobility triggering based on L1/L2 signaling
- Management of TRP/cell candidates
- Robustness via RLM enhancement based on inter-cell TRPs
- Individual TA management for inter-cell TRPs

27 – FGI

We support L1/L2 based inter-cell mobility to be studied in Rel-18. However, in Rel-18, we are not sure which WID/SID (e.g., mobility enhancement, feMIMO) to include this L1/L2 based inter-cell mobility topic. Several potential scenarios such as inter-DU L1/L2 mobility, inter-CU L1/L2 mobility, RRC-involved L1/L2 mobility, measurement and report considering different mobility situations (e.g., high mobility, medium mobility, low mobility), and inter-cell beam management within the unified TCI framework can be further down-selected.

28 – AT&T

We think this is a high priority topic that should be considered in Rel. 18. This was considered in Rel. 17 FeMIMO and was downscoped. In Rel. 18, L1/L2 inter-cell mobility should be considered with serving cell change.

2.3 DAPS/CHO enhancements

Companies are invited to provide your detailed proposals on the main targets and motivation to support potential DAPS/CHO enhancements.

Feedback Form 3: Detailed proposals on the main targets and motivation to support potential DAPS/CHO enhancements

1 – Ericsson LM

When DAPS and CHO were added in Rel-16, there were several restrictions added. For example, DAPS and CHO cannot work together:

1. a DAPS handover cannot be conditionally executed.
2. if a handover fails the UE will trigger re-establishment. But if the UE has a CHO configured, the UE can instead of performing re-establishment execute that CHO. However, this does not work for a DAPS handover. We believe this limitation is unnecessary and, in a sense, artificial.

We would therefore like to allow:

- Conditional execution of DAPS handovers
- Keep conditional reconfigurations during execution of DAPS handover in order to trigger CHO at DAPS handover failure

Carrier Aggregation cannot be used during a DAPS handover. That means that a UE, e.g. a UE with XR or URLLC services, will lose all cells except the PCell at DAPS handover, which greatly would reduce the UEs throughput. And without CA/DC, PDCP duplication can also not be used. So, even if the DAPS handover has no air-interface interruptions, the actual interruption perceived on application layer will be large. We would like to address this restriction by this objective:

- Introduce solutions to reduce mobility interruption time in MR-DC scenarios, such as execution of DAPS while keeping CA/DC/PDCP duplication configured (RAN2, RAN3)

If time allows, we could also consider these CHO enhancements:

- Support for CHO with conditional MR-DC setup
- Support for RRC_INACTIVE
- Enhancements to execution conditions.

2 – Qualcomm CDMA Technologies

Rel-16 DAPS has been a very complicated feature. Further enhancements, especially considering more than 2 active legs, e.g. DAPS for SN, require very high UE and NW complexity and also RAN4 time. Similar comment also applies to CA, MIMO, and mTRP during DAPS HO. The only Rel-16 leftover with minimal RAN2 impact is DAPS for FR2, which we support. For DAPS + CHO, the benefit, especially using DAPS upon CHO trigger is not clear. Other CHO enhancements seem more beneficial and practical and require less specification work, for example CHO + CPC and SCG in CHO (if not done in Rel-17).

3 – Futurewei Technologies

DAPS was specified for 0 ms interruption time during HO. It is not clear that use cases targeted for Rel-18, such as FR2 deployment and XR applications, can benefit much from 0 ms interruption time.

4 – InterDigital France R&D

We prefer focusing efforts on enhancing CHO, since further enhancements to DAPS may have significant complexity, and we believe robustness enhancements should take priority over interruption time enhancements.

Currently, CHO and CPC cannot be configured simultaneously. This limits the usefulness of these two features when MR-DC is configured. If there is not sufficient time to discuss this in Rel17, Rel18 should specify mechanisms for CHO and CPC to be configured simultaneously.

Also, though the normal assumption is that CHO is configured based on earlier measurement configurations, it is not possible to guarantee that the chosen that the chosen CHO candidate is the best for the UE at that time. It would therefore be beneficial to prevent such scenario, or recover from it as soon as possible, by considering the quality of non-candidate cells when checking the CHO triggering conditions, including measurement reports in the CHO complete message, etc.

Finally, another issue with CHO is related to RLF while monitoring CHO triggering conditions. In Rel-16/17 the UE performs CHO towards a cell if re-selection following RLF results in selection of one of the configured CHO targets. Normal re-establishment is performed otherwise. However, in this case, it is possible that the radio conditions towards one of the CHO candidates was good enough even if it was not selected for cell reselection. Performing normal re-establishment in this case could be detrimental, for example, in scenarios where the concerned entity is an IAB node and a cascade of re-establishments is triggered as a result. It would therefore be beneficial to consider prioritization of CHO candidate cells for re-selection in case of RLF.

5 – Apple Hungary Kft.

6 – China Telecommunications

In R16/R17, 3GPP has introduced CHO/CPAC to increase the robustness and DAPS HO to achieve 0ms user plane interruption during mobility procedures, however the above technologies can only be used in limited use cases.

For many new emerging applications (such as XR, 4K/8K video, cloud gaming, etc…) requiring high data rate with low latency, further extensions should be explored to support consistent mobility performance.

Therefore, we support to enhance DAPS and CHO approaches on the following aspects:

For DAPS related enhancement, support such as DAPS + DC/CA, DAPS+CHO/CPAC.

For CHO related enhancement, support such as NG-based CHO, inter-RAT CHO, CHO+CPAC.

7 – vivo Mobile Communication Co.

- We are not sure whether DAPS enhancement is needed if L1/L2 based inter-cell mobility has been specified, considering the less chance for the deployment of DAPS.
- Regarding CHO enh., we think CHO enhancement in FR2 and CHO+CPAC (if not supported in Rel-17) could be considered to improve the mobility robustness in real 5G deployment.

8 – MediaTek Inc.

For DAPS/CHO enhancements, we have the following proposals:

- **Conditional DAPS HO (CHO+DAPS):** CHO execution is a DAPS HO, so as to achieve robust handover with near 0ms interruption.
- **DAPS for FR2-to-FR2 mobility:** This is not supported in Rel-16, and we can investigate the feasibility for some UEs (e.g. UEs with two panels) in Rel-18.

9 – Samsung Research America

We would like to propose with the detailed motivation:

1) Specify to simultaneously configure DAPS HO and CHO for multiple purposes

In Rel-16, DAPS HO and CHO has been specified to achieve 0 ms interruption time and higher reliability, respectively. However, two features are not allowed to be configured simultaneously. With simultaneous configuration on the features, better experience can be clearly provided.

2) Specify to enhance SN mobility, e.g. DAPS-like SCG change

Since high and stable data rate has been requested for XR services, consistent QoS should be ensured even upon SN mobility. For instance, upon SN mobility, the service interruption in SN side would result in lower and unstable data rate. Then, it is beneficial to perform SCG change with simultaneous connectivity with source SN and target SN. For less UE complexity, uplink TX switching can be considered.

10 – ZTE Corporation

<u>DAPS+CA/DC</u>

For the DAPS HO with DC, considering maintaining the connection with source MN/SN and target MN/SN simultaneously (i.e. four connections) will lead to lots of complexity in both standardization and implementation, we think such mechanism shall not be supported and the maximum number of active connection (i.e. cell group) shall still be limited to two. However, although we can not activate four connections simultaneously, some enhancement can still be considered to allow the configuration of suspended/deactivated SCG in HO command. With the configuration of suspended/deactivated SCG, the SCG transmission can be activated immediately after DAPS HO to reduce the interruption time.

For the DAPS with CA, at least, the similar signaling optimization can be considered to allow the configuration of suspended/deactivated SCells during DAPS HO, and the suspended/deactivated SCell shall not consume any UE capability, which is similar as the enhancement to DAPS + DC mentioned above. In addition, for DAPS+CA, one further step can be made to discuss whether active SCell can be maintained

during DAPS HO. Since multiple active UL may cause UL power reduction, which may lead to negative impact on the mobility robustness, we think more study is needed to understand the overall picture of DAPS with CA.

In general, we think the following enhancements can be considered for DAPS+CA/DC.

- Signaling optimization to enable the configuration of suspended/deactivated SCells/SCGs during DAPS HO. With which, the CA/DC can be resumed in a more efficient way after DAPS HO.
  - The suspended/deactivated SCells/SCGs will not consume UE capability during DAPS HO.
- Study the feasibility to maintain the CA SCell transmission in both source side and target side during DAPS HO. Negative impact to mobility robustness shall be avoided.

Other leftover issues for CHO/CPAC

Besides the DAPS+CA/DC enhancement, some Rel-17 leftover issues can be considered as well. :

- Successive CHO (CHO included in the legacy HO command or CHO command)
- Successive CPAC (CPAC included in the legacy PSCell addition/change command)
- NG-based CHO
- Inter-RAT CHO
- CHO/CPAC with inactive (Add CHO/CPAC configuration in the RRC resume)
- Coexistence of CHO and DAPS
- Coexistence of CHO and CPAC

Although we have a long release for Rel-18, it seems we still don't have enough time to address all the left-over issues above and we prefer to prioritize the Inter-RAT CHO, NG-based CHO, CPAC with inactive and coexistence of CHO and DAPS.

11 – HuaWei Technologies Co.

Mobility enhancement should also consider the handover case for inter-gNB scenarios.

1. For MR-DC scenario, we think the existing Rel-17 inter-SN CPC can already support change between SNs. If operators want to support fast SCG change to avoid performance degradation, DAPS+DC is a more straight forward evolution to address the SCG change due to L2 reset/key refresh etc. .

2. For generic inter-gNB handover scenario, data forwarding needs to be improved for E2E latency reduction for DAPS operation, as currently the latency caused by Xn/X2 data forwarding is around 10ms, which is not desirable for URLLC. The main standard efforts would be in RAN3.

3. For CHO enhancements, we think DAPS+CHO may be helpful to support both reliability and 0ms, but this is not seen as high priority. Other than that, we think CHO-specific proposals are still diverging and no significant gains are seen to pursue these proposals. .

Specify DAPS+DC approach to address the fast SCG change for MR-DC scenario.

Specify the dual N3 tunnel approach during the mobility procedure to minimize the network latency caused by Xn/X2 data forwarding, by exploiting the DAPS operation [RAN3-led].

12 – Guangdong OPPO Mobile Telecom.

For DAPS with CA/DC, we agree with the intention on interruption time reduction during handover, while we have some concerns on additional UE complexity, e.g. supporting 3 or 4 legs during handover.

For the miscellaneous CHO enhancement, i.e. CHO in RRC_INACTIVE, CHO condition enhancement, CHO over NG interface, etc., we think studies are needed to reach consensus on the gain of each optimization.

13 – Intel Corporation (UK) Ltd

As mentioned above, there are some limitations on Rel-16 DAPS/CHO solutions:

- DAPS handover cannot support consistent data rate with low interruption (e.g. XR requirement): Data rate is decreased during DAPS handover due to release of CA, DC and without simultaneous UL data transmission;
- Handover Failure Ratio may be increased since DAPS cannot work together with CA,

DC, EHC, UDC, and CHO/CPC and the source has to release the configuration, introducing additional delay, before sending HO command;

DAPS+CA/DC can be used for scenario 2. DAPS+CA will not add additional UE requirement on how many legs the UE shall support, compared with DAPS (2 legs). For DAPS+DC, 3 or 4 legs are required depend on the use cases. If the UE can only support 3 legs, then we can consider the scenario that MCG changes without SCG change, and/or SCG change without MSG change. The scenario 2 should target to high end UEs that who can support XR;

- Scenario 2: To support consistent data rate with low interruption during handover;

DPAS+CHO can be used for scenario 3 as below, i.e. reduce the handover latency and support high reliability simultaneously.

- Scenario 3: To support low interruption + reliability simultaneously during handover;

Therefore we consider following objective for Rel-18:

- **Objective: To improve the reliability and reduce the latency during handover, specify the support of DAPS+CHO;**
- **Objective: To support consistent data rate with low interruption during handover:**
  - o **Specify the support of DAPS+CA and DAPS+DC;**
  - o **Specify the support of simultaneous UL PUSCH transmission for user data;**

14 – SHARP Corporation

DAPS is introduced in Rel-16. The current DAPS doesn't support CA and DC. Therefore, if SCG is configured to UE before DAPS HO, NW needs to release the configuration of CA/DC and may need to modify/release SCG DRBs. This causes the performance degradation in exchange for the almost zero interruption time. Therefore, we think the support of the DAPS with CA/DC should be discussed in Rel-18.

15 – China Mobile Com. Corporation

CHO/CPAC and DAPS are introduced for robustness and 0ms interruption in the previous release, respectively. Currently, CHO+DAPS is not supported due to the lack of time in Rel-16, but some companies express their interests in this combination. On the other hand, during the latest RAN2#115e-meeting, it was clarified that CHO and MRDC cannot be supported simultaneously. To meet higher performance requirements for new scenarios and applications like XR, we support CHO+DAPS, CHO+MRDC (if not discussed in Rel-17). As for other DAPS enhancement, DAPS operating in the DCCA scenario will introduce significant complexity and require high UE capability which should be deprioritized.

16 – NEC Corporation

We support enhancement on this aspect. During Rel-16 WI on mobility enhancement, there were several issues/enhancements not supported, which we suggest to continue working on them. Two enhancements we would like to have in Rel-18 are:

1. Currently, simultaneous configuration of DAPS and CHO is not supported, however there is benefit to support it as it can further improve mobility performance.

2. When DAPS is performed, only Pcell of the source and Pcell of the target can be used, which results in very low data rate during handover and long latency of DC usage after handover. We think there is need to enhance this by allowing CA/DC for DAPS.

17 – Beijing Xiaomi Mobile Software

We see following enhancements is beneficial.

1. CHO + DAPS. High reliability and 0 interruption is enabled, which is important in new services, e.g. XR.

2. CHO with multiple conditions. Currently, only one condition set is used to trigger CHO. However, this condition may not result in optimal performance from UE point of view. We think UE should be allowed to select the condition based on local information, e.g. mobility state, traffic characteristics or UE preference, if multiple conditions are provided by NW.

18 – Lenovo (Beijing) Ltd

DAPS Handover

According to the Rel-16 specification, only PCell is kept during DAPS handover. All other serving cells and multi-DCI/single-DCI based multi-TRP are released by the network before the handover command is sent to the UE. The performance of non-DAPS DRBs e.g. bit rate and reliability will be degraded during DAPS handover to ensure almost zero interruption time of DAPS DRBs. In other words, the overall bit rate of the UE is decreased during DAPS handover. Therefore, **DAPS supporting DC/CA should be supported in Rel-18**.

Coexistence of CHO and DAPS

Both CHO and DAPS were specified in Rel-16. However, only one of DAPS HO and CHO can be configured to UE at a given time according to the current specification to make it simpler. Therefore, CHO recovery cannot be applied after DAPS handover fails in legacy, which will result in UP interruption. As discussed above, the requirement of some services is high reliability and zero interruption time. Therefore, there we see some benefit in supporting the coexistence of CHO and DAPS for Rel-18. Therefore, **coexistence of CHO and DAPS should be supported in Rel-18**.

19 – CATT

We supprot this area. But the detailed work scope should be managed so that it is feasiable from time/effort point of view. In our view, the following should be considered first

a)DAPS+DC/CA, which extend DAPS to wider use cases, especially considering multi frequency layer deployment for many operators around the world,

b) CHO + DAPS, CHO+MRDC are directions for CHO further extension.

Then we could also consider some other enhancements if time allows, e.g., CPAC+CHO, if not part of Rel-17, enhancements to data forwarding during HO, etc.

Esentially we'd prefer we discuss the scope taking into account what's the urgent scenarios from mid and long term deployment point of view.

20 – KDDI Corporation

We are not so motivated to promote additional CHO/DAPS solutions to Primary cell mobility, but we are open to explore something beneficial to Secondary cell mobility.

21 – Nokia Corporation

We see several possible operational enhancements for DAPS/CHO procedures.

General DAPS related enhancements:

- Allow conditional execution of DAPS handover (inter-working of CHO and DAPS) to achieve high reliability and reduce the outage caused by bothfailed and successful handovers.
- Allow CA/DC to operate with DAPS to achieve high throughput during the handover which is necessary for some services (URLLC or XR).Other enhancements that can be considered if time allows:
  - Reduce UL interruption time in DAPS for the cases when no UL data is pending at the UL switch.

General CHO related enhancements:

- Enhancement for random access (increase the likelihood of CFRA at CHO execution) and Xn signalling.
- CHO enhancements in MR-DC and NR-DC:
  - Allow conditional PSCell access for conditional inter-MN handover with SCG (assuming that CHO with SCG will be supported in Rel. 17, otherwise CHO with SCG to be supported in Rel. 18).
  - Inter-working of CHO and CPAC such that they can operate simultaneously (if not defined in MR-DC Rel. 17)

22 – LG Uplus

We have similar view with Huawei. DAPS+DC is prioritized in order to reduce latency during HO with DC. N3 tunneling enhancement is important. Further, RACH-less in HO without SCG change need to be investigated.

23 – Spreadtrum Communications

Currently, DAPS does not support CA. The Scell would be released when DAPS is performed, which will have negative effect on transmission throughput. Along with the development on service requirement, it is significant to study the potential enhancement on CA DAPS.

In Rel-16, CHO and DAPS can be configured simultaneously. In order to improve reliability and realize 0ms interruption, we propose to support CHO + DAPS.

24 – China Unicom

As we commented in general part, the following DAPS/CHO objectives can be highlighted:

- Specify and study solution(s) to support CHO aligned with CPAC.

- Specify and study solution(s) to support CHO and/or CPAC aligned with DAPS

- Specify and study solution(s) to enhance CHO with NG interface or/and support inter-RAT CHO (low priority if time allows)

25 – LG Electronics France

We support this direction of enhancements. In particular, we think the following enhancements are beneficial:

- Support for CHO+CPC for faster CA/DC setup after CHO
- CPAC enhancements to increase SCG robustness by keeping CPAC configuration
- DAPS with CA/DC to increase data rate during DAPS
- FR2-FR2 support for DAPS for wider applicability of DAPS

26 – FGI

We support DAPS/CHO related enhancement in Rel-18. Considering MR-DC deployments, from mobility's perspectives, we can support DAPS + CA, DAPS + DC, CHO with MR-DC, DAPS+CHO for services with high requirements (e.g., data rate, reliability, service continuity). In addition, since FR2 is expected to be deployed, DAPS for FR2-specific enhancement and CHO for FR2-specific enhancement can be further addressed in Rel-18. Other CHO enhancements like the inter-working between CHO and CPAC, fast cell selection using CHO and CHO with fast recovery can also be considered.

2.4 FR2 specific enhancements

Companies are invited to provide your detailed proposals on the main targets and motivation to support potential FR2 specific enhancements.

Feedback Form 4: Detailed proposals on the main targets and motivation to support potential FR2 specific enhancements

1 – Ericsson LM

FR2 mobility is critical. There is lack of FR2 support for DAPS in RAN4. To improve FR2 mobility performance, RAN should consider one of these approaches:

1) Specify requirements for DAPS in FR2

2) Network controlled scheduling allowing for TDM behaviour between source/target during a DAPS handover

3) Make-before-break handover

Also, in particular for FR2 mobility, to allow CHO/CPC within handover/CHO commands would allow that CHO/CPC is configured faster for the UE hence improving robustness.

2 – Qualcomm CDMA Technologies

In addition to DAPS for FR2 mentioned above, it would be good to study and introduce mechanisms to improve FR2 mobility, for example how to reduce HO ping-pong due to beam changes, providing up to date beam information during HO procedure (primarily for inter-DU).

3 – Futurewei Technologies

Inter-cell mTRP change;

DC/CA enhancement for fast activation/switch among multiple configured SCGs;

Security key/context update without releasing SCG and MAC/RLC reset or reestablishment.

4 – InterDigital France R&D

If time permits in the WI, FR2 specific enhancements can be targeted, including DAPS for FR2 or Make-before-break handover.

5 – Apple Hungary Kft.

6 – China Telecommunications

In FR2, users will experience more frequent handovers, the data interruption during the handover procedure will seriously affect users' service experience. However, the DAPS handover for FR2 to FR2 case is not supported in current specification.

We think need to re-consider if the DAPS handover for FR2 to FR2 case can be supported in Rel-18 (e.g. enable RRC-based DAPS handover in FR2 for multiple-panel UE). Other enhancement such as MBB and RACH-less HO, which were specified in LTE but not supported in NR can also be considered.

7 – MediaTek Inc.

We agree that mobility is more challenging in FR2. However, even if some enhancements may be more FR2-oriented, we believe that **mobility enhancements should be applicable in both FR1 and FR2**. The **DAPS for FR2-to-FR2 mobility** described above may be considered as a FR2-specific enhancement.

8 – Samsung Research America

We would like to propose with the detailed motivation:

1) Specify Make-Before-Break (MBB) Handover, as in LTE

From UE requirement perspective, it is expected that it's not easy to support DAPS HO in FR2-to-FR2 Handover. Thus, DAPS HO in FR2-to-FR2 is not feasible in Rel-16.

Even though the gain expected by MBB HO is less than DAPS HO, the MBB HO is a good alternative in complexity aspect.

Furthermore, the current DAPS HO requests high UE requirement for the simultaneous connectivity. Hence, the MBB HO can be a valuable option even for low-capability UEs requiring less interruption time upon Handover.

It is applicable even for FR1 and SN mobility.

2) Specify RACH-less Handover, as in LTE

RACH-less is another solution to minimize the interruption time upon handover. 2-Step RA specified in Rel-16 is also helpful for the goal. However, UE not supporting 2-step RA has no option to minimize the interruption resulting from RA procedure.

It is applicable even for FR1 and SN mobility.

9 – ZTE Corporation

According to current specs, DAPS HO is not supported in FR2 due to the restriction mentioned by RAN4. For the enhancement in Rel-18, now we have two potential solutions on the table:

- MBB+RACH less
- DAPS in FR2

From our perspective, we think complexity has to be taken into account to ensure the feature can be deployed in the market. Considering simultaneous transmission to both source and target is not required in MBB, the MBB+RACH less based solution seems the simple one and we prefer to support the MBB+RACH less in Rel-18.

10 – HuaWei Technologies Co.

FR2-FR2 DAPS can be considered in R18 assuming UE is capable of multi-panel, and the main standard efforts would be in RAN4. We don't see benefit to discuss MBB approach to further fragment the solution, as DAPS can already support UL TDM transmission and the only remaining thing is to specify requirements in RAN4.

Specify FR2-FR2 DAPS for UEs capable of multi-panel support and the work is mainly in RAN4.

11 – Guangdong OPPO Mobile Telecom.

For R18 mobility enhancement, the FR2 specific enhancement should be studied as the first priority, e.g. L1/2 centric mobility.

For DAPS in FR2, we have some concerns on whether it can work since DAPS requires simultaneous connectivity on both source and target cell, and the other interruption time reduction solutions, e.g. MBB and RACH-less HO, we think they can be considered for FR2.

12 – Intel Corporation (UK) Ltd

For FR2 specific enhancements, RACH-less, MBB and fast cell group switching were proposed by companies. We considered fast cell group switching with only one activated cell group at a time can be applied for the FR2 scenario as well as for FR1. We could consider this as a possible 'enhanced Make-before-break solution'. It would be good to have common solution for multiple scenarios, i.e. FR1 and FR2, and therefore we would suggest to only work on fast cell group switching in Rel-18, and not to work on solutions that are specific to FR2 only.

13 – China Mobile Com. Corporation

In addition to inter-cell L1/L2 mobility and Rel-16 leftovers, mobility enhancement especially for FR2 is another important aspect. However, are not sure what kind of RAN2 work should be involved to support DAPS for FR2 since it is more related to UE capability. We deem that one of the issues of FR2 is frequent handovers, and it seems that cascade of cells/antennas could be employed to reduce the number of handovers.

14 – NEC Corporation

FR2 experiences more server mobility performance deterioration than FR1 due to smaller cell coverage. We support to consider mobility enhancement for FR2 in Rel-18, e.g. make before break.

15 – Beijing Xiaomi Mobile Software

We understand the main challenge in FR2 is the low robustness due to rapidly changed radio environment. CHO and L1/L2 mobility enhancement should be enough. Regarding 0 interruption, DAPS could be reused.

16 – Lenovo (Beijing) Ltd

In the current specification, DAPS handover from FR2 to FR2 case is not supported in this release of the specification because it may result in the high complexity of UE. However, some services with high throughput and low delay are popular e.g. 4k/8k TV, online game, and XR/VR according to the market. Therefore, the DAPS handover from FR2 to FR2 case should be supported in Rel-18.

17 – NTT DOCOMO INC.

We are supportive for mobility improvements that makes FR2 more usable. We would like to discuss further about reducing interruption time and improving robustness. (e.g. DAPS HO in FR2) If possible, solution for FR2 should also be available for FR1.
As for CHO, since it has been discussed in both Rel-16 and 17, we would be help to discuss the use cases and the gains sufficiently to avoid over-engineering.

18 – CATT

In our understanding the main challenge for FR2 is the rather small cell size, which requires higher HO frequency. The issue is increased system overhead, as well as higher probaility of HO failure/or interuption. So for this area we prefer to prioritze those possible work that really benfits the performance. Regarding the enhancements we can start with DAPS+CA/DC (DAPS applied to PScell), MBB, RACH-less HO, etc. But it is good to not work on several enhancemnts aiming at the same issues/benefits.

19 – KDDI Corporation

We guess many operators use FR2 as secondary cells, so we believe it's better to focus solutions work for FR2 secondary cell mobility. In that sense, we are supportive to DC/CA enhancement for fast activation/switch among multiple configured SCGs (proposed by Futurewei). It may be similar to Mobility between configured cells (proposed by MediaTek) and also it may be done as a potential enhancement for conditional L1/L2 mobility.

20 – Nokia Corporation

Some mobility procedures are either not specified for FR2 (e.g. DAPS) or could have improved performance (as the mobility requirements for FR2 are quite loose). Enhancements to those would allow better FR2 performance.

- Reduce the handover interruption time in FR2-FR2 handover by defining a make-before-break solution (e.g., DAPS, SAPS, enhanced MBB, etc.)
- Fast cell selection enabled by keeping CHO/CPAC configuration after the cell change, i.e., the time and signaling overhead for the cell preparation is reduced which can improve mobility robustness in case of rapid signal degradations.
- MPE handling in handover procedures, i.e., MPE has not been considered so in mobility.
- Enhanced CHO execution triggering for CFRA and/or multi-panel UEs, i.e., prepare cells on non-serving panel such that they can be used as fallback in case the radio communication cannot be maintained on the serving panel (caused by obstacle/blockage)
- UE beam refinement during cell change/handover execution, i.e., speed up UE beam refinement while reducing signalling overhead.

21 – LG Uplus

We support DAPS in FR2.

22 – Spreadtrum Communications

Currently, DAPS handover for FR2 to FR2 case is not supported. Considering frequent FR2 change happened in FR2 deployment, which will cause negative effect on transmission interruption, it is significant to support DAPS handover for FR2 to FR2. Since FR2 cell usually have a relatively small radius and frequent handover seems inevitable, we should further study on how to reduce the frequency of handover. Other enhancement on beam management for FR2 mobility also should be studied.

23 – China Unicom

We support FR2-FR2 DAPS with multi-TRP/multi-panel in R18, especially for ToB scenarios.

24 – LG Electronics France

In general, we think DAPS/CHO/CPC enhancements are applicable for both FR1 and FR2, and hence capable of addressing FR2-specific issues. We would like avoid developing completely new mobility solutions to avoid further fragmentation of mobility solution space.

Other than those enhancements mentioned above, given that SCG on FR2 would become more interesting, the support for configuring more than two cell groups can be beneficial to exploit SN diversity with the limitation on the number of simultaneously active CGs, e.g., up to two.

25 – FGI

We support FR2-related mobility enhancement in Rel-18. mTRP based fast recovery/failure avoidance and inter-cell and intra-cell beam switching can be further considered.

2.5 Other enhancements

For those proposals which do not belong to any of the above example areas, companies are invited to list here with main targets and motivation explanation.

Feedback Form 5: Other enhancements

1 – Apple Hungary Kft.

2 – China Telecommunications

We observed some other areas related to mobility enhancement discussed in the last R18 workshop:

1. Data forwarding optimization
2. Support inter-RAT PScell change
3. Fast failure detection and recovery
4. Network signaling reduction

Regarding to data forwarding optimization, we think the current data forwarding procedure can be enhanced to ensure data continuity and reduce network latency;

Regarding to support inter-RAT PScell change, as there may be transition from EN-DC to NR-DC (and vice versa) in actual deployment, we think it is worth to be enhanced to reduce data interruption and speed up the transition time.

Regarding to the fast failure detection and recovery, we think the current failure detection mechanism needs to be enhanced to adapt to the rapid change of FR2 channels. Besides, we noticed that some companies proposed to support fast PCell failure recovery form Scell in CA scenario in last R18 workshop contributions, we also feel open to support it in R18.

Regarding to network signaling reduction, frequent signaling interactions between networks may increase complexity and lead to RLF in some case, we noticed that some companies proposed to support UL signal based mobility in last R18 workshop contributions, the UL signal based mobility procedure could potentially reduce measurement reporting overhead and power consumption, we feel open to support it in R18.

3 – vivo Mobile Communication Co.

Considering frequent DL measurement and Handover in dense network, e.g. in case Cell/TRP to UE ratio is high, or high speed scenario, handover robustness need to be enhanced in such deployment. UL signal based L3 mobility should be considered in Rel-18 mobility enhancement. For example, UE only need to send UL signals periodically. Network could perform handover based on UL measurement.

4 – MediaTek Inc.

We also have some proposals that are applicable to FR1 and FR2, and not in any of the above areas:

- **Mobility between configured cells**: Dense deployment in FR2 make a UE more likely to be in overlapped coverage of multiple cells, and switch between the cells. If these cells can keep UE context, and UE can keep configurations or even fine timing of these cells, UE can do fast switching between these configured cells, and thus reduce latency/interruption.

- **TA acquisition optimization:** RACH towards target cell contributes to uncertain long interruption. In Rel-18, we may investigate optimized ways for timing advance acquisition, so as to minimize the need of RACH during handover.

- **Make-before-break:** If DAPS cannot be supported by a UE, we may allow UE to do make-before-break handover, where the UE continues source cell data connection after handover command, until some point before switching to target cell. This interruption can be largely reduced, even not reduced to 0ms.

- **Improvements to handover delay requirements:** Current requirements of handover delay in TS 38.133 may be too long; we may consider improving them with better UE implementation.

- **Early evaluation termination:** Measurement-related actions (e.g. measurement report, RLF declaration) may be too late if UEs perform evaluation according to network configurations. We may solve the problem by UE-initiated early evaluation termination based on measurement results.

5 – HuaWei Technologies Co.

For generic inter-gNB handover scenario, data forwarding needs to be improved for E2E latency reduction for DAPS operation, as currently the latency caused by Xn/X2 data forwarding is around 10ms, which is not desirable for URLLC. The main standard efforts would be in RAN3.

Specify the dual N3 tunnel approach during the mobility procedure to minimize the network latency caused by Xn/X2 data forwarding, by exploiting the DAPS operation [RAN3-led].

6 – Intel Corporation (UK) Ltd

We consider the scenario that "handover between nodes with different releases" will be more popular when NPN is used widely. It would be good to improve the performance since currently

Lossless handover cannot be guaranteed due to full configuration.

Therefore we consider following objective for Rel-18:

- **Objective: Specify the solution to support lossless HO and delta signalling for HO between nodes with different releases;**

7 – Lenovo (Beijing) Ltd

CHO is designed for robustness mobility. CPAC can speed up the setup of DC. Therefore, CHO and CPAC have the different purpose. Coexistence of CHO and CPAC can be that the separate configuration of CHO and CPAC are configured to UE at a given time. Alternatively, CAPC can be contained in the CHO configuration. Therefore, coexistence of CHO and CPAC should be supported in Rel-18.

8 – NTT DOCOMO INC.

Idle/inactive measurement for non-CA/DC case: This feature would be beneficial in non-CA/DC case for delay reduction. Use cases include distributing each UE to the optimal frequency bands taking into account the measured radio quality etc.

9 – CATT

It time allows we further suggest to consider enhancements such as

a) enhancement to inactive mobility btw LTE and NR

b) inter-RAT PScell change

10 – Nokia Corporation

Solution to reduce handover interruption for UEs using a single transceiver, e.g., MBB and/or RACH-less handover could be considered.

11 – LG Uplus N3 tunneling enhancement is important. Further, RACH-less in HO without SCG change need to be investigated.
12 – China Unicom Considering realistic network requirements, we strongly propose mobility enhancement for 5G RAN sharing should also be taken with high priority. Thus the following objective is suggested to be considered in R18: **Support mobility enhancement for 5G RAN sharing** **- Study and specify solution(s) for UE in RAN sharing network to quickly re-select to the secondary PLMN non-sharing network in edge of MR-DC/NR-CA network.**

2.6 Summary of initial phase

Regarding 2.1:

There seems a general support to have mobility enhancements in Rel-18 and companies are willing to consider a reasonable scope for this enhancement. There seems significant interest is shown on L1/L2 mobility and FR2 enhancements. There is also interest on DAPS/CHO enhancements. Some companies also raised interest to consider mobility enhancements for XR and URLLC scenarios. As detailed proposals were proposed by companies in each example area, we can try to converge on a reasonable scope for each example area in the next round.

Observation: there is a wide support to have mobility enhancements in Rel-18 and the potential scope convergence can be discussed under each example area in the next round.

Some companies also mentioned about the leading group for this topic, this can be further discussed in intermediate round.

Guidance 1: companies are invited to indicate the leading group and impacted groups for mobility enhancements in intermediate round.

Regarding 2.2:

Around 27 companies joined the discussion and all participants showed support for this example area. It seems that there is wide interest to pursue L1/L2 mobility in Rel-18. Many companies clarified the applicable scenarios for L1/L2 mobility and they can be categorized as below:

1. whether it applies to standalone, CA or other deployment options
2. whether it applies to intra-DU, inter-DU(intra-CU) or inter-CU cases

3. whether it applies to intra-frequency and inter-frequency cases
4. whether it applies to both FR1 and FR2

Regarding the major principle to support L1/L2 mobility, majority of companies proposed to have:

1. Configuration and maintenance for multiple candidate cells;
2. dynamic switch mechanism for the potential applicable scenarios;
3. L1 enhancements, including inter-cell/mTRP beam management, L1 measurement, timing management etc,
4. FR2 specific enhancements for L1/L2 mobility.

There are also some other enhancements mentioned by companies, but seems not widely supported.

According to the above situation, it is seen possible to converge in the next round on what are major aspects to be discussed and what are essential scenarios to apply L1/L2 mobility.

Guidance 2: companies are invited to clearly indicate your most interested scenarios to support L1/L2 mobility, and the major aspects to be specified for L1/L2 mobility.

Please note that in the initial round nothing is excluded, but in the intermediate round it aims at converging a reasonable scope. So it is highly appreciated that companies can provide the feedback considering your high priority requirements, instead of listing everything.

Regarding 2.3

Around 26 companies joined the discussion. Companies showed interest on different enhancements, which includes:

- DAPS+CA/DC
- DAPS+CHO/CPAC
- CHO + MR-DC (pending on Rel-17 progress)
- CHO + CPC
- Other enhancements which are proposed by only a few companies

There were some proposals indicating support of DAPS for FR2, and we discuss this aspect in Sec 2.4.

There are also views expressing no much interest on some of the above aspects. It is observed that there are various aspects proposed and seems not realistic to accommodate all these enhancements within Rel-18 timeline. Therefore it is suggested to further down select the most important aspects that companies care about. Again it is encouraged to only feedback on the top priority items, instead of listing everything.

Guidance 3: companies are invited to provide Top 3 interested items from the above list, to try to converge on the most useful enhancements on DAPS/CHO.

Regarding 2.4:

Around 25 companies joined the discussion. There seems a wide support to consider DAPS for FR2-FR2, and there were also some support considering MBB/RACH-less. There are also proposals relevant to CHO/CPAC, which can be discussed further in DAPS/CHO enhancements to avoid duplicated discussion. Some companies also proposed enhancements on beam management, mTRP etc., which can be further discussed in L1/L2 mobility to also avoid duplicated discussion.

So for the intermediate round, the discussion can be focused on whether to have DAPS for FR2-FR2, and/or some other enhancements are still seen required, .e.g MBB/RACH-less.

Guidance 4: companies are invited to provide feedback on whether you see it essential to consider both DAPS for FR2-FR2 and/or other enhancements, e.g. MBB/RAH-less.

Guidance 5: for CHO/CPAC enhancements, it can be further discussed in DAPS/CHO part; for L1 enhancements it can be further discussed in L1/L2 mobility.

Regarding 2.5:

There are also misc proposals from companies on other enhancements. The list is shown as below:

1. Data forwarding and N3 tunnelling optimization

2. inter-RAT PScell change

3. Fast failure detection and recovery

4. UL signalling mobility

5. Idle/inactive measurement for non-CA/DC case

6. lossless handover and delta signalling for handover between nodes with different releases

7. Support mobility enhancement for 5G RAN sharing

8. Enhancement to inactive mobility btw LTE and NR

9. Improvements to handover delay requirements

10. UE-initiated early evaluation termination

Some companies also proposed MBB, RACH-less, CHO/CPAC here and these should be discussed in the corresponding example areas. Although there seems quite different proposals from companies, it is observed some proposals did not provide very clear motivation or potential impacts. As the example areas have already had considerable number of candidate aspects for Rel-18, companies are invited to provide your comments on each proposal above whether it is seen really important or essential for Rel-18.

Guidance 6: companies are invited to provide further feedback on whether you see any of the above proposal is essential for Rel-18.

3 Intermediate Phase

3.1 Leading group and impacted group

Companies are invited to indicate the leading group and impacted groups for mobility enhancements in intermediate round.

Feedback Form 6: Leading group and impacted groups for mobility enhancements

1 – Futurewei Technologies Leading WG: RAN2; Impacted WG: RAN1, RAN3, RAN4.
2 – InterDigital France R&D Leading: RAN2 Impacted: RAN1, RAN3, RAN4

3 – China Telecommunications Leading WG: RAN2; Impacted WG: RAN1, RAN3, RAN4.
4 – Apple Hungary Kft. Leading WG: RAN2; Impacted WG: RAN1, RAN3, RAN4.
5 – vivo Mobile Communication Co. Leading WG: RAN2 Impacted WGs: RAN1, RAN3, RAN4 Final decision is up to detailed scope.
6 – Qualcomm CDMA Technologies Agree with others above.
7 – MediaTek Inc. Leading WG: RAN2 Impacted WGs: RAN1, RAN3, RAN4
8 – HuaWei Technologies Co. Leading WG: RAN2 Impacted WG: RAN1, RAN3, RAN4
9 – Beijing Xiaomi Mobile Software Agree with majority views
10 – RadiSys Agree with others
11 – Lenovo (Beijing) Ltd Leading WG: RAN2 Secondary WG: RAN1, RAN3, RAN4
12 – Samsung Research America Leading WG: RAN2 Impacted WGs: RAN1, RAN3, RAN4
13 – Guangdong OPPO Mobile Telecom. Leading WG: RAN2 Impacted WGs: RAN1, RAN3, RAN4

14 – Spreadtrum Communications Leading WG: RAN2 Impacted WGs: RAN1, RAN3, RAN4
15 – NEC Corporation Leading WG: RAN2; Impacted WG: RAN1, RAN3, RAN4.
16 – China Unicom Leading WG: RAN2; Impacted WG: RAN1, RAN3, RAN4.
17 – Fujitsu Limited Leading WG: RAN2 Impacted WG: RAN1, RAN3, RAN4
18 – LG Uplus Leading WG: RAN2; Impacted WG: RAN1, RAN3, RAN4.
19 – Nokia Corporation Same view as others: RAN2 as leading group, RAN134(5) as impacted WGs.
20 – China Mobile Com. Corporation Leading WG: RAN2 Impacted WG: RAN1, RAN3, RAN4
21 – FGI Leading WG: RAN2 Impacted WG: RAN1, RAN3, RAN4.
22 – ZTE Corporation Leading WG: RAN2; Impacted WG: RAN1, RAN3, RAN4.
23 – Sony Europe B.V. Leading WG: RAN2 Impacted WG: RAN1, RAN3, RAN4

24 – Intel Corporation (UK) Ltd Same as others, RAN2 should be the leading WG and RAN1/ RAN3 and RAN4 should be involved as the secondary WG.
25 – Ericsson LM Agree with others
26 – SHARP Corporation Leading WG: RAN2 Impacted WG: RAN1, RAN3, RAN4

3.2 L1/L2 mobility enhancements

Clearly indicate your most interested scenarios to support L1/L2 mobility, and the major aspects to be specified for L1/L2 mobility.

Applicable scenarios for L1/L2 mobility and they can be categorized as below:

1. whether it applies to standalone, CA or other deployment options
2. whether it applies to intra-DU, inter-DU(intra-CU) or inter-CU cases
3. whether it applies to intra-frequency and inter-frequency cases
4. whether it applies to both FR1 and FR2

Feedback Form 7: Indicate your most interested scenarios to support L1/L2 mobility

1 – Verizon UK Ltd We were unable to submit Round 1 input due to the NWM issue and out time zone. This work item addresses some of the most fundamental issues in the network. Now with what R17 has done with the new TCI framework and L1/2 mobility enabler, we think this should be one of the more important work items in Rel-18. We are interested in all the scenarios above.
2 – Futurewei Technologies 1), 2), 3), 4).
3 – InterDigital France R&D While all scenarios above are possible, to limit the scope of the work item to something manageable, we can make some simplifying assumptions (e.g. standalone, intra-DU, FR1) in a first release and extend to other scenarios in subsequent releases.
4 – AT&T We think all the scenarios in 1-4 are possible and should be studied and specified.

5 – China Telecommunications

1), 2), 3), 4).

6 – Apple Hungary Kft.

Applicable to all of these (1/2/3/4) equally. There should not be any preference, as mobility entails that the UE is not precluded to go through any of these scenarios with lower possibility. But we do see that in "other" deployment scenarios, where the NR is in SCG, then mobility would not be same as in MCG/SA case. So in (1), the other deployments case might be the last essential/relevant item to this discussion.

7 – vivo Mobile Communication Co.

- We think all scenarios are possible and need to be studied, but in Rel-18, L1/L2 based inter-cell mobility for standalone and intra-DU should be prioritized. We are also open to study CA and other deployment options and inter-DU/CU if time is allowed.
- Regarding intra-/inter-frequency and FR1/FR2, less impact on procedure could be assumed for different scenarios. In this way, both intra-/inter-frequency and FR1/FR2 could be considered in Rel-18.
- Besides, there is no discussion on the scenarios of synchronized and non-synchronized. Does this assume both synchronized and non-synchronized scenarios are included?

8 – Qualcomm CDMA Technologies

In general, all scenarios are possible. L1-L2 mobility should be applicable to PCell, PSCell, and SCells for both intra- and inter-frequency cases. Intra-DU is the highest priority while inter-DU should also be considered. Inter-CU will require more RAN3 work. Both FR1 and FR2 should be in the scope while also considering FR2 specific enhancements. The essential components for L1/L2 mobility are 1-) configuration of the candidate cells 2-) measurements by the UE for these cells, 3-) L1/L2 signaling for candidate cell management and corresponding beam switching 4-) L1/L2 signaling to change PCell/PScell/SCell to/from the candidate cells.

9 – MediaTek Inc.

All scenarios mentioned should be studied. We thinks that

- L1/L2 mobility can be applicable to PCell/PSCell/SCell

- We should **prioritize intra-DU scenario**: Inter-DU or even inter-CU mobility involve L2/3 reset/re-establishment, etc., and thus may not allow UE to do fast switching between cells

- L1/L2 mobility should be applicable in both intra- and inter-frequency cases

- L1/L2 mobility should be applicable in both FR1 and FR2

In addition, we need to discuss **network synchronization** scenarios, e.g. how can L1/L2 mobility work if the source and target cells are asynchronous?

10 – HuaWei Technologies Co.

1. Focus on Standalone and CA cases first; It is unclear on DC case, whether it means MCG switch or SCG switch, this requires other aspects and we think this is not the high priority scenario..

2. Focus on Intra-DU and Intra-CU Inter-DU cases first, we think inter-CU would bring more complicated and extra issues like key refresh etc., and should be de-prioritized;

3. Intra-frequency, Inter-frequency

4. Both FR1 and FR2. We think a generic framework is more desirable.

We also agree with MTK that synchronization cases should be the main target.

11 – Beijing Xiaomi Mobile Software

Although all cases are possible, we agree intra-DU and inter-DU intra-CU case should be prioritized. If time allows, we could consider other cases as well.

12 – CATT

We think 1,2,3 and 4 are all possible. For 1 we could discuss further what are the extra complexity for CA. Then for 2 we also think we could first focus on cases other than inter-CU due to complexity and standardization effort.

13 – RadiSys

Scenarios 1, 2, 3 and 4 are possible and should be studied. However if there are time constraints then intercell and intra DU mobility for FR1 and FR2 should be taken on priority. Inter CU mobility needs RAN3 co ordination.

14 – Samsung Research America

1. whether it applies to standalone, CA or other deployment options

It can apply to both CA and standalone scenarios.

2. whether it applies to intra-DU, inter-DU(intra-CU) or inter-CU cases

We are fine to support all deployment scenarios (especially for inter-vendor support).

3. whether it applies to intra-frequency and inter-frequency cases

It can apply to both intra-frequency and inter-frequency use cases. But RAN4 would be the main WG to decide this function.

4. whether it applies to both FR1 and FR2

This feature is more useful for FR2 for fast beam acquisition during inter-cell mobility.

15 – Lenovo (Beijing) Ltd

1), 2) 3, 4). In addition, we would like to point out that Intra-DU can be prioritized over other case. and Intra-frequency can be prioritized over inter-frequency cases in Rel-18.

16 – Spreadtrum Communications

1), 2), 3), 4).

17 – Guangdong OPPO Mobile Telecom.

we think all the scenarios are possible. And except standalone and CA, DC case can also be studied.

18 – NEC Corporation

Thanks for the summary, our preference is as follows.

1. Standalone, open to CA
2. Intra-DU, open to inter-DU
3. Intra-frequency, open to inter-frequency
4. FR2 has a higher priority since the problem is more severe, but we also prefer to have an unified solution for FR1/FR2

19 – Fujitsu Limited

All scenarios

20 – Ericsson LM

Our preferences:

On 1: Standalone, CA and MR-DC.

On 2: We think we can limit to intra-DU in Rel-18. Extensions can be considered in later releases

On 3: Both intra- and inter-frequency

On 4: Both FR1 and FR2.

21 – Nokia Corporation

For 1), NR functionality should be applied to **at least NR SA/CA**. As per usual, if this can also work for MR-DC that should not be prevented, but focusing on NR SA/CA would keep the scope in check at first.

For 2), **priority should be intra-DU and inter-DU, intra-CU scenarios**. Whether that also enables support also for inter-CU scenarios can be considered once the basic operation is done.

For 3), we would propose to **focus on intra-frequency** as that's the primary case for mobility.

For 4), **both FR1 and FR2** should be considered but due to the beam nature of FR2, the design could **focus on FR2 first**.

22 – China Mobile Com. Corporation

We are open to all options above and think it's better to have a more common architecture.

As we mentioned before, we should prioritize intra-DU and inter-DU intra-CU cases for both FR1 and FR2. Other cases could be also be studied if time allows.

23 – FGI

We agree with AT&T that all scenarios are possible and should be studied.

24 – Sony Europe B.V.

All scenarios should be addressed

25 – Nokia Corporation

One clarification on scope: Focusing on NR SA means that we would not consider DC in the first phase. Since mobility aims at PCell change, focusing on that would provide the main gains of the L1 mobility anyway.

26 – Intel Corporation (UK) Ltd

We support 1, 2, 3 and 4, In addition, for 1, we should consider DC case. And cover following cases:

- Switching of PCell;
- o Switching of PSCell;
- o Switching between sPCell and SCell;
- o Switching between PCell and PSCell;
- o More than two cell groups, e.g. three;

As we commented in the initial round discussion, we see the value to use this framework to cover multiple scenarios, e.g. :

- Scenario 1: mobility enhancements on FR2, including intra-DU, inter-DU case;
- Scenario 4: Low interruption upon switching of PCell, switching of PSCell, switching between sPCell and Scell, switching between Pcell and PSCell, etc;

27 – VODAFONE Group Plc

Ideally all scenarios including inter-CU should be studied. For down scoping, dropping FR2 first would be our preference.

28 – ZTE Corporation

Q1: We prefer to have a future proof framework to support both standalone and CA.

Q2: To minimize the impact and complexity, we prefer to focus on intra-DU and inter-DU(intra-CU) cases, where fast back and forth mobility should be allowed. For the inter-CU cases, considering the path switch, inter-gNB interaction and security key update, the ping-pong issue has to be solved and the benefit of L1/L2 mobility seems non-existent.

Q3: Both intra-frequency and inter-frequency shall be considered.

Q4: Both FR1 and FR2 should be supported.

29 – SHARP Corporation

We think all scenarios are possible and should be studied.

30 – NTT DOCOMO INC.

1) It applies to standalone, CA or DC or other.

2) We think intra-DU, inter-DU (intra-CU) have higher priority.

3) We think it applies to both intra-frequency and inter-frequency cases.

4) It applies to both FR1 and FR2.

31 – China Unicom

1. We prefer CA scenario. We are open to standalone.
2. intra-DU, inter-DU(intra-CU) cases can be taken with highest priority. Inter-CU cases may can be discussed if time limits.
3. Support both intra-frequency and inter-frequency cases.
4. Both FR1 and FR2 are fine.

Potential major aspects to be specified for L1/L2 mobility as below:

1. Configuration and maintenance for multiple candidate cells;

2. Dynamic switch mechanism for the potential applicable scenarios;

3. L1 enhancements, including inter-cell/mTRP beam management, L1 measurement, timing management etc,

4. FR2 specific enhancements for L1/L2 mobility.

Feedback Form 8: Which major aspects do you think should be specified for L1/L2 mobility

1 – Verizon UK Ltd

We were unable to submit Round 1 input due to the NWM issue and out time zone. All 4 above we are very supportive. They should ALL be addressed. Of them, #4 FR2 specific enhancement is the one lacking the most, since FR1 has been performing far better in this department.

2 – Futurewei Technologies

1), 2), 3), 4).

3 – InterDigital France R&D

We think a complete solution requires specifying all of these aspects.

4 – China Telecommunications

1), 2), 3), 4).

5 – Apple Hungary Kft.

Again, all of these are needed for effective L1/L2 mobility. In our view, we do not see that ”some” or a selection of these alone, are enough for L1/L2 mobility. L1/L2 mobility involves beams from multiple TRPs, and FR2 is inherent, and so (4) is implied, but spec allows beams even for FR1.

6 – vivo Mobile Communication Co.

- 1, 2, 3, 4. Besides, we also need to study the DL/UL centric L1/L2 measurement and corresponding report for both synchronized and non-synchronized scenarios, and dynamic switch based on DL/UL signals. In Rel-18, a complete mechanism for inter-cell mobility with serving cell change should be specified.

7 – Qualcomm CDMA Technologies

All of them.

8 – MediaTek Inc.

We think 1, 2, and 3 can be considered. These aspects are important in FR2, but we believe that the enhancements should also be applicable in FR1. Besides, for "L1/L2 mobility", we need to study the feasibility of **triggering PCell/PSCell change using L1/L2 signal**.

9 – HuaWei Technologies Co.

We think all aspects should be considered.

Regarding L1 enhancements, we think applying same/different TA values is worthy more consideration for extending the applicable scenarios of inter-cell BM (continuation from R17) and L1/L2 mobility (new in R18). We are also interested in reducing latency and overhead of L1 measurement, such as L1-event-triggered reporting of beams from neighboring cells.

10 – Beijing Xiaomi Mobile Software

We agree with 1, 2 and 3. Regarding 4, it's unclear which aspect is included. Further clarification is needed.

11 – CATT

We support to consider all these aspects.

12 – RadiSys

All of them

13 – Samsung Research America

On 4) FR2 specific enhancements, L1/L2 mobility enhancements with inter-cell beam management can support fast mobility between a source cell and a target cell in FR2

14 – Lenovo (Beijing) Ltd

all of them

15 – Guangdong OPPO Mobile Telecom.

All these aspects should be considered.

16 – NEC Corporation

Thanks for the summary, we believe all mentioned aspects are essential.

17 – Fujitsu Limited

All scenarios

18 – China Mobile Com. Corporation

All of them.

19 – FGI We support the four aspects should be specified for L1/L2 mobility.
20 – Ericsson LM We agree that the 4 major aspects listed above are applicable. For bullet 2 (”dynamic switch mechanism”) we understand the bullet to mean that the switch mechanism is to switch among the ”multiple candidate cells”
21 – Nokia Corporation All of the above seem valid points to consider.
22 – Sony Europe B.V. All of them
23 – Intel Corporation (UK) Ltd Regarding the solution itself, we support 1, 2, 3 and 4. However we should avoid the terminology “L1/L2 mobility”, as we commented in the initial round discussion, the name of “L1/L2 based mobility” is too limited, and implies the solution discussed in Rel-17 under FeMIMO. We would prefer to have a more general name “fast cell/cell group switching” for the discussion in Rel-18 to enable a more open discussion of potential solutions.
24 – ZTE Corporation All of them.
25 – SHARP Corporation All aspects should be considered.
26 – NTT DOCOMO INC. We can support all aspects.
27 – China Unicom We support 1, 2 and 3. Regarding 4, it can be clarified on whether it means FR2 standalone enhancements for L1/L2 mobility or FR2 enhancement in specific scenarios (such as high-speed scenario), and we are open to the both.

3.3 DAPS/CHO enhancements

Companies are invited to provide Top 3 interested items from the following list, to try to converge on the most useful enhancements on DAPS/CHO:

- DAPS+CA/DC
- DAPS+CHO/CPAC

- CHO + MR-DC (pending on Rel-17 progress)
- CHO + CPC
- Any other items with valid justification of needs

Feedback Form 9: Provide Top 3 interested items from the above list

1 – Futurewei Technologies CHO + MR-DC, CHO + CPC.
2 – InterDigital France R&D CHO+CPC CHO + MR-DC enhancements to CHO, as discussed in phase 1, to address new topologies (such as IAB) and improve CHO performance.
3 – China Telecommunications 1□DAPS+CA/DC 2□DAPS+CHO/CPAC 3□CHO + MR-DC (pending on Rel-17 progress)
4 – Apple Hungary Kft. 1) CHO+ MR-DC, 2) DAPS+CHO/CPAC, 3) DAPS+CA/DC(with L1/L2 mobility)
5 – vivo Mobile Communication Co. • Considering real 5G deployment, mobility robustness with CHO enhancements, e.g. CHO+CPAC, CHO+MR-DC could be focused in Rel-18.
6 – Qualcomm CDMA Technologies CHO + CPC and CHO + MR-DC are highest priority on this list. DAPS + CHO can be considered for the DAPS fallback scenario. We do not see a need for other DAPS enhancements. CHO enhancements in the context of L1 beam-based measurements should also be considered due to its importance for FR2 operation.
7 – MediaTek Inc. We may study **CHO+CPC, CHO+MR-DC, DAPS+CHO**. The support of DAPS+CA/DC largely depends on UE capability.

8 – HuaWei Technologies Co.

DAPS+DC

DAPS+CHO

We think DAPS+CPAC may be too complicated. It should be first decided whether DAPS+DC can be supported, and then discuss further if DAPS+CPAC is really essential for Rel-18.

9 – Beijing Xiaomi Mobile Software

CHO + DC

CHO + DAPS

10 – CATT

DAPS+CA/DC, DAPS+CHO/CPAC, and CHO+MRDC, taking into account both motivations and complexity.

11 – RadiSys

CHO+CPC and CHO+MR-DC

12 – Samsung Research America

Our initial preference is

1) DAPS + CHO/CPAC

(We have assumed that DAPS-like SN mobility can be also considered in this scenario)

2) CHO + MR-DC

3) CHO + CPC

DAPS + CA/DC may be considered only for FR1, but it's not sure for FR2 due to heavy complexity.

13 – Lenovo (Beijing) Ltd

DAPS+CA/DC

DAPS+CHO/CPAC

CHO + CPC: We also support CHO+CPA.

14 – Guangdong OPPO Mobile Telecom.

CHO + CPC and CHO + MR-DC

15 – Spreadtrum Communications

DAPS+CA/DC

DAPS+CHO/CPAC

CHO + CPC

16 – NTT DOCOMO INC.

(1)DAPS+CA/DC
(2)DAPS+MR-DC
(3)CHO+CPC
We concerned about the complexity of the implementation of DAPS□CHO/CPAC.

17 – NEC Corporation

(1) DAPS+CHO/CPAC

(2) CHO + MR-DC if not handled in Rel-17, otherwise CHO + CPAC

(3) DAPS+CA/DC

18 – Fujitsu Limited

1. DAPS+CHO/CPAC
2. CHO + MR-DC
3. DAPS+CA/DC

19 – LG Uplus

We have similar view with Huawei. DAPS+MR-DC should be prioritized.

20 – China Mobile Com. Corporation

CHO+MR-DC (pending on Rel-17 progress), CHO+DAPS, CHO+CPAC (if time allows).

21 – FGI

DAPS+CA/DC, DAPS+CHO/CPAC, CHO + MR-DC (pending on Rel-17 progress)

22 – Nokia Corporation

For RAN2, CHO+CPC, DAPS+CHO/CPAC and DAPS+CA/DC, could be considered.

For RAN3, some X2/Xn signalling aspects for CHO could also be considered as those could be contained within RAN3 scope.

23 – Sony Europe B.V.

1) DAPS+CHO/CPAC

2) DAPS+CA/DC

3) CHO + MR-DC

24 – Intel Corporation (UK) Ltd

Our preference is DAPS+CA/DC and DAPS+CHO, in addition, we would like to remove the limitation on "the support of simultaneous UL PUSCH transmission for user data".

The most important scenarios we consider in Rel-16 are:

- Scenario 1: Mobility enhancements on FR2, especially to enable low interruption for XR, 4k/8k, cloud gaming, etc new services;

- Scenario 2: To support consistent data rate with low interruption during handover for XR, 4k/8k, cloud gaming, etc new services;
- Scenario 3: To support low interruption + reliability simultaneously during handover for URLLC services;
- Scenario 4: Low interruption upon switching of SCG, switching between MCG and SCG, etc for XR, 4k/8k, cloud gaming, etc new services;
- Scenario 5: support lossless HO and delta signalling for HO between nodes with different releases, especially for NPN scenarios;

Then DAPS+CA/DC can be used for scenario 2, and DAPS+CHO can be used for scenario 3.

Therefore from our side, DAPS+CA/DC and DAPS+CHO is more important. In addition, we should also remove the limitation on "the support of simultaneous UL PUSCH transmission for user data" since there is no blocking issue on this.

Regarding DAPS+CPAC, it is not clear to us, whether this is to support DAPS on SCG and then work together with CPAC, i.e. similar to DAPS+CHO? Or it is DAPS in PCell and CAPC?

25 – VODAFONE Group Plc

1) CHO + CPC

2) CHO + MR-DC

26 – ZTE Corporation

CHO+CPC

CHO + MR-DC

DAPS + CA

27 – Ericsson LM

1) DAPS + CA/DC - With subitems in priority order: DAPS+CA, DAPS+DC, DAPS for PSCell change)
2) DAPS + CHO/CPAC - We think executing DAPS with CHO is important, but we should should consider keeping CHO conditions while executing DAPS.
3) CHO + MR-DC - This would imply to have CHO with conditional MR-DC setup.

28 – SHARP Corporation

DAPS+CA/DC

DAPS+CHO/CPAC

CHO + MR-DC

29 – China Unicom

(1) CHO+CPC

(2) DAPS+CHO/CPAC

3.4 FR2 specific enhancements

Companies are invited to provide feedback on whether you see it essential to consider both DAPS for FR2-FR2 and/or other enhancements, e.g. MBB/RAH-less.

Feedback Form 10: Whether it essential to consider both DAPS for FR2-FR2 and/or other enhancements, e.g. MBB/RAH-less

1 – InterDigital France R&D

We think it would be ideal to consider both DAPS for FR2-FR2 and MBB/RACH-less in the initial stage of the WI. However, to avoid complexity, relying on MBB/RACH-less only for this release would be preferable to keep the scope manageable.

2 – Futurewei Technologies

As DAPS and MBB/RACH-less mostly serve the purpose of reducing interruption time, which can also be addressed by L1/L2 mobility, it'd be difficult to consider DAPS for FR2-FR2 and MBB/RACH-less essential, given the wide support of specifying L1/L2 mobility in Rel-18.

3 – China Telecommunications

We think the DAPS handover for FR2 to FR2 case can be supported in Rel-18 (e.g. enable RRC-based DAPS handover in FR2 for multiple-panel UE), since it can achieve 0ms data interruption. For UEs with low capabilities, we can specify MBB and RACH-less HO to reduce data interruption.

4 – Qualcomm CDMA Technologies

DAPS for FR2-FR2 is essential since reducing FR2 HO latency is important for XR and online gaming which can benefit from the high throughput provided by FR2. MBB and RACH-less are second priority and their benefit is diminished with L1/L2 mobility support.

5 – MediaTek Inc.

DAPS for FR2-to-FR2 mobility helps achieve near 0ms interruption also in FR2. However, for UEs not able to support that (due to e.g. hardware limitation), MBB and RACH-less also helps reduce interruption. Therefore all of these can be considered in Rel-18. Notice that RACH-less HO or TA acquisition optimization may be needed even if we have L1/L2 mobility, so as to support UE moving between TRPs/cells with different TAs.

6 – HuaWei Technologies Co.

DAPS FR2-FR2 only

We don't see benefit to discuss MBB approach to further fragment the solution as DAPS can already support UL TDM transmission and the only remaining thing is to specify requirements in RAN4.

For RACH-less, we can consider it in L1/L2 mobility discussion when TA update is not required.

7 – Beijing Xiaomi Mobile Software

DAPS is the only way to achieve 0 ms interruption in FR2. L1/L2 mobility can already achieve similar performance as MBB and RACH-less.

8 – CATT

We agree that it is perhaps difficult to get all these done with reasonable TU allocation. So we are ok to first focus on DAPS FR2-FR2 enhancements, and then if time allows we consider others. In any case we agree that FR2 specific enh is something that needs to be well taken into account in Rel-18, so that it pave the way for next step worldwide 5G deployment with more diverse frequency status.

9 – RadiSys

RACH less is our first priority, and then DAPS to reduce interruption time.

10 – Samsung Research America

We would like to consider MBB and RACH-less while targeting both FR2 mobility enhancements and low capability UEs.

On the other hand, we need to carefully consider DAPS HO over FR2-FR2, due to heavy complexity.

11 – Lenovo (Beijing) Ltd

DAPS for FR2-FR2 is important to reduce the time interruption in the FR2 case.

12 – Guangdong OPPO Mobile Telecom.

As replied in initial phase, we have some concerns on whether DAPS can work for FR2, and the candidate interruption time reduction solutions, e.g. MBB and RACH-less HO, we think they can be considered for FR2.

13 – NTT DOCOMO INC.

We think DAPS for FR2-FR2 is essential to reduce interruption time.
For MBB, it may help throughput improvement, but it's not urgent.

For RACH-less, we wonder whether the applicable scenario is restricted within that source cell and target cell has a same TA value. if the applicable scenario is restricted, then we see few benefits for this considering the practical deployment.

14 – NEC Corporation

We are OK that both DAPS and MBB is considered for FR2, but only one of them should be selected as they serve the same purpose, i.e. the same principle as NR FR1.

15 – LG Uplus

DAPS for FR2 is prioritized. Our RACH-less is mainly for the case of Pcell change without Scell change.

16 – China Mobile Com. Corporation

The main purpose of this objective is to reduce the interruption time. We are open to discuss all the potential solutions but just choose one. So we would like to evaluate the complexity and prefer DAPS in FR2 if it is mainly about UE capability.

17 – FGI

We consider 0 ms interruption is important in FR2-FR2 scenarios. Thus, both DAPS and MBB/RACH-less can be studied in Rel-18 FR2 specific enhancements.

18 – Nokia Corporation

We think **FR2 requires some focus for all topics** as it has been somewhat neglected in the past (due to the more complex nature of the beam management aspects).

Otherwise, **DAPS for FR2** seems the clearest omission currently, but allowing **FR2 MBB could be much easier to specify for FR2** and might save lot of effort in all WGs (instead of full DAPS).

19 – Intel Corporation (UK) Ltd

We are considering to use fast cell group switching (i.e. L1/L2 mobility) for FR2-FR2 handover since it would be good to have common solution for multiple scenarios, i.e. FR1 and FR2, and therefore we would suggest to only work on fast cell group switching in Rel-18, and not to work on solutions that are specific to FR2 only.

20 – VODAFONE Group Plc

Not a priority for Rel 18

21 – ZTE Corporation

As we mentioned in our phase 1 comments, compared to MBB/RACH-less solution, the DAPS for FR2 seems more complex. Even if the DAPS-FR2 can be supported in specs, it is very much likely the DAPS-FR2 can only be supported by high-end UEs in the market. Therefore, considering the MBB/RACH-less based solution has less complexity in both standardization and implementation, we think it is more promising to the market, and we prefer to prioritize the MBB/RACH-less solution.

22 – Ericsson LM

We think that we should not specify several solutions for enhanced FR2 mobility. One is enough. We see the point from Huawei about avoiding market fragmentation and hence the best approach is probably to go for DAPS in FR2.

23 – China Unicom

If multi-TRP/multi-panel can be supported in R18, then DAPS FR2-FR2 can be specified. Besides, MBB for FR2 can be deprioritized when considering the plentiful work under this topic.

3.5 Other enhancements

Companies are invited to provide further feedback on whether you see any of the following proposal is essential for Rel-18.

1. Data forwarding and N3 tunnelling optimization

2. inter-RAT PScell change

3. Fast failure detection and recovery

4. UL signalling mobility

5. Idle/inactive measurement for non-CA/DC case

6. lossless handover and delta signalling for handover between nodes with different releases

7. Support mobility enhancement for 5G RAN sharing

8. Enhancement to inactive mobility btw LTE and NR

9. Improvements to handover delay requirements

10. UE-initiated early evaluation termination

Feedback Form 11: Which ONE is essential for Rel-18

1 – China Telecommunications

If time allows, we think we need to enhance current data forwarding procedure and support inter-RAT PScell change:

For data forwarding optimization, there are two potential use cases as below:

1□Early data forwarding enhancement: Enhance current data forwarding procedure to release the data which has been successfully transmitted timely can help the BS reduce the cache pressure, especially when early data forwarding is used in CHO/CPAC.

2□Exception handling: Design the data acquisition procedures to help the base station retrieve the UE context when necessary (i.e. in case of HO to wrong cell/too early HO, if HO failed before UE set up connection to the target cell, and the source node has dropped the UE context), which can reduce data interruption due to failure cases.

For inter-RAT PScell change, we observed that inter-RAT PScell change procedure with single RRC re-configuration is not supported in current specification (i.e. no transition from EN-DC to NR-DC), support inter-RAT PScell change procedure can reduce data interruption and ensure service continuity for the users.

2 – vivo Mobile Communication Co.

- We do observe some motivation for **UL signaling based mobility** in Rel-18. Considering the deployment timeline for Rel-18, there will be many scenarios with dense network, especially for coverage purpose in high frequency, or capacity purpose. In this scenario, frequent DL based handover will cause poor mobility performance, e.g. high handover failure rate due to late handover. Similar issue could be observed in high speed cases. In order to improve the handover robustness, UL signaling based mobility should be considered in Rel-18, which could highly mitigate the handover failure rate in dense network. At the same time, no additional UE power consumption will be introduced for UL signal transmission as frequent DL measurement could be saved.
- Comparing with CHO enhancements which needs network to reserve multiple resources for potential candidates, UL signaling based mobility could have higher system spectrum efficiency.

3 – Apple Hungary Kft.

We think that link maintenance for FR2 is something that needs improvement - based on the field testing that is going on, and to us, link maintenance with L2 for FR2 specific aspects (like asymmetric UL/DL link due to for eg., MPE, UE panel based actions etc..) are critical to ensuring that FR2 performance is similar to FR1 (esp with even narrower beams from FR2.x). So we that the below are of top priority:

3. Fast failure detection and recovery

10. UE-initiated early evaluation termination

2. inter-RAT PScell change

4 – Qualcomm CDMA Technologies

QC Fast failure detection and recovery, especially for FR2, is essential. In addition, up to date reporting of beams during handover should be considered. We do not consider other enhancements as essential.

5 – MediaTek Inc.

We think that

- **4. UL signalling mobility** is essential, since beam /measurement report towards serving cell may fail in FR2, and robustness can be improved if we allow potential target cells to monitor UL signals from UE.

- **10. UE-initiated early evaluation termination** is also essential, due to fast channel variation. It actually covers **3. Fast failure detection and recovery** (plus fast measurement reporting).

6 – HuaWei Technologies Co.

Data forwarding and N3 tunneling optimization

We understand R18 Mobility topic should be a generic one to cover all the scenarios and requirements that are essential to the emerging traffic from all relevant topics. In addition to the reliability and interruption time reduction approaches, as one of the proponents, we believe E2E latency reduction for DAPS operation is one of the key requirements for delay-sensitive traffic, e.g. XR. Therefore, we support to specify the enhancements to this area and the main work could be in RAN3.

7 – Beijing Xiaomi Mobile Software

We think UL signaling mobility could be considered.

8 – CATT

Well it is perhaps not very accurate to say how essential it is, but we think the following bullets are important so that R18 mobility enhancement covers more practical use cases.

2. inter-RAT PScell change

8. Enhancement to inactive mobility btw LTE and NR

9 – RadiSys

We support Fast failure detection and recovery via internode signaling to be taken up for Rel18 study

10 – Lenovo (Beijing) Ltd

We don't see the necessary to support any one.

11 – Fujitsu Limited

Fast failure detection and recovery could be considered if time allows.

12 – LG Uplus

1. Data forwarding and N3 tunnelling optimization

6. lossless handover and delta signalling for handover between nodes with different releases

11(further one). RACH-less HO is for the case of Pcell change without Scell change.

13 – FGI 5. Idle/inactive measurement for non-CA/DC case: For Idle/inactive measurement for non-CA/DC case, NR-U may be considered in R-18. For example, additional criteria (e.g., RSSI or channel occupancy) may be considered for idle/inactive measurement, which would be beneficial to NR-U operation. 7. Support mobility enhancement for 5G RAN sharing: As RAN sharing is supported in 5G, we suggest any mobility enhancement mechanisms in Rel-18 should consider 5G RAN sharing. 8. Enhancement to inactive mobility btw LTE and NR: As inactive mode is an important feature in 5G and the inactive mode is supported in LTE and NR, we suggest enhancement to inactive mobility between LTE and NR should be studied.
14 – Sony Europe B.V. 4) We think UL signaling mobility should be considered and led by RAN2. 1) In addition, Data forwarding and N3 tunneling optimization led by RAN3.
15 – Intel Corporation (UK) Ltd The handover for the nodes with different releases will be more and more popular when NPN is used widely, and therefore 6. lossless handover and delta signalling for handover between nodes with different releases is import to us.
16 – Ericsson LM The following one was discussed in Rel-16 and is now discussed in RAN2 under TEI17. Hence, we hopefully wont need to capture it in Rel-18. 5. Idle/inactive measurement for non-CA/DC case
17 – China Unicom We strongly support 7, as we clarified that mobility enhancement for 5G RAN sharing is aimed to resolve realistic network problems. Besides, the support of 7 will only take a little bit of standard work.

3.6 Summary of intermediate phase

Regarding leading group:

Companies are invited to indicate the leading group and impacted groups for mobility enhancements inintermediate round.

Around 30 companies joined the discussions, and it can be seen that company's views are quite aligned with each other. All companies think RAN2 is expected to be the leading WG while RAN1, RAN3 and RAN4 are impacted WGs. Given the situation, it can be concluded that it is expected that RAN2 is the leading WG and RAN1/2/3 are impacted WGs to support this work.

Proposal 1: RAN2 is the leading WG for mobility enhancement in Rel-18, while RAN1, RAN3 and RAN4 are impacted WGs.

Regarding L1/L2 mobility:

Around 30 companies joined the discussion of the scenarios.

Regarding whether it applies to SA/CA cases, almost all the companies support to consider standalone and CA. For the MR-DC case, there are some companies explicitly indicated support of MR-DC cases, but there are also some companies indicating this is not top priority scenarios to be considered at the beginning. Based on the current feedback, it is suggested to focus on standalone and CA cases as first priority, and MR-DC can be a second priority scenario only if time allows.

Regarding whether it applies to intra-DU, inter-DU and inter-CU cases, all the companies think intra-DU should be considered. There is also wide support to consider intra-CU inter-DU case but some companies think it would involve more standard work and thus intra-DU can be prioritized over intra-CU inter-DU. For inter-CU case, several companies have concerns on the complexity and feasibility, and thus it is suggested to de-prioritize inter-CU case.

Regarding intra and inter-frequency scenarios, all the companies think it can be applied to both. One company further indicated that inter-frequency may need to consult with RAN4 and one company think intra-frequency is of high priority. It seems that it can be converged that both intra and inter-frequency are considered.

Regarding FR1 and FR2, some companies think this feature is more useful in FR2 and all the companies agree that both FR1 and FR2 can be considered. So it is concluded that both FR1 and FR2 are considered.

In addition, several companies think it is not clear whether both synchronized and non-synchronized cases can be included. From the moderator's point of view, intra-DU case is already synchronized cases, and inter-DU may have synchronized and non-synchronized cases. As there is already significant support to consider intra-CU inter-DU cases, maybe this part can be left to the potential impacts.

Proposal 2: For L1/L2 mobility, the following scenarios will be considered:

prioritized scenarios:

(1) Standalone, CA

(2) Intra-DU case and intra-CU inter-DU case

(3) Both intra-frequency and inter-frequency

(4) Both FR1 and FR2

second-priority scenarios only if time is allowed

(1) MR-DC

(2) inter-CU case

Regarding potential major aspects to be specified for L1/L2 mobility:

Around 30 companies joined the discussion, and it seems most companies think all the aspects are essential and need to be considered for a complete solution. Two companies think with bullet 4, the enhancements may

be also applicable to FR1. One company think inter-cell beam management can be made clearer to support mobility between different cells.

Some companies think it is also needed to check whether both synchronized and non-synchronized scenarios are considered. This mainly impacts how to handle the TA issue. All other objectives seem common for both cases. Therefore it is proposed to update the high-level objectives as below.

Proposal 3: The following aspects should be specified for L1/L2 mobility:

(1) Configuration and maintenance for multiple candidate cells [RAN2, RAN3];

(2) Dynamic switch mechanism among candidate serving cells for the potential applicable scenarios [RAN2, RAN1];

(3) L1 enhancements, including inter-cell/mTRP beam management L1 measurement, timing management [RAN1, RAN2, RAN4]

(4) FR2 specific enhancements for L1/L2 mobility [RAN2, RAN1, RAN4].

Regarding DAPS/CHO:

Companies are invited to provide Top 3 interested items from the following list, to try to converge on the mostuseful enhancements on DAPS/CHO. As this is quite diverging, the moderator listed all the companies' feedback here

- DAPS+CA/DC: China Telecom, Apple, Huawei, CATT, Lenovo, Spreadtrum, Docomo, NEC, Fujitsu, LG Uplus, FGI, Nokia, Sony, Intel, ZTE, Ericsson, Sharp (17)

- DAPS+CHO/CPAC : China Telecom, Apple, Qualcomm, MediaTek, Huawei, Xiaomi, CATT, Samsung, Lenovo, Spreadtrum,NEC, Fujitsu, CMCC, FGI, Nokia, Sony, Intel, Ericsson, Sharp, China Unicom (20)

- CHO + MR-DC (pending on Rel-17 progress): Futurewei, InterDigital, China Telecom, Apple, Vivo, Qualcomm, MediaTek, Xiaomi, CATT, RadiSys, Samsung, OPPO, Docomo, NEC, Fujitsu, CMCC, FGI, Sony, Vodafone, ZTE, Ericsson, Sharp (22)

- CHO + CPC: Futurewei, InterDigital, Vivo, Qualcomm, MediaTek, RadiSys, Samsung, Lenovo, OPPO, Spreadtrum, Docomo, CMCC, Nokia, Vodafone, ZTE, China Unicom (16)

- Any other items with valid justification of needs

Considering the overall workload of R18 and the current very wide scope of mobility enhancement, moderator proposes the following two options and invite companies to have further down selection:

Option 1: Support CHO + MR-DC (pending on Rel-17 progress) in R18.

Option 2: None of the above items will be supported in R18. Further enhancement on this should be postponed until commercial utilization.

Regarding FR2:

The detailed discussion under this area is summarized as below:

Prefer DAPS: Qualcomm, China Telecom, Huawei, Xiaomi, CATT, Lenovo, DAPS, LG Uplus, CMCC, Ericsson, China Unicom (11)

Prefer MBB/RACH-less: InterDigital, RadiSys, Samsung, OPPO, ZTE (5)

Both: China Telecom, MediaTek, FGI, Nokia (4)

None: Futurewei, Intel, Vodafone (3)

Either of the solution: NEC

In addition, 2 companies mentioned RACH-less can be considered in L1/L2 mobility and this can be further discussed in the detailed design of L1/L2 mobility, the moderator does not see urgency to further discuss this in this email thread.

It seems more companies prefer to specify DAPS for FR2 and it is suggested to consider this in Rel-18 at this stage.

Proposal 4: it is proposed to consider DAPS for FR2-FR2 in Rel-18.

Regarding the specific impact on supporting DAPS for FR2-FR2, it seems the major impact is RAN4. Companies are invited in the next round to confirm whether the below is the major impacts:

RAN4 requirements and UE capability to support DAPS for FR2-FR2 [RAN4, RAN2]

Regarding other enhancements:

There is no light on any convergence on other enhancements and it does not make much sense to continue this discussion in this email thread. The moderator encourages companies to bring contributions with good justification and support to next plenary, if anything is really important for the proponents.

4 Final Phase

4.1 Discussion

There are serval proposals should be discussed and conduced in the final phase.

Proposal 1: RAN2 is the leading WG for mobility enhancement in Rel-18, while RAN1, RAN3 and RAN4 are impacted WGs.

Feedback Form 12: Do you agree proposal 1?

1 – Futurewei Technologies Yes.
2 – MediaTek Inc. Yes
3 – vivo Mobile Communication Co. Yes.
4 – Beijing Xiaomi Mobile Software Agree
5 – China Telecommunications Yes
6 – Qualcomm CDMA Technologies Agree
7 – Apple Hungary Kft. Agree
8 – InterDigital France R&D Agree
9 – Samsung Research America Yes
10 – China Unicom Yes
11 – NTT DOCOMO INC. Agree
12 – ZTE Corporation Agree
13 – Guangdong OPPO Mobile Telecom. Yes

14 – Nokia Corporation Yes (this was what 100% of responding companies already proposed)
15 – CATT Agree.
16 – HuaWei Technologies Co. Agree
17 – Spreadtrum Communications Yes
18 – Fujitsu Limited Yes
19 – NEC Corporation Yes
20 – Lenovo (Beijing) Ltd yes
21 – Ericsson LM Yes
22 – China Mobile Com. Corporation Yes
23 – VODAFONE Group Plc Yes
24 – RadiSys Yes
25 – Intel Corporation (UK) Ltd Yes, we agree proposal 1.
26 – SHARP Corporation Yes
27 – LG Electronics France Yes

28 – ROBERT BOSCH GmbH Yes

Proposal 2: For L1/L2 mobility, the following scenarios will be considered:

prioritized scenarios:

(1) Standalone, CA

(2) Intra-DU case and intra-CU inter-DU case

(3) Both intra-frequency and inter-frequency

(4) Both FR1 and FR2

second-priority scenarios only if time is allowed:

(1) MR-DC

(2) inter-CU case

Feedback Form 13: Do you agree proposal 2?

1 – Futurewei Technologies We'd like to suggest not to put NR-DC as secondary scenario. SCG is widely used in providing high data rate service. The degradation of user experience, e.g., the drop of user experienced throughput, occurs during cell change in MCG, as well as during SCG change. A consistent L1/L2 mobility scheme to address cell change, for serving cells in both MCG and in SCG, would be preferred.
2 – MediaTek Inc. We still have concern about inter-DU case, but we are fine to list it here.
3 – vivo Mobile Communication Co. Yes
4 – Beijing Xiaomi Mobile Software Agree
5 – China Telecommunications We support the prioritized scenarios listed above and agree to deprioritize the inter-CU scenario. For MRDC scenario, we think the following cases can be considered in R18: 1) Switching between sPCell and SCell; 2) Switching between PCell and PSCell;

6 – Qualcomm CDMA Technologies

Agree with the proposal. Also support moving NR-DC to the first group. There is little delta between MN and SN case for the L1/L2 aspects in Proposal 3 so the additional work will be small.

7 – Apple Hungary Kft.

While we are ok with the direction, since the L1/L2 mobility framework from UE perspective is largely agnostic of intra/inter-CU, and since we also think RAN2 should design the over-all L1/L2 mobility framework without specific scenarios, and since the leading workgroup is RAN2, we think, the proposal can be re-worded such that RAN2 focuses on a unified L1/L2 mobility applicable to all cases and then applicability to inter-CU can be re-visited during the WG meetings (based on input from RAN3).

8 – InterDigital France R&D

Agree

9 – Samsung Research America

Agree this proposal.

For clear scope, we would like to request to slightly update it as follows:

Proposal 2: For L1/L2 mobility **based on inter-cell beam management**, the following scenarios will be considered

10 – China Unicom

Agree

11 – NTT DOCOMO INC.

Suggest moving MR-DC to the prioritized scenarios. Because the serving cell change procedure via L1/L2 signaling for a CC in SCG is similar as that for a CC in MCG.

12 – Guangdong OPPO Mobile Telecom.

Agree

13 – CATT

Basically, we are OK with such prioritization. But techinical wise we failed to see why MR-DC is much more complex compared with the other cases. Of course it is possible that we do the feature so that it later turns out MR-DC is actually applicable (in that sense bullet 1 may be Spcell, CA, etc..)

14 – HuaWei Technologies Co.

Agree

15 – Spreadtrum Communications

Agree

16 – Nokia Corporation

First, about SA/CA/DC: Mobility means PCell change. We should focus on PCell changes first and foremost. Trying to apply the same mechanism for CA is fine, and if the PCell procedures can (with minor alterations) work also for SCells and SCG, very good. But opening up scope for all cases immediately just makes it more difficult to progress any work.

Hence, **SA should be first priority** (which can include also CA) and MR-DC (which includes also NR-DC) as second priority.

Second, about inter-frequency: It's not clear what this means and we are opening up the work for a lot more complexity. As others have commented, this opens up all sorts of cases where we switch roles of PCell and SCells, switch SCells between frequencies, and even switch SCells from one SCG to another. In short, there is a lot of complexity. That's why we would strongly support **focusing on intra-frequency and keep inter-frequency as second priority**. That both ensures the most important use case is handled and doesn't preclude using the intra-frequency-like operation for inter-frequency, but keeps the priorities clear. It also manages the RAN4 work better as WI could state that only intra-frequency requirements are done in Rel-18, which ensures RAN4 workload is more reasonable.

As for those saying additional work is small: If that is truly the case, then there should be no problem in keeping those cases as second priority because they can be done anyway. But if it's not the case, we risk having overly large scope that hinders progress. And that is something 3GPP can ill afford at these times.

17 – Fujitsu Limited

Yes

18 – NEC Corporation

Support in general.

For inter-CU case, we think it should be precluded already from the beginning in order to complete the work successfully on time.

19 – ZTE Corporation

For MR-DC, we think it depends on whether MR-MC will be merged into mobility WI. MR-MC has been discussed in the CA/DC enhancement thread and have majority support. If MR-MC has been merged here, then we think the NR-DC related enhancement will be merged to MR-MC and will be promoted to high priority topics. Otherwise, it is fine to mark the NR-DC as second priority in mobility.

For inter-CU case, we also think it should be precluded at very beginning.

20 – Ericsson LM

Bullet 2: We can put "intra-CU inter-DU" as second priority to get a more focused WI that does not risk delay. If we later realize WGs have spare capacity, we can add "intra-CU inter-DU" later.

Inter-CU will likely have very large impacts and could be postponed to a later release, meaning we don't need to do this even with lower priority.

Other than this the proposal looks good!

21 – VODAFONE Group Plc

We would refer to have MR-DC in the initial priority list, but otherwise the list is fine

22 – VODAFONE Group Plc OK to accept the opinion of the majority, BUT any service-level-agreement we offer to customers tends to be dominated by the worst case scenario, i.e. inter-CU is an important case (and inter-CU is probably more frequent than the intra-CU case).
23 – RadiSys We agree to the prioritization of scenarios proposed by Moderator
24 – Intel Corporation (UK) Ltd We also consider MR-DC is the important scenario, and would prefer to put it under first priority. In addition, too avoid the restriction implied by the term L1/L2, we should add a Note "Note: the term of L1/L2 mobility does not preclude the L3 signalling for mobility"
25 – SHARP Corporation Agree
26 – LG Electronics France Yes
27 – ROBERT BOSCH GmbH We support the proposal

Proposal 3: The following aspects should be specified for L1/L2 mobility:

(1) Configuration and maintenance for multiple candidate cells [RAN2, RAN3];

(2) Dynamic switch mechanism among candidate serving cells for the potential applicable scenarios [RAN2, RAN1];

(3) L1 enhancements, including inter-cell/mTRP beam management L1 measurement, timing management (if needed, as a second priority) [RAN1, RAN2, RAN4];

(4) FR2 specific enhancements for L1/L2 mobility [RAN2, RAN1, RAN4].

Feedback Form 14: Do you agree proposal 3?

1 – Futurewei Technologies Yes.
2 – MediaTek Inc. Yes.
3 – vivo Mobile Communication Co. In general, we agree with the proposal. Besides, L1/L2 measurement and dynamic switch based on both DL/UL signals should be considered.

4 – Beijing Xiaomi Mobile Software

We can follow majority view. However, 4) may need further clarification.

5 – China Telecommunications

Yes.

6 – Qualcomm CDMA Technologies

Agree

7 – Apple Hungary Kft.

Agree

8 – InterDigital France R&D

Agree, however, for bullet 4, we think RAN1 should be the leading group for this work (and be listed first).

9 – Samsung Research America

For further exact scope, we would like to request to update the third bullet as follows:

(3) L1 enhancements, including inter-cell/mTRP beam management L1 measurement **and reporting, beam indication, and** timing management (if needed, as a second priority) [RAN1, RAN2, RAN4];

Also, since already targeting FR2 either, the fourth bullet is not required.

10 – China Unicom

Agree.

11 – NTT DOCOMO INC.

Agree. Also fine to delete the last bullet since both FR1 and FR2 should be considered for L1/L2 mobility.

12 – ZTE Corporation

Agree

13 – Guangdong OPPO Mobile Telecom.

Agree

14 – CATT

Agree

15 – HuaWei Technologies Co.

Agree. As both FR1 and FR2 would be considered, we are also OK to remove bullet 4.

16 – Spreadtrum Communications

Agree, we are also fine to remove the last bullet.

17 – Nokia Corporation

For 1), we would propose to use ”**Procedures**, configuration and maintenance” so it’s clear RAN2 defines how the overall mechanism will work.

For 2), it’s better to remove the ”dynamic” to avoid having huge discussions on how ”dynamic” it will be. That discussion has to anyway happen and ”dynamic” can mean many things.

For 3), Samsung wording proposals look good.

For 4), we think having some emphasis for FR2 (e.g. in 4) is good: to avoid having the design based on FR1 and not easily suitable for FR2.

18 – Fujitsu Limited

Yes

19 – NEC Corporation

Support in general

20 – Lenovo (Beijing) Ltd

Agree

21 – MediaTek Inc.

More comments

For 1), we do not see the need to add ”Procedure” as Nokia suggested. We think 2) is about the procedure.

For 2), switch mechanism among candidate serving cells can be based on **DL or UL signal**.

For 3), if real mobility via L1/L2 signaling is to be supported, timing management is important, otherwise we may be restricted to a multi-TRP scenario. Therefore we should **remove ”(if needed, as a second priority)”** . Also we agree with Samsung’s suggestion to add beam reporting and indication. Therefore, 3) may be revised as: **L1 enhancements, including inter-cell/mTRP beam management, L1 measurement and reporting, beam indication, and timing management.**

22 – ZTE Corporation

For ”**Dynamic switch mechanism among candidate serving cells for the potential applicable scenarios [RAN2, RAN1];** ”, since inter-DU case will be considered, we think RAN3 will be invovled as well.

23 – China Mobile Com. Corporation

Agree

24 – Ericsson LM

It looks good in general. Some small comments:

We think there should be no user plane impact so that the benefits of L1/L2 mobility can be achieved over RRC driven mobility.

Note, there is a missing comma in bullet 3:

(3) L1 enhancements, including inter-cell/mTRP beam management**<missing comma>** L1 measurement, timing management (if needed, as a second priority) [RAN1, RAN2, RAN4];

25 – VODAFONE Group Plc

Agree in general

26 – Intel Corporation (UK) Ltd

Yes, we agree proposal 3.

27 – SHARP Corporation

Agree

28 – LG Uplus

We cannot agree that DAPS for DC is excluded. Crucial pain point for DC is HO now. It should be enhanced.

29 – RadiSys

We agree to the proposal. We think dynamic switching might have some RAN3 impacts as well for notification of switching.

30 – LG Uplus

Sorry for the above comments being located in wrong place.

31 – LG Electronics France

LGE: Yes but for (3), we think, the concerned enhancements are not necessarily limited to L1. Thus, we suggest changing the term 'L1' to 'L1/L2'; L1/L2 enhancement, including inter-cell/mTRP beam management with L1/L2 measurement, timing management.

Proposal 4: it is proposed to consider DAPS for FR2-FR2 in Rel-18.

Feedback Form 15: Do you agree proposal 4?

1 – Futurewei Technologies

Our understanding is that DAPS for FR2-FR2 was considered challenging for practical implementation by RAN4 in Rel-16. Considering the usually heavy RAN4 load, should we add a note that it is subject to RAN4 workload management?

2 – MediaTek Inc.

The reason why DAPS for FR2-FR2 was not supported in Rel-16 was RAN4 issue, we should add a note about potential RAN4 opinion.

3 – vivo Mobile Communication Co.

We are not sure whether DAPS enhancement is critical for FR2 if L1/L2 based inter-cell mobility has been specified, considering L1/L2 inter-cell mobility would have more chance to be deployed in 5G.

Besides, according to the discussion during intermediate phase, it seems DAPS for FR2-FR2 has less support than any of DAPS/CHO enhancements.

4 – Beijing Xiaomi Mobile Software

Although DAPS is the only way to achieve 0 ms interruption, we agree with other companies that RAN4 should be consulted on the feasibility of DPAS in FR2.

5 – China Telecommunications

We agree with this proposal, DAPS solution is the best way to achieve 0ms interruption.

6 – Qualcomm CDMA Technologies

Agree with the conclusion. The workload for WGs will be up to RAN to decide, considering all the approved Study and Work Items, and it is business as usual.

7 – Apple Hungary Kft.

Agree with the moderator's summary on this.

8 – InterDigital France R&D

We think the opinions on this are split, and it should be discussed further. If consensus is not reached, this specific aspect can be down-prioritized as it is not essential given the support of L1/L2 mobility also for FR2.

9 – Samsung Research America

We are really worried about heavy UE complexity resulting from FR2-FR2 DAPS HO, even though the majority view was to introduce it.

On the other hand, the supports for MBB/RACH-less and both (i.e. DAPS for FR2 & MBB/RACH-less) are totally 9 (5 + 4). Thus, we don't think there was less support for MBB/RACH-less.

Since the enhancements for MBB/RACH-less result in just minor update in the specification, we would like to ask the support again.

10 – China Unicom

If multi-TRP and multi-panel is supported for FR2, then we support P4.

11 – ZTE Corporation

We understand the DAPS based solution can provide slight better performance. However, we also think the complexity has to be taken into account to ensure the feature can be implemented in the market. If only few UE can support this then the feature seems less useful. Considering the complexity is not crystal clear at this stage, we prefer to keep both solutions (i.e. DAPS and MBB/RACH-less) on the table, and postpone the down selection to WI phase.

12 – Guangdong OPPO Mobile Telecom.

We think DAPS for FR2-FR2 should be down-prioritized as companies have not reach consensus on supporting it.

13 – CATT

Agree.

14 – HuaWei Technologies Co.

Agree with the moderator's proposal.

15 – Spreadtrum Communications

Agree

16 – Nokia Corporation

One way to resolve this would be to say that **a solution for minimizing user plane interruption is considered for FR2-FR2 HO.** Then the exact solution (e.g. DAPS or MBB) can be left for WI phase to be determined and the UE (and network) complexity aspects will be taken into account. While this risks longer discussions, at least it puts the burden on technical merits and complexity analysis while still making it clear that FR2 HO performance is improved.

17 – NEC Corporation

The main difficulty is from RAN4, thus we think it is up to RAN4's decision on whether to support it.

18 – Lenovo (Beijing) Ltd

Agree with Proposal since FR2 will be applied.

19 – NTT DOCOMO INC.

We agree with P4 that would reduce interruption for FR2. RAN4 workload aspects should also be discussed.

20 – Ericsson LM

Agree

21 – China Mobile Com. Corporation

Agree

22 – VODAFONE Group Plc

This feature may not be left to later release due to complexity and time constrains

23 – Intel Corporation (UK) Ltd

In rel-16, RAN4 concluded that DAPS on FR2-FR2 cannot be supported. Therefore this should be confirmed by RAN4 before we agree this.

24 – SHARP Corporation We agree to consider DAPS for FR2-FR2 in Rel-18, but feasibility of this may depend on RAN4 decision.
25 – LG Uplus We cannot agree that DAPS for DC is excluded. Crucial pain point for DC is HO now. It should be enhanced.
26 – RadiSys We are neutral to this proposal. We do not have any strong views
27 – LG Electronics France **We think DAPS enhancements for FR2-FR2 is more appropriate than developing new mobility schemes such as RACH-less HO. But, RAN4 and possibly RAN1 may need to do a initial checking to see whether whether FR2-FR2 DAPS can be done in Rel-18.**

Regarding the specific impact on supporting DAPS for FR2-FR2, it seems the major impact is RAN4. Companies are invited to confirm whether the below is the major impacts:

Observation 1: RAN4 requirements and UE capability to support DAPS for FR2-FR2 [RAN4, RAN2]

Feedback Form 16: Do you agree observation 1?

1 – Futurewei Technologies Yes.
2 – MediaTek Inc. Yes.
3 – vivo Mobile Communication Co. Yes. The main reason why this was not supported in Rel-16 comes from RAN4.
4 – Beijing Xiaomi Mobile Software Agree
5 – China Telecommunications Yes.
6 – Qualcomm CDMA Technologies Yes. Agree with Vivo.
7 – Apple Hungary Kft. Agree

8 – InterDigital France R&D We agree with the observation.
9 – Samsung Research America We agree the majority impact would happen in RAN4 scope. However, we should need to identify practical feasibility, e.g. in UE complexity.
10 – China Unicom Yes
11 – Guangdong OPPO Mobile Telecom. Yes
12 – ZTE Corporation We agree RAN4 and RAN2 will be involved. In addition, we want to clarify whether the observation means no additioanl inter-node coordination will be considered for DAPS FR2-FR2 HO.
13 – CATT Yes
14 – HuaWei Technologies Co. Agree. The detailed impacts on RAN4 can be left to RAN4 for further check.
15 – Spreadtrum Communications Agree
16 – Nokia Corporation See above - RAN4 aspects are critical in this so sufficient time is needed (whichever solution is adopted).
17 – NTT DOCOMO INC. Yes.
18 – NEC Corporation Yes
19 – Lenovo (Beijing) Ltd Yes
20 – Ericsson LM Agree, this is our understanding as well.

21 – China Mobile Com. Corporation Yes
22 – VODAFONE Group Plc Yes
23 – Intel Corporation (UK) Ltd In rel-16, RAN4 concluded that DAPS on FR2-FR2 cannot be supported. Therefore this should be confirmed by RAN4 before we agree this.
24 – SHARP Corporation Yes
25 – LG Uplus We cannot agree that DAPS for DC is excluded. Crucial pain point for DC is HO now. It should be enhanced.
26 – LG Electronics France Yes

Considering the overall workload of R18 and the current very wide scope of mobility enhancement, moderator proposes the following two options and invite companies to have further down selection:

Option 1: Support CHO + MR-DC (pending on Rel-17 progress) in R18.

Option 2: None of the above items will be supported in R18. Further enhancement on this should be postponed until commercial utilization.

Feedback Form 17: Which above-mentioned option do you prefer?

1 – Futurewei Technologies Option 1.
2 – MediaTek Inc. Option 1.
3 – vivo Mobile Communication Co. Option 1 could be considered if time allowed.
4 – Beijing Xiaomi Mobile Software option 1

5 – China Telecommunications

Option1.

6 – Qualcomm CDMA Technologies

Option 1. We would also support adding additional ”CHO/CPC enhancements for FR2”, to improve the robustness (some schemes were discussed in Rel-16 but dropped due to lack of time).

7 – InterDigital France R&D

We prefer option 1 from the above options. However, we think Rel-17 leftovers (CHO + MR-DC, CHO+CPC) should be given higher priority, and so CHO+CPC should also be included as part of the R18 work.

8 – Apple Hungary Kft.

We are ok option-1, but that might not be enough. We think FR2 related beam impairments that we are observing in the field, needs to be addressed at least in Rel-18 and so we think atleast a sub-bullet to include options addressing this should be included, as at least to us, this is not a nice to have, but rather a performance/efficiency topic for FR2.

9 – Samsung Research America

We have a concern that we should select between the options only.

We have assumed that the draft summary was too much down-selected, e.g.

CHO + MR-DC and DAPS + CHO/CPAC got supports from 22 and 20 companies, respectively.

Thus, we don’t think that DAPS + CHO/CPAC and others (including R17 mobility leftover) should be excluded, due to the difference of just 2 a few votes.

We also supports DAPS+CA/DC for FR1, but our company is missed in DAPS+CA/DC company list.

10 – China Unicom

We suggest to consier other enhancements on R16 features such as DAPS + CHO/CPAC, CHO+CPAC.

11 – Guangdong OPPO Mobile Telecom.

Option 1

12 – ZTE Corporation

Option 1.

13 – CATT

Btw these two we’d prefer Option 1.

14 – HuaWei Technologies Co.

We understand this discussion is difficult, and on the other hand we also understand the intention from the moderator to at least converge sth. with a reasonable scoping. In this case, we can accept Option 1.

15 – Spreadtrum Communications

Option 1.

16 – Nokia Corporation

We think these are not necessarily the only options to consider and more discussion is needed (as others have also indicated).

We would propose to continue working on the details of proposed CHO-related objectives (including their motivation) could allow better estimates on TUs needed in each WG and help to get a better picture of what's realistically possible in Rel-18 timeframe.

17 – Fujitsu Limited

Option 1

18 – NEC Corporation

Same view as Samsung that it is down scoped too much. We also suggest to consider other cases like DAPS + CHO, since there are only 2 votes less than CHO + MRDC, and it is the only case that can further improve mobility performance.

19 – Lenovo (Beijing) Ltd

Option1

20 – NTT DOCOMO INC.

We have a concern about narrowing down to option1/2 at this stage, because companies have different views on the proposals with different scenarios in their mind. We should discuss the proposals (including other topics than CHO + MR-DC) further along with possible use cases and gains. For example, we think DAPS + DC/CA is useful for IIoT, while some companies aim for lower complexity UEs by MBB.

21 – Ericsson LM

CHO+MR-DC is useful. However, considering the XR use case (high bit-rate and low interruptions), we think that DAPS+CA/DC is a more important feature, especially DAPS+CA.

It seems that in the previous rounds in this discussion, there were significant support for DAPS+CA.

22 – China Mobile Com. Corporation

We in general support Option1. If time allows, we are open to discuss DAPS+CHO (without DAPS +CPAC since we even don't want DAPS+CA/DC) and CHO+CPAC.

23 – VODAFONE Group Plc

Alternative options as stated above

24 – VODAFONE Group Plc

more discussion would seem useful (but option 1 is preferred over option 2)

25 – Intel Corporation (UK) Ltd

More discussion is needed. So far, Option 1 is unclear to us, does that mean CHO with SCG as discussed in Rel. 17 (then we will have nothing if it will be specified in Rel-17)? Or anything else?

We still prefer to keep DAPS+CA/DC, and DAPS+CHO on the table since it is important to XR and URLLC requirement.

26 – SHARP Corporation

Option 1

27 – LG Uplus

We cannot agree that DAPS for DC is excluded. Crucial pain point for DC is HO in latency perspective not robustness now. It should be enhanced.

28 – RadiSys

We support Option 1

29 – LG Electronics France

We are not sure if listing only two options is acceptable to companies at this moment, given that the amount of expressed support/interest across options is not so different. So let us express our preference over all listed options .

- **1st preference: we think it is reasonable to prioritize left-overs of Rel-17. Given that both CHO+MR-DC and CHO+CPC are pending on Rel-17 progress, Rel-18 can prioritize both CHO+MR-DC and CHO+CPC**
- **2nd preference: Regarding DAPS+CHO/CPAC, we think DAPS+CHO/CPC is beneficial to reduce interruption caused by changing a special cell (here, DAPS+CPC use case needs some clarification whether it is either DAPS+only PSCell or DAPS+PSCell+SCells). We do not see much value of the combination DAPS+CPA, so propose to deprioritize DAPS+CPA.**
- **3rd preference: To us, DAPS+CA/DC is of relatively low priority due to its significant complexity, even though this feature may be useful for mobile XR and etc.**

4.2 Summary

There are serval proposals should be discussed and conduced in the final phase.

All the companies agree with Proposal 1 so it can be taken as consensus of this email discussion.

Conclusion 1: RAN2 is the leading WG for mobility enhancement in Rel-18, while RAN1, RAN3 and RAN4 are impacted WGs.

The majority is fine with proposal 2. 4 companies asked to move MRDC to high priority but 1 company strongly asked this as second priority; 2 companies think intra-CU inter-DU case can be the second priority but not strong, 4 companies want to remove inter-CU case completely, and only 1 company strongly asked inter-frequency should be second priority.

Based on this situation, it is suggested to remove inter-CU case for the time being, as from moderator's observation the comments are valid that inter-CU demands more complicated discussion. Regarding the MR-DC part, although several companies indicated higher priority, the exact scenarios to be supported are not the same. Therefore it is suggested to maintain it in second priority, but this can be revisited if the target becomes clearer. Companies are encouraged to bring contributions to make clear proposal on which scenarios for MR-DC are required to be high priority, if deemed necessary. Thus the proposal 2 is updated as below.

and Proposal 2 is updated as below.

For L1/L2 mobility, the following scenarios will be considered:

prioritized scenarios:

(1) Standalone, CA

(2) Intra-DU case and intra-CU inter-DU case

(3) Both intra-frequency and inter-frequency

(4) Both FR1 and FR2

second-priority scenarios only if time is allowed (can be revisited once the scenarios are clearly described):

(1) MR-DC

All companies are fine with Proposal 3 and some companies suggested to have some rewordings for clarity. Some companies think the last bullet is not specifically required as both FR1 and FR2 are agreed to be applicable. The moderator think some of the editorial comments make sense and Proposal 3 is updated as below. On the other hand this is just high-level description and detailed refinement can be further discussed, and companies are encouraged to focus on the major aspects instead of going into too many details.

In summary, the L1/L2 mobility discussion has very good convergence, and the overall summary can be seen below:

Conclusion 2: L1/L2 inter-cell mobility got very wide support and should be specified in Rel-18 with the following high-level objectives:

To specify mechanism and procedures of L1/L2 based inter-cell mobility :

Configuration and maintenance for multiple candidate cells [RAN2, RAN3];

Dynamic switch mechanism among candidate serving cells for the potential applicable scenarios [RAN2, RAN1];

L1 enhancements, including inter-cell/mTRP beam management, L1 measurement and reporting, beam indication and timingmanagement (if needed, as a second priority) [RAN1, RAN2, RAN4];

NOTE:FR2 specific enhancements are not precluded, if any.

NOTE: the procedure of L1/L2 based inter-cell mobility are applicable to the following scenarios:

Prioritized scenarios:

- Standalone, CA
- Intra-DU case and intra-CU inter-DU case
- Both intra-frequency and inter-frequency (can be revisited)
- Both FR1 and FR2

Second-priority scenarios only if time is allowed (can be revisited once the scenarios are clearly described):

- MR-DC

Regarding proposal 4, all the companies agree the major impact would be in RAN4 scope. Around 15 companies explicitly indicate the support of DAPS for FR2-FR2 where 2 companies also support MBB/RACH-less as well due to UE complexity. Some companies have asked this to be further discussed/confirmed in RAN4. Since RAN4 is the major WG to evaluate this and the moderator also observed there were already discussion in RAN4's email thread on this topic , we can keep Proposal 4 as the assumption and leave the final decision to RAN4.

Conclusion 3: DAPS for FR2-FR2 is assumed to be specified in Rel-18, and the major impact is in RAN4. So the final decision is left to RAN4.

Considering the overall workload of R18 and the current very wide scope of mobility enhancement, moderator proposes the following two options and invite companies to have further down selection:

Option 1: Support CHO + MR-DC (pending on Rel-17 progress) in R18.

Option 2: None of the above items will be supported in R18. Further enhancement on this should bepostponed until commercial utilization.

Support Option 1 (17): Futurewei, MediaTek, vivo, Xiaomi, China Telecommunication, Qualcomm, InterDigital, Apple, Oppo, CATT, Huawei, Spreatrum, Fujitsu, Lenovo, Ericsson, CMCC, Vodafone

Support other enhancements (5): Qualcomm, InterDigtal, Samsung, China Unicom, Nokia

In addition to the above, it is worth mentioning in the XR discussion, a considerable number of companies also proposed to support DAPS+CA/DC due to the high data rate for XR services. This was proposed by Samsung, Docomo, Ericsson, Intel etc. again. As XR topic has a converging conclusion that this would be considered in mobility discussion, the moderator in this case propose to consider DAPS+CA/DC for XR services. Another thing mentioned in XR is to support DAPS for FR2, which has already been addressed above and so no need to repeat here. On the other hand, this does not indicate we re-open this discussion to add more things as the majority can accept Option 1 only, and so it is suggested that Option 1 and DAPS with CA/DC can be further considered in Rel-18.

There were also discussion under CA/DC enhancements whether fast CG change should be considered under mobility. However from the moderator's observation, unlike XR topic, the discussion was diverging on the supported scenarios and thus it is not mature to discuss here.

Conclusion 4: As the baseline, CHO+MRDC and DAPS+CA/DC will be considered in Rel-18. Other items (i.e., DAPS+CHO/CPAC ,CHO + CPC) will be further discussed online.

Primary responsible WG: RAN2

Secondary responsible WG: RAN1, RAN3, RAN4

The following objectives of this part are described as below and moderator suggests to use it as baseline for further discussion:

CHO enhancements in MR-DC scenario

Procedure and configuration of CHO in MR-DC scenario [RAN2, RAN3];

DAPS operation for CA/DC

Support simultaneous configuration and procedures of DAPS and CA/DC [RAN2, RAN4].

5 Conclusions

Conclusion 1, 2 and 3 are non-controversial.

Conclusion 1: RAN2 is the leading WG for mobility enhancement in Rel-18, while RAN1, RAN3 and RAN4 are impacted WGs.

Conclusion 2: L1/L2 inter-cell mobility got very wide support and should be specified in Rel-18 with the following high-level objectives:

To specify mechanism and procedures of L1/L2 based inter-cell mobility

(1) Configuration and maintenance for multiple candidate cells [RAN2, RAN3];

(2) Dynamic switch mechanism among candidate serving cells for the potential applicable scenarios [RAN2, RAN1];

(3) L1 enhancements, including inter-cell/mTRP beam management, L1 measurement and reporting, beam indication and timing management (if needed, as a second priority) [RAN1, RAN2, RAN4];

NOTE: FR2 specific enhancements are not precluded, if any.

NOTE: the procedure of L1/L2 based inter-cell mobility are applicable to the following scenarios:

Prioritized scenarios:

(1) Standalone, CA

(2) Intra-DU case and intra-CU inter-DU case

(3) Both intra-frequency and inter-frequency (can be revisited)

(4) Both FR1 and FR2

Second-priority scenarios only if time is allowed (can be revisited once the scenarios are clearly described):

(1) MR-DC

Conclusion 3: DAPS for FR2-FR2 is assumed to be specified in Rel-18, and the major impact is in RAN4. So the final decision is left to RAN4.

DAPS/CHO enhancements is the controversial part but moderator still suggests to try the conclusion 4 online because it is one-step forward with enough flexibility.

Conclusion 4: As the baseline, CHO+MRDC and DAPS+CA/DC will be considered in Rel-18. Other items (i.e., DAPS+CHO/CPAC ,CHO + CPC) will be further discussed online. The following description can be used as the baseline for further discussion on the scoping of objective on DAPS/CHO enhancements:

To specify mechanism and procedures for CHO enhancements in MR-DC scenario

- Procedure and configuration of CHO in MR-DC scenario [RAN2, RAN3];

To specify mechanism and procedures for DAPS operation for CA/DC

- Support simultaneous configuration and procedures of DAPS and CA/DC [RAN2, RAN4]