RWS-210562 Email discussion summary for RAN-R18-WS-non-eMBB-CMCC - Version 0.0.6
RAN

3GPP TSG-RAN Rel-18 Workshop RWS-210562

Electronic Meeting, June 28-July 2, 2021

Agenda item: 4.2

Source: Moderator (CMCC)

Document for: Discussion

1 Introduction

This document is used for email discussion before the workshop to collect comments/questions from companies for the submitted contributions of CMCC under agenda item 4.2 and provide answers.

CMCC submitted 9 contributions under agend item 4.2, including one overview [1] and five seperate topics (URLLC through dual UEs[2][3], RSU-like network node[4][5], Inter-UE Handover or Replication for Same User[6][7],Further enhancement of RAN slicing[8], Requirements from automotive industry [9]). The following sections are structrued as following.

Section 2 is used for collecting comments/questions in 1st round emaill discussion, in which section 2.1 is to collect the general comments, and section 2.2 is used to collect comments/questions regarding URLLC through dual UEs[2][3], and section 2.3 is used to collect comments/questions regarding RSU-like network node[4][5], and section 2.4 is used to collect comments/questions regarding Inter-UE Handover or Replication for Same User[6][7], and section 2.5 is used to collect comments/questions regarding Further enhancement of RAN slicing[8], and section 2.6 is used to collect comments/questions regarding Requirements from automotive industry [9]. Section 3 is used for providing answers to the comments/questions in 1st round.

Section 4 is used for collecting comments/questions in 2nd round emaill discussion, and Section 5 is used for providing answers to the comments/questions in 2nd round. They are structrued similar as in section 2 and 3.

2 [1st Round] Comments/Questions

2.1 General Comments in 1st Round

Feedback Form 1: General Comments in 1st Round

2.2 URLLC through Dual UEs

Feedback Form 2: Comments/Questions on URLLC through Dual UEs[2][3]

1 – LG Electronics Inc.

We share the identified issue of legacy backup mechanism and see the need for enhancement. LG also highlighted in RWS-210229 the cost of legacy backup mechanism and proposed some enhancement for better resource-efficiency. To understand more on the potential enhancement area, we would like to ask

Q1. What kind of mechanism do you consider in order to avoid data disorder in backup UE transmission/reception?

Q2. Given that it is mentioned group scheduling for data reception in multicast mode, we would like hear more on uplink scheduling. Do you assume shared resource in uplink?

2 – Sony Europe B.V.

1) What is the latency is expected in switching over to backup UE under dual UE operations?

2) Which layer is the messaging expected to be, in failure detection and indication of switching to backup UE?

3 – Spreadtrum Communications

Thanks for the well-written contribution,we have some questions.

1. Does UE1 and UE2 locate in different cells or a same cell ?
2. How to determine the first UE which will transmit the packet?
3. For the basic mobility with service continuity, what are key issues or problems need to considered?

4 – vivo Mobile Communication Co.

Thank you for the contribution. We are quite interesting about this use case. It is similar with our case1.1 and case1.2 in our Tdoc RWS-210172(PIOT). How to connect two UEs in CMCC mind?

5 – HuaWei Technologies Co.

We have similar undertanding on this motivation, see RWS-210454.
Is group scheduling having specific impact on UE backup? We think this may be a general consideration under MBS.
We think the latency and reliability should still be fulfilled during taking over procedure, and therefore do you think this area should consider that UL traffic data needs to be generated to both UEs and only one UE transmits to the network?

6 – Nokia Germany

-

For this to work, one prerequisite is that RAN is aware that two or more UEs are deployed to provide backup for the same service (e.g. signalled by the core network). SA2 already studied the topic: Redundant user plane paths based on multiple UEs per device (TS 23.501 Annex F (informative)), and it was concluded not supporting such feature and it is only included for information. Without support from CN, how RAN enhancements can work?

-

What would be the benefit of standardized solutions compared to higher-layer/RAN-transparent solutions such as 2 or more UEs serving the application and using e.g. MPTCP to select the best UE at any given time or FRER based solution?

7 – Intel Corporation (UK) Ltd

Q1: For the URLLC requirement from RWS-210342 of 4ms, 99.9999% @ 400UE/5000m2, do you have estimates which fraction of the latency could be up to radio interface? Also, for the 400UE/5000m2, how many gNBs/TRP in which spectrum could be typically assumed based on your trials?"

Q2: Do you think RAN1 study or work is required? If yes, what would be the main RAN1 part to focus? To us this looks like a higher layer issue, and may even be supported by existing mechanisms.

8 – Lenovo Mobile Com. Technology

Thanks for the interesting proposals! we think such kind of backup could provide potential benifits to high reliability scenario, and we have following questions for further understanding

1. when the backup UE to take over working UE needs inter-UE coordination, and how does such coordination done in your mind e.g. via direct link between UEs or signaling from network

2. although the figure illustrate 2 UEs in the scenario, but in normal text *multiple UE* is used. Does this implies more than two UEs can be deployed and does there has max UE number limitation?

3. for the group scheduling and multicast mode, what will be the difference compared with ongoing MBS features in your mind?

9 – TCL Communication Ltd.

Q1: Would lossless switching be supported during taking over procedure?

Q2: What is the latency requirement which will impact designing the switching over procedure?

10 – ZTE Corporation

Thanks for the interesting contribution. We have several clarification questions.

1. Does 'real-time' backup mean 0ms interruption for backup?

2. For group scheduling, what's the difference compared to the mechanisms in Rel-17 MBS?

3. Compared to UE aggregation you proposed in another contribution, is it a correct understanding that this proposed SID is not focus on simultaneous transmission/reception from multiple UEs?

11 – Huawei Tech.(UK) Co.. Ltd

Regarding URLLC through dual UEs, we agree that so far 3GPP has not addressed the reliability of the UE itself. We have also raised this topic in RWS-210454.

12 – Qualcomm Incorporated

Use of dual-UE was specified at architecture level by SA2 in Rel-16. Is the proposal for dual-UE to study the performance/functional gaps at RAN level under the SA2 specified architecture, or to also consider new architectures?

13 – Apple Portugal

We think It should be studied in SA first, because the assumption is that gNB can recognize the two UEs are backup to each other, and trigger the link switch based on some condition, which should be first studied and identified in SA2.

14 – Qualcomm Technologies Int

1. In Figure 3-2 and 3-3, is the smartphone in the picture acting as a SL or non-3GPP access relay? Are Rel-17 SL L2 or L3 relay or both considered for the smartphone?
2. For multi-UE backup, is there a direct connection between the UEs assumed or is it coordinated via gNB?

15 – Asia Pacific Telecom co. Ltd

Many thanks for sharing the interesting proposal.

Do you also consider improving UL throughput as a target here? What is the difference between multiple-UE backup scheme and UE aggregation scheme (RWS-210355) besides using PC5 interface between multiple UEs for multiple-UE backup scheme?

16 – NTT DOCOMO INC.

Thanks for raising this interesting topic. we have question regarding how the back up UE can be informed of failure e.g. through gNB or sidelink communcation or both in your assumpation. If the former one, after RLF, how can the failed UE to indicate backup request to gNB and how the remaining UL data in UE buffer can be tranfered to the backup UE? It ssems, in either way, the latency requirement for back up procedure may be necessary to be studied first. Also, is it possible for the backup UE to reject the back up request for various reasons e.g. incapble of handling multiple back-up requests from multiple UEs come or high load condition inside the UE?

17 – Beijing Xiaomi Mobile Software

Thanks for the response! One question for clarification:

For for the group scheduling and multicast mode, you said the difference compared with ongoing MBMS is that only one UE decode. Is you want a enhancement to the current MBMS that the NW will indication a UE not decode the MBMS service?

2.3 RSU-like Network Node

Feedback Form 3: Comments/Questions on RSU-like Network Node[4][5]

1 – CATT

Thanks for the contribution. We have two question for clarification.
1) It seems such node is using PC5 to communicate with the UEs. We'd like to understand whether it requires enhancement to the R17 SL relay mechanism?

2) Is there any mobility requirement for such type of node?

2 – LG Electronics Inc.

Q1: Can you elaborate on the difference from the sidelink relay UEs that are deployed by the operator?

3 – Intel Corporation (UK) Ltd

What's the difference between RSU-like and IAB node? Why can't an IAB node help address the use case?

4 – InterDigital

One of the objective of the work includes discovery and reselection. In your view, how would RSU discovery and (re)selection be different from the Rel-17 relay discovery and reselection, given that RSU will support PC5?

5 – Apple (UK) Limited

We are wondering the difference between RSU like network node and sidelink relay? if any enhancement is needed, perhaps we can merge it into sidelink relay?

6 – ZTE Corporation

Thanks for the contribution. It looks like that the RSU-like network node is of gNB type but can communicate with UE via PC5 interface. In addition to this, could you please clarify what is the other fundamental difference between the operation of RSU-like network node and U2N relay UE?

7 – Fujitsu Limited

1. It seems that RSU-like node behaves like relay UE. Considering that RSU-like node should be more powerful than a regular UE, could you clarify a bit more on the difference between RSU-like node and relay UE?
2. As for the network interface between RSU-like node and gNB, it is assumed to be Uu interface or it can be some interfaces else?

8 – MediaTek Inc.

Thank you for the contribution. We would like to understand better the relation between this proposal and the Rel-17 U2N relay functionality using an RSU as a relay UE. Our understanding is that the main difference is in the backhauling (network interface vs. Uu), and the SID tasks RAN3 to look at the definition of the network interface, but we are a bit unsure what the functional difference should be in this network interface compared to Uu backhauling for a relay.

9 – Samsung Electronics Co.

Q1: How does "RSU-like network node supporting access via PC5 and backhauling via network interface between RSU-like node and gNB" differ from Rel-17 UE-2-NW relay?

Q2: Do you have any specific AS layer feature to be defined for RSU-like node comparing from SL U2N relay in R17?

2.4 Inter-UE Handover or Replication for Same User

Feedback Form 4: Comments/Questions on Inter-UE Handover or Replication for Same User[6][7]

1 – Beijing Xiaomi Mobile Software

Thanks for the contributions.

We are interested in this use case of negotiation/coordination procedures between multiple UE devices for back up reasons.

For objectives of the UE handover case□

1□"Target device(s) discovery [RAN2]": Are you meaning we need to specify the interface between those UEs?

2) "Study user plan functionalities that will support data forwarding": are you meaning the data forwarding between those UEs?

For objectives of the UE handover case□

1) Identify required specification changes on the group scheduling options to allow multiple UEs to receive signalling/data in Multicast mode:

Can this be achieved by the current MBMS?

And what is the purpose of this objectives? Are we still want to enhance the existing backup mechanism?

2 – Spreadtrum Communications

Thanks for the contribution.

We share the similar views in objective1 and objective2.

For the objective3, is the data forwarding amongst multiple devices of the same end-user performed via the direct inferface between UEs?

3 – vivo Mobile Communication Co.

Thank you for the contribuition. We are quite interesting about this use case. It is similar with our case1.1 and case1.2 in our Tdoc RWS-210172(PIOT). How to connect two UEs in CMCC mind?

4 – Intel Corporation (UK) Ltd

Can you explain what are the drawbacks from application layer service continuity? Is there a the strong motivation to support this functionality within the 5G network?"

5 – Lenovo Mobile Com. Technology

Thanks for the interesting proposals! we have some questions for further understanding

1. target device discovery: does this mean sidelink is used for discovery between UEs? we understand sidelink has mature discovery function and could be served as a baseline solution for further study, but not sure if is your intention here

2. for control plane procedure and user plane procedure, how does RAN identify two UEs belongs to the same end user? does application layer need to be invovled? we would like to have more clarification here.

6 – ZTE Corporation

Thanks for your contribution. The inter-UE transfer scenario looks very interesting and useful. We have following questions for clarification:

1) How could the CN or RAN detect the nearby alternative UE and then trigger the inter-UE transfer? e.g. based on sidelink or positioning?

2) For the data flow, what is your main target? switch from one device to another device, or maintain two or more legs towards different UEs? For the latter one, does it mean that data split or data duplication should be supported? For the replication, should the PTM transmission could be used?

7 – TCL Communication Ltd.

This topic is interesting. Would you please explain a little bit more under which scenario ”transfer” is used instead of ”switching”, and vice versa?

8 – Apple Portugal

Both CN based or RAN based solutions should be studied in SA first. CN based solution should be studied in SA. And for RAN based solution, since gNB is able to recognize the two UEs are associated, the UE association and identification issue should be also studied in SA first.

9 – NTT DOCOMO INC.

Thanks for your contribution. we are interested in how the service continuity can be guaranteed. For DL data, the application layer solution seems work as well. For UL, Is it necessary to replicate the UL data in UE buffer to antoher device in your assumpation?

10 – MediaTek Inc.

Thank you for the contribution. In the concerned scenario, are there any UP or even application layer impacts expected?

11 – Nokia Germany

Since none of the intended applications seem to be latency/reliability-critical, what would be the main benefit of doing this inside the 5GS (RAN and/or core) compared to application-based approach (note that this kind of device handover is already supported by many of the listed applications e.g. msoft Teams, Spotify, etc.). Do you think these benefits justify the envisioned spec impact?

12 – Beijing Xiaomi Mobile Software

Thanks for the response!

2 questions for clarification:

1)For the benefits over the app layer, you mentioned ”the drawback from application layer service continuity is the restriction of the different UEs should belong to a same vendor”, is possible that devices of the same end-user will from different vendors?

In this case, will they still use the PDN session for sharing? I do not know whether there will be SA2/SA3 impact.

And except for this, do you see other more benefits over app layer?

2)For the the UL service continuity, do you mean replicate the UL data in UE buffer to another device by the interface of the 2 UEs?

2.5 Further enhancement of RAN Slicing

Feedback Form 5: Comments/Questions on Further enhancement of RAN Slicing[8]

1 – ZTE Corporation

Thanks for your proposal. We also see the need for further enhancement for RAN slicing to continue the work for slice remapping and evaluate the RAN impact of Rel-18 progress in other WG (SA1/SA2). Further enhancement on slice aware cell (re)selection can also be considered in addition to what we have in Rel-17.

In addition, we are interested in UE leverage different slice resource in MN and SN as mentioned in our paper RWS-210482.

For the following bullet:

For non-supported slice by the serving cell, the solutions to support UE to access to the intended slice by setting up DC or CA can be considered.

We understand this can be supported via implementation to a certain extent so we are wondering what would be the potential spec impact.

2 – Intel Corporation (UK) Ltd

As discussed in Rel-17, performing cell reselection at the point that MO is triggered does not provide fast access. Also this situation will not happen if allowed slices are uniform across a TA. What has changed to include such scenario for Rel-18?

3 – Apple (UK) Limited

We generally support to further discuss Rel-17 leftover issues and new SA2 solutions. In addition to the three listed Rel-17 leftover issues, we need to double check the list after RAN2 progress more. Regarding using DC/CA for non-supported slice by serving cell, we think it can be already supported?

4 – Huawei Tech.(UK) Co.. Ltd

Thank you for the contribution.

Do you believe that the SA1 requirements to enhance UE access to the slices will be full filed by completion of rel-17 left over or new mechanism needs to be study?

5 – CATT

Thank you for the proposals.In general,we share the similar view that further enhancement on slicing should be considerred in Rel-18.For MO triggered slice based cell reselection,we are wondering whether the issue of homogeneous TA should be resolved first?

6 – Samsung Electronics Co.

We agree to continue the work of R17 leftovers. And for the proposal "For non-supported slice by the serving cell, the solutions to support UE to access to the intended slice by setting up DC or CA can be considered." Could you please clarify more? What enhancement could be in R18? Our understanding is this is already supported by NW even in R15/16. and R17 will do.

7 – LG Electronics UK

Thanks for the proposal. We agree that RAN slicing enhancements should be discussed in Rel-18 to address further network slice enhancements discussed in SA1/SA2. If any of Rel-17 ongoing discussion is not finalized, we can continue discussion in Rel-18.

Regarding CA/DC configuration for non-supported slice by the serving cell, do you expect to enhance the slice uniform availability principle in Rel-18, or assume uniform availability in Rel-17 considering enhancements between network elements ?

2.6 Requirements from Automotive Industry

Feedback Form 6: Comments/Questions on Requirements from Automotive Industry[9]

1 – Sony Europe B.V.

In RWS-210350, Slide 9, you have the following requirement:

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Chip capability: Self-contained is not supported in the chip and URLLC should be compatible with the current chip ecosystem.

Can you clarify what is meant by self-contained chip capability that is not supported?

2 – ZTE Corporation

In RWS-210350, page 9, the requirement in Rel-16 URLLC for factory automation is 32 byte packets, 1ms latency and 99.9999% reliability. So, is the intention of the new proposed URLLC requirement is to relax the latency while increase the user density? What's about the packet size?'

3 – Fraunhofer HHI

Q1: Based on the requirements listed for 5G-Advanced, would you be interested in location-based resource configurations that would result in high resource efficiency to achieve the perception use case? It could optimize power consumption as well, as described in our contribution RWS-210325.

Q2: Would you rather prefer a RedCap UE (<5MHz bandwidth) instead for the same use case?

4 – Intel Corporation (UK) Ltd

We posted this question in the first feedback form but maybe it is more appropriate for this one. Therefore it is repeated here.

Q1: For the URLLC requirement of 4ms, 99.9999% @ 400UE/5000m2, do you have estimates which fraction of the latency could be up to radio interface? Also, for the 400UE/5000m2, how many gNBs/TRP in which spectrum could be typically assumed based on your trials?"

5 – Qualcomm Incorporated

Thanks for the overview of requirements for IIoT. Could you elaborate on the URLLC desired improvements for the case of different TDD configurations for indoor and outdoor. If the indoor UEs are served by indoor gNBs, and outdoor UEs are served by outdoor gNBs, would the factory walls provide enough

isolation? Or is it also a case of interest that some indoor UEs are served by the outoor network (e.g. due to CAG/NPN restriction for the indoor network?).

6 – Samsung Electronics Co.

1. What is your view on Rel-18 WI: independent Wis for URLLC enhancement, postioning enhancement, and passive IoT? Or one WI for all of them?
2. Is high cost of UWB positioning from equipent cost by itself? Could you provide further details for this point?
3. Which RAT-based positioning technique do you envision for passive IoT?
4. What kinds of RAN enhancements are required for massive URLLC?

7 – Intel Corporation (UK) Ltd

<2nd round questions>

Comment box in Section 4 [2nd Round] is not active and so we put our 2nd round questions here.

Further Q: Thanks, for Q1 we've placed the question in 2.6 as well. But Q2 was intended for this section. Thus, could you please answer Q2?

3 [1st Round] Answers

3.1 General

3.2 URLLC through Dual UEs

Answers on URLLC through Dual UEs[2][3]

LG Electronics Inc.

1

We share the identified issue of legacy backup mechanism and see the need for enhancement. LG also highlighted in RWS-210229 the cost of legacy backup mechanism and proposed some enhancement for better resource-efficiency. To understand more on the potential enhancement area, we would like to ask

Q1. What kind of mechanism do you consider in order to avoid data disorder in backup UE transmission/reception?

Q2. Given that it is mentioned group scheduling for data reception in multicast mode, we would like hear more on uplink scheduling. Do you assume shared resource in uplink?

Answer

For Q1 and Q2, there two alternatives as follows:

Alt 1) If one UE can detect the state (normal or false) of the associated UEs fast enough, which depends on the approximately zero transmission delay over the connection between the UEs and extremely high frequent heartbeat exchange, for DL, there will be a logical common layer to switch the data of the service to the leg of

another UE in DL and align the between the two UEs in network to avoid the data disorder when the fault of one UE had been detected. For UL, since there will be a connection between the two UEs with a logical common layer to switch the data to another UE in UL and align the SN allocation between the two UEs when the fault of one UE had been detected. And the logical common layer can be located in application layer or L2-layer, e.g. PDCP.

Alt 2) If one UE cannot detect the state (normal or false) of the associated UEs fast enough, which depends on the transmission delay over the connection between the UEs and frequency of the heartbeat exchange, for DL, there will be a logical common layer to forward the multiple copies of the data towards the involved UEs for backup and align the SNs between the two UEs in network to avoid the data disorder. For UL, since there will be a connection between the two UEs with a logical common layer to forward the multiple copies of the data towards the involved UEs to another UE in UL and align the SN allocation between the two UEs. And the logical common layer can be located in application layer or L2-layer, e.g. PDCP. However, in the normal case, there is only one UE decode/encode and process the data in DL/UL although the data had been delivered to all associated UE for backup. Only in case of any failure in one of the UEs, the subsequent associated UE is to take over the service(s) of the UE in abnormal state, i.e. to start decoding/encoding and processing the data in DL/UL previously for the UE in abnormal state.

Sony Europe B.V.

2

1) What is the latency is expected in switching over to backup UE under dual UE operations?

2) Which layer is the messaging expected to be, in failure detection and indication of switching to backup UE?

Answer

Since this is for URLLC's high reliability performance requirement, the total latency taking the switching latency into account must meet the latency performance target defined for URLLC, e.g. the extremely stringent low end-to-end latency is 1ms.

Spreadtrum Communications

3

Thanks for the well-written contribution, we have some questions.

1. Does UE1 and UE2 locate in different cells or a same cell ?

2. How to determine the first UE which will transmit the packet?

3. For the basic mobility with service continuity, what are key issues or problems need to considered?

Answer:

For Q1, there is no limitation on the use case which is the UEs in different cells or a same cell, however, the UEs are connected to a same cell in our understanding is the main case.

For Q2, the determination of switching occasion/backup triggering can be through the detection by the associated UE through Heartbeat Mechanism which can be left to the implementation:

Under normal circumstances, terminal 1 and terminal 2 are responsible for different services respectively

If the data/signalling cannot be successfully received by the terminal 1, then the subsequent associated terminal 2's action is that the terminal2 is to take over or start/activate the service(s) of the terminal1 declaring in abnormal state

For Q3, since the service taken over by the associated UE for backup from the original UE when the original UE suddenly falls into an abnormal state is a kind of one-shot behaviour, there is no obvious impact on mobility procedure in our understanding.

vivo Mobile Communication Co.,

4

Thank you for the contribution. We are quite interesting about this use case. It is similar with our case1.1 and case1.2 in our Tdoc RWS-210172(PIOT). How to connect two UEs in CMCC mind?

Answer:

The motivation of the real-time backup is for the reliability performance target in the special use case, for example, for PLC and freight forwarding in the harbour, while the motivation of the PIOT mainly focus on the service transfer or co-ordination between different UEs. We are open the selection of the connection technology between the two UEs.

HuaWei Technologies Co., Ltd

5

We have similar understanding on this motivation, see RWS-210454. Is group scheduling having specific impact on UE backup? We think this may be a general consideration under MBS. We think the latency and reliability should still be fulfilled during taking over procedure, and therefore do you think this area should consider that UL traffic data needs to be generated to both UEs and only one UE transmits to the network?

Answer:

Yes, as we mentioned above, since this is for URLLC's high reliability performance requirement, the total latency taking the switching latency into account must meet the latency performance target defined for URLLC, e.g. the extremely stringent low end-to-end latency is 1ms. The difference from the current MBS is that in the normal case, there is only one UE decode and process the data in DL although the data had been delivered to all associated UE for backup in group mode. For UL, since we assume there is a connection between the UEs, there will be a logical common layer to deliver the copy of the data to another UE in UL and align the between the two UEs. In our understanding, the logical common layer can be located in application layer or L2-layer, e.g. PDCP. And in the normal case, there is only one UE decode/encode and process the data in DL/UL although the data had been delivered to all associated UE for backup.

Nokia Germany

6

For this to work, one prerequisite is that RAN is aware that two or more UEs are deployed to provide backup

for the same service (e.g. signalled by the core network). SA2 already studied the topic: Redundant user plane paths based on multiple UEs per device (TS 23.501 Annex F (informative)), and it was concluded not supporting such feature and it is only included for information. Without support from CN, how RAN enhancements can work? What would be the benefit of standardized solutions compared to higher-layer/RAN-transparent solutions such as 2 or more UEs serving the application and using e.g. MPTCP to select the best UE at any given time or FRER based solution?

Answer:

For Q1, the approach brought up in SA2 (TS 23.501 Annex F (informative): The UEs belonging to the same terminal device request the establishment of PDU Sessions that use independent RAN and CN network resources using the mechanisms outlined below.) is two separate end-to-end tunnel, including separate radio bearers and separate GTP-U tunnels. In our understanding, the associated UE for backup can be realized with one single GTP-U tunnel and two Radio bearers' legs.

For Q2, to best of our knowledge, to improve robustness and reliability of stream transmissions especially for safety-critical traffic, the TSN task group introduces the IEEE 802.1CB standard, where a sender or a relay system (e.g. switch) with FRER capability can first generate and encode a sequence number for each outgoing frame, then it forwards the multiple copies of the packets towards the destination over multiple routes. Hence, in case of any failure in one of the routes, the packet is delivered to the destination via the redundant path. In this way, the FRER mechanism decreases the probability of traffic loss considerably. Consequently, the effect of the FRER mechanism still rely on the redundant stream transmission. However, in our proposal, under normal circumstances, terminal 1 and terminal 2 are responsible for different services respectively. Only if the data/signalling can not be successfully received by the terminal 1, then the subsequent associated terminal 2's action is that the terminal2 is to take over or start/activate the service(s) of the terminal1 declaring in abnormal state

Intel Corporation (UK) Ltd

7

Q1: For the URLLC requirement from RWS-210342 of 4ms, 99.9999% @ 400UE/5000m2, do you have estimates which fraction of the latency could be up to radio interface? Also, for the 400UE/5000m2, how many gNBs/TRP in which spectrum could be typically assumed based on your trials?"

Q2: Do you think RAN1 study or work is required? If yes, what would be the main RAN1 part to focus? To us this looks like a higher layer issue, and may even be supported by existing mechanisms.

Answer:

This question is not for this topic. It is for 2.6.

Lenovo Mobile Com. Technology

8

Thanks for the interesting proposals! we think such kind of backup could provide potential benifits to high reliability scenario, and we have following questions for further understanding

1. when the backup UE to take over working UE needs inter-UE coordination, and how does such

coordination done in your mind e.g. via direct link between UEs or signaling from network

2. although the figure illustrate 2 UEs in the scenario, but in normal text *multiple UE* is used. Does this implies more than two UEs can be deployed and does there has max UE number limitation?

3. for the group scheduling and multicast mode, what will be the difference compared with ongoing MBS features in your mind?

Answer:

For Q1, we are open on the connection, which can be standardized link or link in implementation.

For Q2, the number can be extent to more than two. The specific number depends on the implementation. Alternatively, we can define the max UE number during the study.

For Q3, The difference from the current MBS is that in the normal case, there is only one UE decode and process the data in DL although the data had been delivered to all associated UE for backup in group mode.

TCL Communication Ltd.

9

Q1: Would lossless switching be supported during taking over procedure?

Q2: What is the latency requirement which will impact designing the switching over procedure?

Answer:

For Q1, yes, we assume there is a connection between the UEs.

For Q2, since this is for URLLC's high reliability performance requirement, the total latency taking the switching latency into account must meet the latency performance target defined for URLLC, e.g. the extremely stringent low end-to-end latency is 1ms.

ZTE Corporation

10

Thanks for the interesting contribution. We have several clarification questions.

1. Does 'real-time' backup mean 0ms interruption for backup?

2. For group scheduling, what's the difference compared to the mechanisms in Rel-17 MBS?

3. Compared to UE aggregation you proposed in another contribution, is it a correct understanding that this proposed SID is not focus on simultaneous transmission/reception from multiple UEs?

Answer:

For Q1, yes, we assume there is a connection between the UEs to guarantee this target.

For Q2, The difference from the current MBS is that in the normal case, there is only one UE decode and process the data in DL although the data had been delivered to all associated UE for backup in group mode.

For Q3, yes, this is for backup with mitigating the redundant data transmission or processing to the greatest extent.

Huawei Tech.(UK) Co.. Ltd

11

Regarding URLLC through dual UEs, we agree that so far 3GPP has not addressed the reliability of the UE itself. We have also raised this topic in RWS-210454.

Answer:

Great, it seems that we are on the same page.

Qualcomm Incorporated

12

Use of dual-UE was specified at architecture level by SA2 in Rel-16. Is the proposal for dual-UE to study the performance/functional gaps at RAN level under the SA2 specified architecture, or to also consider new architectures?

Answer:

For Q1, the approach brought up in SA2 (TS 23.501 Annex F (informative): The UEs belonging to the same terminal device request the establishment of PDU Sessions that use independent RAN and CN network resources using the mechanisms outlined below.) is two separate end-to-end tunnel, including separate radio bearers and separate GTP-U tunnels. In our understanding, the associated UE for backup can be realized with one single GTP-U tunnel and two Radio bearers' legs. Consequently, this is a new architecture.

Apple Portugal

13

We think It should be studied in SA first, because the assumption is that gNB can recognize the two UEs are backup to each other, and trigger the link switch based on some condition, which should be first studied and identified in SA2.

Answer:

Currently, we identify some options has SA2 impact, while some options only impact on RAN. Hence, in our understanding, RAN can start the study work firstly, and identify whether SA2 need to be involved.

Qualcomm Technologies Int

14

1. In Figure 3-2 and 3-3, is the smartphone in the picture acting as a SL or non-3GPP access relay? Are Rel-17 SL L2 or L3 relay or both considered for the smartphone? 2. For multi-UE backup, is there a direct connection between the UEs assumed or is it coordinated via gNB?

Answer:

For Q1, the smartphone is either SL nor non-3GPP access relay, it is just a UE connected to the device.

For Q2, both are possible, however, if the low latency is required, we assume there is a direct connection between the UEs.

Asia Pacific Telecom co. Ltd

15

Many thanks for sharing the interesting proposal.

Do you also consider improving UL throughput as a target here? What is the difference between multiple-UE backup scheme and UE aggregation scheme (RWS-210355) besides using PC5 interface between multiple UEs for multiple-UE backup scheme?

Answer:

This is not for UL throughput improvement (i.e. UE aggregation scheme), it is for high reliability target. And we are open on the connection between the UEs, no limitation on just PC5 interface, and the specific communication technology selection depends on the latency and reliability requirement.

NTT DOCOMO INC.

16

Thanks for raising this interesting topic. we have question regarding how the back up UE can be informed of failure e.g. through gNB or sidelink communcation or both in your assumpation. If the former one, after RLF, how can the failed UE to indicate backup request to gNB and how the remaining UL data in UE buffer can be tranfered to the backup UE? It ssems, in either way, the latency requirement for back up procedure may be necessary to be studied first. Also, is it possible for the backup UE to reject the back up request for various reasons e.g. incapble of handling multiple back-up requests from multiple UEs come or high load condition inside the UE?

Answer:

Both are possible, however, if the low latency is required, we assume there is a direct connection between the UEs. And we assume there is a connection between the UEs. The latency requirement can be met by implementation, such as, wire connection with the approximately zero transmission delay over the connection between the UEs and extremely high frequent heartbeat exchange. Yes, it is possible that the backup UE to reject the back up request for various reasons in some use cases, e.g., there are more than one backup UEs can be selected or the latency requirement is not so stringent.

3.3 RSU-like Network Node

CATT:

Q: Thanks for the contribution. We have two questions for clarification. 1) It seems such node is using PC5 to communicate with the UEs. We'd like to understand whether it requires enhancement to the R17 SL relay mechanism?

2) Is there any mobility requirement for such type of node?

Answer:

R17 SL relay can be treated as baseline. To support dual-connectivity between RSU-like node and gNB, further enhancement is needed.

Yes for the remote UE, but for the RSU-like network node, normally it is stationary but not preclude mobility. As we described in that contribution for remote UE, mobility between RSU-like nodes and mobility between RSU-like node and gNB are both considered. Furthermore, dual-connectivity between RSU-like node and gNB will also be studied

LG:

Q: Can you elaborate on the difference from the sidelink relay UEs that are deployed by the operator?

Answer:

Thanks for the comment. For the SL relay UEs that deployed by operator, the relay UE connected to network with Uu interface. The RSU-like network node works as a network node and supports backhauling via the network interface between RSU-like network node and gNB. That is the most basic difference. Some more details, as it has been discussed in R17 SL relay WI, Network should establish separated radio bearer for remote UE and relay UE for L2 RELAY and mapping rule between PC5 RLC to uu RLC should be configured and reconfigured to fulfill the transmission requirements. Such above issues may also exist in SL relay UEs that deployed by operator. These challenges can be appropriately avoided by RSU-like network node. The PC5 to backhaul link mapping can be handled by the interface between RSU-like node and gNB.

Intel:

Q: What's the difference between RSU-like and IAB node? Why can't an IAB node help address the use case?

Answer:

In IAB, both the access and backhauling replies on Uu interface. In the proposed RSU-like node, UE access the network via PC5 and backhauling with a network interface between the RSU-like network node and the gNB. Indeed, IAB can also be utilized to extend the coverage, but the main motivation of this proposal is to pursue a low-cost network node and reuse existing backhaul link for indoor coverage, e.g., to replace pico RRU with the RSU-like node and resue the transport beween pico RRU and BBU.

Interdigital

Q: One of the objective of the work includes discovery and reselection. In your view, how would RSU discovery and (re)selection be different from the Rel-17 relay discovery and reselection, given that RSU will support PC5?

Answer:

Thanks for the comment. Yes, RSU-like node could reuse PC5 part procedure as much as possible. Discovery procedure and relay (re)selection in Rel-17 sidelink relay work item could be regarded as baseline.

Apple

Q: We are wondering the difference between RSU like network node and sidelink relay? if any enhancement is needed, perhaps we can merge it into sidelink relay?

Answer:

Sidelink relay is intrinsically a UE, which is not deployed and owned by the operator. So the coverage extension with sidelink relay is not always guaranteed and to a large extent replies on whether there is a sidelink relay UE nearby. RSU-like node works as a network node, it could reuse as much as possible the link between the remote UE and relay UE/RSU-like network node. But besides that, a new interface needs to be defined to perform the backhauling function, the procedure of mapping PC5 to Uu RLC channel is not needed in our scenario, adaption layer may be also not needed, since all the functionalities are handled by the network interface.

ZTE

Q: Thanks for the contribution. It looks like that the RSU-like network node is of gNB type but can communicate with UE via PC5 interface. In addition to this, could you please clarify what is the other fundamental difference between the operation of RSU-like network node and U2N relay UE?

Answer:

Firstly, we confirm your understanding about RSU-like node. As to funder mental difference, The RSU-like network node supports backhauling via the network interface between RSU-like network node and gNB. Functionality and procedures of network interface design between RSU-like node and gNB should be studied. Some more details, as it has been discussed in R17 SL relay WI, Network should establishment separated radio bearer for remote UE and relay UE for L2 RELAY and mapping rule between PC5 RLC to uu RLC should be configured and reconfigured to fulfill the transmission requirements. Such above issues may also exist in SL relay UEs that deployed by operator. These challenges can be appropriately avoided by RSU-like network node.

FUJITSU

Q:

1. It seems that RSU-like node behaves like relay UE. Considering that RSU-like node should be more powerful than a regular UE, could you clarify a bit more on the difference between RSU-like node and relay UE?

2. As for the network interface between RSU-like node and gNB, it is assumed to be Uu interface or it can be some interfaces else?

Answer:

Sidelink relay is intrinsically a UE, which is not deployed and owned by the operator. RSU-like node works as a network node. The RSU-like network node supports backhauling via the network interface between RSU-like network node and gNB. Network should establishment separated radio bearer for remote UE and relay UE for L2 RELAY and mapping rule between PC5 RLC to uu RLC should be configured and reconfigured to fulfill the transmission requirements. Such above issues may also exist in SL relay UEs that deployed by operator. These challenges can be appropriately avoided by RSU-like network node. It is more simple and reliable than sidelink relay UE because we could have dedicated UE-associated signaling on the interface rather than to multiplexing remote UEs traffic into the relay UE RLC channels.

It is a network interface different from uu interface, similar as Xn/F1 interface and the backhauling is from PC5 RLC to Uu PDCP. We need to define the application protocol of the interface.

MTK

Q: Thank you for the contribution. We would like to understand better the relation between this proposal and the Rel-17 U2N relay functionality using an RSU as a relay UE. Our understanding is that the main difference is in the backhauling (network interface vs. Uu), and the SID tasks RAN3 to look at the definition of the network interface, but we are a bit unsure what the functional difference should be in this network interface compared to Uu backhauling for a relay.

Answer:

Yes, your understanding is correct. From functional point of view, it has a lot of commonalities with sidelink relay UE, but the backhauling design on the network interface and Uu interface is different.

Samsang

Q:

How does ”RSU-like network node supporting access via PC5 and backhauling via network interface between RSU-like node and gNB” differ from Rel-17 UE-2-NW relay?

Do you have any specific AS layer feature to be defined for RSU-like node comparing from SL U2N relay in R17?

Answer:

For the SL relay UEs, the relay UE connected to network with uu interface. The RSU-like network node works as a network node and supports backhauling via the network interface between RSU-like network node and gNB. That is the most basic difference. Some more details, as it has been discussed in R17 SL relay WI, Network should establishment separated radio bearer for remote UE and relay UE for L2 RELAY and mapping rule between PC5 RLC to uu RLC should be configured and reconfigured to fulfill the transmission requirements. Such above issues may also exist in SL relay UEs that deployed by operator. These challenges can be appropriately avoided by RSU-like network node. The PC5 to backhaul link mapping can be handled by the interface between RSU-like node and gNB

The specific AS layer feature compared with Rel-17 sidelink relay UE is to support dual-connectivity between RSU-like node and gNB.

3.4 Inter-UE Handover or Replication for Same User

Beijing Xiaomi Mobile Software

1

Thanks for the contributions. We are interested in this use case of negotiation/coordination procedures between multiple UE devices for back up reasons.

For objectives of the UE handover case□

1□"Target device(s) discovery [RAN2]": Are you meaning we need to specify the interface between those UEs?

2) "Study user plan functionalities that will support data forwarding": are you meaning the data forwarding between those UEs?

For objectives of the UE handover case□

1) Identify required specification changes on the group scheduling options to allow multiple UEs to receive signalling/data in Multicast mode:

Can this be achieved by the current MBMS?

And what is the purpose of this objectives? Are we still want to enhance the existing backup mechanism?

Answer:

Regarding "Target device(s) discovery", it is just a target in our understanding, we are open on the specific approaches and interfaces. For example, it can be realized by human selection with some network assistant information.

Regarding "Study user plan functionalities that will support data forwarding", from our perspective, this can bring lossless service transfer in DL.

Regarding handover case, I failed to find the mentioned proposal.

Spreadtrum Communications

2

Thanks for the contribution.

We share the similar views in objective1 and objective2.

For the objective3, is the data forwarding amongst multiple devices of the same end-user performed via the direct inferface between UEs?

Answer:

From our perspective, basically, the data forwarding amongst multiple devices of the same end-user can bring lossless service transfer in DL through the network. For UL, there is no mandatory demands on this.

vivo Mobile Communication Co.,

3

Thank you for the contribuition. We are quite interesting about this use case. It is similar with our case1.1 and case1.2 in our Tdoc RWS-210172(PIOT). How to connect two UEs in CMCC mind?

Answer:

From our perspective, in the inter-UE handover case, the communication through network can be regarded as baseline.

Intel Corporation (UK) Ltd

4

Can you explain what are the drawbacks from application layer service continuity? Is there a the strong motivation to support this functionality within the 5G network?"

Answer:

This can enable the users to initiate, handover (transfer/ switch), or sometimes replicate communication streaming (e.g. video, speech, audio) between multiple devices from different vendors of the same end-user for a variety of reasons. And the drawback from application layer service continuity is the restriction of the different UEs should belong to a same vendor.

Lenovo Mobile Com. Technology

5

Thanks for the interesting proposals! we have some questions for further understanding

1. target device discovery: does this mean sidelink is used for discovery between UEs? we understand sidelink has mature discovery function and could be served as a baseline solution for further study, but not sure if is your intention here

2. for control plane procedure and user plane procedure, how does RAN identify two UEs belongs to the same end user? does application layer need to be invovled? we would like to have more clarification here.

Answer:

Regarding "Target device(s) discovery", it is just a target in our understanding, we are open on the specific approaches and interfaces. For example, it can be realized by human selection with some network assistant information. And from our perspective, in the inter-UE handover case, the communication through network can be regarded as baseline.

Regarding Q2, either RAN or CN, or both can identify the associated UEs by UE's request. During the binding procedure of the two UEs, the application layer can be agnostic.

ZTE Corporation

6

Thanks for your contribution. The inter-UE transfer scenario looks very interesting and useful. We have following questions for clarification:

1) How could the CN or RAN detect the nearby alternative UE and then trigger the inter-UE transfer? e.g. based on sidelink or positioning?

2) For the data flow, what is your main target? switch from one device to another device, or maintain two or more legs towards different UEs? For the latter one, does it mean that data split or data duplication should be supported? For the replication, should the PTM transmission could be used?

Answer:

Regarding "Target device(s) discovery", it is just a target in our understanding, we are open on the specific approaches and interfaces. For example, it can be realized by human selection with some network assistant information.

Regarding data flow, the most important intention is for Inter UE service transfer, i.e., switch the data from one device to another device as you mentioned.

TCL Communication Ltd.

7

This topic is interesting. Would you please explain a little bit more under which scenario ”transfer” is used instead of ”switching”, and vice versa?

Answer:

Yes, it is. The essential part is that to handover at the RAN-level or Core Network level of all or some of the services between UEs under the control of the same end-user while maintaining service continuity.

Apple Portugal

8

Both CN based or RAN based solutions should be studied in SA first. CN based solution should be studied in SA. And for RAN based solution, since gNB is able to recognize the two UEs are associated, the UE association and identification issue should be also studied in SA first.

Answer:

As you mentioned that for RAN based solution, since gNB is able to recognize the two UEs are associated, the UE association and identification issue can be addressed in RAN, consequently, RAN can start the study work firstly, and identify whether SA2 need to be involved.

NTT DOCOMO INC.

9

Thanks for your contribution. we are interested in how the service continuity can be guaranteed. For DL data, the application layer solution seems work as well. For UL, Is it necessary to replicate the UL data in UE buffer to antoher device in your assumpation?

Answer:

This can enable the users to initiate, handover (transfer/ switch), or sometimes replicate communication streaming (e.g. video, speech, audio) between multiple devices from different vendors of the same end-user for a variety of reasons. And the drawback from application layer service continuity is the restriction of the different UEs should belong to a same vendor. For UL, if no direct link between the UE, e.g. PC5, the service continuity is pursued in best effort manner.

MediaTek Inc.

10

Thank you for the contribution. In the concerned scenario, are there any UP or even application layer impacts expected?

Answer:

Since either RAN or CN, or both can identify the associated UEs by UE's request. During the binding procedure of the two UEs, the application layer can be agnostic. But the L2-UP architecture can be enhanced for DL lossless data forwarding.

Nokia Germany

11

Since none of the intended applications seem to be latency/reliability-critical, what would be the main benefit of doing this inside the 5GS (RAN and/or core) compared to application-based approach (note that this kind of device handover is already supported by many of the listed applications e.g. msoft Teams, Spotify, etc.). Do you think these benefits justify the envisioned spec impact?

Answer:

This is aim to address the issue that application-based approach has the restriction of the different UEs should belong to a same vendor.

3.5 Further enhancement of RAN Slicing

 # 1 ZTE Corporation

Thanks for your proposal. We also see the need for further enhancement for RAN slicing to continue the work for slice remapping and evaluate the RAN impact of Rel-18 progress in other WG (SA1/SA2). Further enhancement on slice aware cell (re)selection can also be considered in addition to what we have in Rel-17.

In addition, we are interested in UE leverage different slice resource in MN and SN as mentioned in our paper RWS-210482.

For the following bullet:

For non-supported slice by the serving cell, the solutions to support UE to access to the intended slice by setting up DC or CA can be considered.

We understand this can be supported via implementation to a certain extent so we are wondering what would be the potential spec impact.

Answer:

In order to leverage the slices that supported only on the SN but not supported by the MN, we expect there may be spec impacts on the Uu and NG interface.

 # 2 Intel Corporation (UK) Ltd

As discussed in Rel-17, performing cell reselection at the point that MO is triggered does not provide fast access. Also this situation will not happen if allowed slices are uniform across a TA. What has changed to include such scenario for Rel-18?

Answer:

The use case is that, the smart phone user may trigger an APP that belongs to the slice X which is not inside the allowed NSSAI list, while the slice X is supported on another frequency. The intention is to let the UE reselect to the neighbour frequency to access the slice X. In current spec, the NAS layer will not deliver the slice X to AS layer, which prevent the AS layer from reselect to the target cell. We hope this issue can be studied in Rel-18.

 # 3 Apple (UK) Limited

We generally support to further discuss Rel-17 leftover issues and new SA2 solutions. In addition to the three listed Rel-17 leftover issues, we need to double check the list after RAN2 progress more. Regarding using DC/CA for non-supported slice by serving cell, we think it can be already supported?

 # 6 Samsung Electronics Co., Ltd

We agree to continue the work of R17 leftovers. And for the proposal "For non-supported slice by the serving cell, the solutions to support UE to access to the intended slice by setting up DC or CA can be considered." Could you please clarify more? What enhancement could be in R18? Our understanding is this is already supported by NW even in R15/16. and R17 will do.

Questions from Apple and Samsung are related with whether using DC/CA for non-supported slice by serving cell is already supported.

Answer:

Yes, we agree the leftover issue need to be checked later according to RAN2/3 latest progress.

In current spec, for a slice X that isn't supported by the serving cell, the slice X is not inside the allowed NSSAI list for the UE. And the UE cannot initiate the slice X. Even the slice X can be supported by another gNB nearby, the gNB cannot be configured as SN for that UE.

We hope in Rel-18, the UE can leverage the SN to provide slices that doesn't support on the MN node.

 # 4 Huawei Tech.(UK) Co.. Ltd

Thank you for the contribution.

Do you believe that the SA1 requirements to enhance UE access to the slices will be full filed by completion of rel-17 left over or new mechanism needs to be study?

Answer:

The SA1 Potential Consolidated Requirements 1 and 2 are quite related with the slice WI in RAN2/3. I think we will re-evaluate whether the requirements can be meet by RAN2/3 spec when our running CRs become stable.

 # 5 CATT

Thank you for the proposals.In general,we share the similar view that further enhancement on slicing should be considerred in Rel-18.For MO triggered slice based cell reselection,we are wondering whether the issue of homogeneous TA should be resolved first?

Answer:

We are open on the homogeneous TA.

 # 7 LG Electronics UK

Thanks for the proposal. We agree that RAN slicing enhancements should be discussed in Rel-18 to address further network slice enhancements discussed in SA1/SA2. If any of Rel-17 ongoing discussion is not finalized, we can continue discussion in Rel-18.

Regarding CA/DC configuration for non-supported slice by the serving cell, do you expect to enhance the slice uniform availability principle in Rel-18, or assume uniform availability in Rel-17 considering enhancements between network elements ?

Answer:

We have no strong opinion on the homogeneous slice within TA. Based on the agreements, if MN and SN supporting different slices, the MN and SN belong to different TA. We think some enhancement can be done to enable the DC of MN and SN that supporting different slices.

3.6 Requirements from Automotive Industry

 # 1 Sony Europe B.V.

In RWS-210350, Slide 9, you have the following requirement:

Chip capability: Self-contained is not supported in the chip and URLLC should be compatible with the current chip ecosystem.

Can you clarify what is meant by self-contained chip capability that is not supported?

Answer:

Self-contained subframe is the sub-frame that contains both UL and DL symbols, which is supported since R15 for TDD. The intention is to reduce the delay caused by waiting for the UL subframe for TDD. However, we observed that self-contained subframe is not widely supported by chipset. This is an observation from the

URLLC market.

 # 2 ZTE Corporation

In RWS-210350, page 9, the requirement in Rel-16 URLLC for factory automation is 32 byte packets, 1ms latency and 99.9999% reliability. So, is the intention of the new proposed URLLC requirement is to relax the latency while increase the user density? What's about the packet size?'

Answer:

In the field trial, we observed that as the number of UE in an area becomes larger, the latency and reliability decreased. From automotive industry customers point of view, the performance for single UE is not an important KPI. But, the requirement needs to be meet at a certain density like 400UE at 5000m^2. At such kind of density, 32 byte packets, 4ms latency and 99.9999% reliability is acceptable for automotive factory.

 # 3 Fraunhofer HHI

Q1: Based on the requirements listed for 5G-Advanced, would you be interested in location-based resource configurations that would result in high resource efficiency to achieve the perception use case? It could optimize power consumption as well, as described in our contribution RWS-210325.

Answer:

Yes, we are interested in the methods that can save battery life, especially for some UEs in automotive industry that is designed to work without power supply for 1 year.

Q2: Would you rather prefer a RedCap UE (<5MHz bandwidth) instead for the same use case?

Answer:

Yes, vertical use cases are cost sensitive. For instance, car positioning inside automotive factory, if the RedCap UE can support the desired positioning accuracy but with lower cost, we would be interested in it. But, for now, CMCC would not be supportive for RedCap UE for lower than 5MHz bandwidth.

 # 4 Intel Corporation (UK) Ltd

We posted this question in the first feedback form but maybe it is more appropriate for this one. Therefore it is repeated here.

Q1: For the URLLC requirement of 4ms, 99.9999% @ 400UE/5000m2, do you have estimates which fraction of the latency could be up to radio interface? Also, for the 400UE/5000m2, how many gNBs/TRP in which spectrum could be typically assumed based on your trials?"

Answer:

For the first question, approximately 3ms latency is left for radio interface. And, all the others take 1ms in

total, including delay caused by CN, N3 interface and application layer.

For the second question, it should be noted that the 400 UE/5000m2 requirement is estimated based on envisioned commercial deployment in Shenyang BMW Brilliance Automotive body shop. In this case, approximately 16 TRPs is assumed within the considered area and 4.9GHz is used in our trial. Each TRP covers 18m x 18m area.

 # 5 Qualcomm Incorporated

Thanks for the overview of requirements for IIoT. Could you elaborate on the URLLC desired improvements for the case of different TDD configurations for indoor and outdoor. If the indoor UEs are served by indoor gNBs, and outdoor UEs are served by outdoor gNBs, would the factory walls provide enough isolation? Or is it also a case of interest that some indoor UEs are served by the outoor network (e.g. due to CAG/NPN restriction for the indoor network?).

Answer:

The TDD DL/UL interference for indoor and outdoor is an important issue for us, since the TDD configuration is different. The factory walls would not provide enough isolation, if indoor and outdoor are deployed in the same frequency. In the trial, we use 4.9GHz for indoor URLLC and 2.6GHz for outdoor eMBB.

 # 6 Samsung Electronics Co., Ltd

1. What is your view on Rel-18 WI: independent Wis for URLLC enhancement, postioning enhancement, and passive IoT? Or one WI for all of them?

Answer: No strong view, independent WI looks fine.

2. Is high cost of UWB positioning from equipent cost by itself? Could you provide further details for this point?

Answer:

The deployment of UWB network (Base station) is high cost, which can only provide positioning service while not support wireless communication. CMCC and automotive industry customers expect to deploy one single network to meet the requirement of URLLC, positioning and perception.

3. Which RAT-based positioning technique do you envision for passive IoT?

Answer: We expect the passive IOT can connect to 5G gNB, no preference for any specific technique.

4. What kinds of RAN enhancements are required for massive URLLC?

Answer:

We have no idea. We just shared some feedback requirements we collected after performing field trial with automotive industry customers. We currently have no preference on any technique enhancements.

4 [2nd Round] Comments/Questions

4.1 General

4.2 General

4.3 URLLC through Dual UEs

Feedback Form 7: Comments/Questions on URLLC through Dual UEs[2][3]

1 – ZTE Corporation

Thanks for the response. One follow-up clarification regarding our question#2 raised in the first round. For the normal case, if the data had been delivered to all associated UEs for backup, how would these UEs know whether it should decode and process the data or not?

2 – Nokia Germany

Thanks to CMCC for the 1st round replies. Some small follow-up from our side:

1. We understand the approach brought up in SA2 (TS 23.501 Annex F (informative)) is just 'informative' but not actually supported and no other section addressing the essential issue of supporting multiple UEs per device as shown in Fig. 3 of RWS-210346. Don't you think that additional progress in SA2 would be needed before moving forward with this work in RAN?

2. Regarding the reply to Huawei's question "the total latency taking the switching latency into account must meet the latency performance target defined for URLLC, e.g. the extremely stringent low end-to-end latency is 1ms". Do you think it is feasible for the RAN/gNB to detect and switch the connection to a backup UE with less than 1 millisecond latency? Since a very frequent heart beat from backup UE may be needed, wouldn't it be better to simply replicate the data across two or more UEs all the time?

3. Regarding the reply to LGE, "And the logical common layer can be located in application layer or L2-layer, e.g. PDCP." Is our understanding correct that: in case the logical common layer in application layer, then the operation is transparent to 5G? And in case the logical common layer on L2, e.g. PDCP, then it is similar as PDCP duplication?

3 – VODAFONE Group Plc

We have a different understanding with regard to the Nokia comment on Annex F of TS 23.501. Our understanding is that this Release 16 Annex IS already fully supported in Release 15 systems (and indeed, can basically be supported in Release 8, EPC). It is an informative annex because no specification changes are needed in order for it to be implemented.

4.4 RSU-like Network Node

Feedback Form 8: Comments/Questions on RSU-like Network Node[4][5]

1 – LG Electronics Inc.

Q1: Now we understand that RSU-like network node is connected to the network using an interface connecting network nodes, not UEs. Do you assume wireless connection or wireline connection for RSU-like network nodes? In case of wireless connection, do you also think Uu interface, assuming that the network interface protocol is operated over the Uu interface?

2 – Samsung Electronics Co.

Q. Based on your answer, it seems that the propsed scenaio is to use PC5 direct (i.e., R16 NR SL comm) between RSU-like node and UE. The connectivity of RSU-like node to network can be up to implementation including wireless or wired backhaul. Our understanding is that current RAN specification does not exclude the communication via both Uu and PC5 direct from remote UE perspective. What specifically further AS enhancement is needed?

3 – ZTE Corporation

If the interface between the RSU-like network node and network node is similar to the Xn/F1 interface, does it mean that the wireline connection of RSU-like network node is assumed?

4.5 Inter-UE Handover or Replication for Same User

Feedback Form 9: Comments/Questions on Inter-UE Handover or Replication for Same User[6][7]

1 – Nokia Germany

Thanks to CMCC for the 1st round replies. Some small follow-up from our side:

We did not fully understand your point on "application-based approach has the restriction of the different UEs should belong to a same vendor". Isn't it the opposite? i.e. 5GS-based approach would require all UEs to be served by same operator, whereas application-based approach may work on any device (even non-cellular) that have the application installed and have access to internet.

2 – HuaWei Technologies Co.

Can you please clarify what is the difference of the motivation and spec impact than UE backup?

3 – China Unicom

Thank you for the contribuition. We support to study the scenarios you proposed in R18, and we have a question, how does the network distinguish the devices for same end-user, if the UEs belong to same end-user subscibed with a same group or other method? And how to gurantee the data forwording delay?

4.6 Further enhancement of RAN Slicing

Feedback Form 10: Comments/Questions on Further enhancement of RAN Slicing[8]

1 – China Telecomunication Corp.

Thanks for the proposals.

We are also interested in further enhancement on RAN slicing. Some R17 leftovers shall be further discussed in R18. One question is of all the proposed objectives, what is the preference/priority of R18 RAN slicing?

4.7 Requirements from Automotive Industry

Feedback Form 11: Comments/Questions on Requirements from Automotive Industry[9]

1 – Intel Corporation (UK) Ltd

<2nd round questions>

Comment box in Section 4 [2nd Round] was not active and so we reiterate our question here.

Further Q: Thanks, for Q1 we've placed the question in 2.6 as well. But Q2 was intended for this section. Thus, could you please answer Q2?

5 [2nd Round] Answers

5.1 General

5.2 URLLC through Dual UEs

ZTE Corporation

Thanks for the response. One follow-up clarification regarding our question#2 raised in the first round. For the normal case, if the data had been delivered to all associated UEs for backup, how would these UEs know whether it should decode and process the data or not?

Answer:

Thanks for your question. In the normal case, there is only one UE decode/encode and process the data in DL/UL although the data had been delivered to all associated UE for backup. Only in case of any failure in one of the UEs, the subsequent associated UE is to take over the service(s) of the UE in abnormal state, i.e. to start decoding/encoding and processing the data in DL/UL previously for the UE in abnormal state. And the determination of switching occasion/backup triggering can be through the detection by the associated UE through Heartbeat Mechanism which can be left to the implementation:

Nokia Germany

2

Thanks to CMCC for the 1st round replies. Some small follow-up from our side:

1. We understand the approach brought up in SA2 (TS 23.501 Annex F (informative)) is just 'informative' but not actually supported and no other section addressing the essential issue of supporting multiple UEs per device as shown in Fig. 3 of RWS-210346. Don't you think that additional progress in SA2 would be needed before moving forward with this work in RAN?

2. Regarding the reply to Huawei's question "the total latency taking the switching latency into account must meet the latency performance target defined for URLLC, e.g. the extremely stringent low end-to-end latency is 1ms". Do you think it is feasible for the RAN/gNB to detect and switch the connection to a backup UE with less than 1 millisecond latency? Since a very frequent heart beat from backup UE may be needed, wouldn't it be better to simply replicate the data across two or more UEs all the time?

3. Regarding the reply to LGE, "And the logical common layer can be located in application layer or L2-layer, e.g. PDCP." Is our understanding correct that: in case the logical common layer in application layer, then the operation is transparent to 5G? And in case the logical common layer on L2, e.g. PDCP, then it is similar as PDCP duplication?

Answer:

Thanks for your questions. For Q1, we think this topic can be studied without waiting for the SA2 progress, since the approach of the UE real-time backup can be different from the approach in SA2 (TS 23.501 Annex F (informative)). And the associated UE for backup can be realized with one single GTP-U tunnel and two Radio bearers' legs, where the service taken over by another backup UE completed in RAN side.

For Q2, in our understanding, in implementation, the detection and switching the connection to a backup UE with less than 1 millisecond latency is possible to rely on some implementation devices through wire connection, not gNB.

For Q3, exactly, we are on same page.

VODAFONE Group Plc

3

We have a different understanding with regard to the Nokia comment on Annex F of TS 23.501. Our understanding is that this Release 16 Annex IS already fully supported in Release 15 systems (and indeed, can basically be supported in Release 8, EPC). It is an informative annex because no specification changes are needed in order for it to be implemented.

Answer:

Thanks for your question. We think your understanding is correct. Anyway, the approach of the UE real-time backup can be different from the approach in SA2 (TS 23.501 Annex F (informative)). And the associated UE for backup can be realized with one single GTP-U tunnel and two Radio bearers' legs, where the service taken over by another backup UE completed in RAN side.

5.3 RSU-like Network Node

Thanks for your questions. Since the three questions in the second round are all about the interface between RSU-node and gNB, we provide common answers below.

Firstly, in our proposal, the interface between RSU-node and gNB is a network interface, which is similar as other interfaces, e.g., NG/S1/X2/Xn/F1/E1. Normally, the function of the interface comprises two parts, the transport network layer (TNL) and the radio network layer (RNL). The transport network layer could be Ethernet, microwave, fibre, whatever. Take Xn interface for example, the TNL could be fiber, microwave, even other wireless interface, it depends on operator deployment, but it is out of the scope of 3GPP. What is within responsibility of RAN WG is to specify the application protocol (AP) of the interface, e.g., Xx-AP. So to enable inter-operability among different vendors, the interface between RSU-node and gNB should be defined, which is the task of RAN3. Additionally, to support the dual-connectivity or seamless switching between PC5 and Uu, some further enhancement of AS may be needed, e.g., the protocol split at which layer. The discussion on sidelink relay could be regarded as baseline.

Hopefully, this clarifies all the concerns.

5.4 Inter-UE Handover or Replication for Same User

NOKIA

Thanks to CMCC for the 1st round replies. Some small follow-up from our side:

We did not fully understand your point on “application-based approach has the restriction of the different UEs should belong to a same vendor”. Isn’t it the opposite? i.e. 5GS-based approach would require all UEs to be served by same operator, whereas application-based approach may work on any device (even non-cellular) that have the application installed and have access to internet.

Answer:

Thanks for your question. As we know, the application-based approach has the restriction of the different UEs should belong to a same device vendor (not operator), e.g., involved mobile phone and pad are from Apple, or the involved mobile phone and pad are from Huawei.

HuaWei Technologies Co., Ltd

2

Can you please clarify what is the difference of the motivation and spec impact than UE backup?

Answer:

Thanks for your question. The intention is that the network can enable the users to initiate, handover (transfer/switch), or sometimes replicate communication streaming (e.g. video, speech, audio) between multiple devices of the same end-user for a variety of reasons. For example, a User is having a call (audio/video stream) on his mobile while he is goanna to get on a car. After getting on the car, then he would like to switch the connection with the network for the video stream from his mobile to another device equipped in the car that belongs to him, and transfer the data of audio/video steam from his mobile to another device equipped in the car as well.

On the other hand, the motivation of UE backup is obviously to meet the high reliability performance by

multiple UEs.

China Unicom

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Thank you for the contribution. We support to study the scenarios you proposed in R18, and we have a question, how does the network distinguish the devices for same end-user, if the UEs belong to same end-user subscribed with a same group or other method? And how to guarantee the data forwarding delay?

Answer:

Thanks for your question. From our perspective, either RAN or CN, or both can identify the associated UEs with the same user by the information conveyed in the UE's request.

Basically, the data forwarding amongst multiple devices of the same end-user can bring lossless service transfer in DL through the network. For UL, there is no mandatory demand on this.

5.5 Further enhancement of RAN Slicing

1 China Telecomunication Corp.

Thanks for the proposals.

We are also interested in further enhancement on RAN slicing. Some R17 leftovers shall be further discussed in R18. One question is of all the proposed objectives, what is the preference/priority of R18 RAN slicing?

Answer:

Thanks for your question. No strong view. We slightly prefer to take the leftover issues as higher priority. The corresponding work to meet SA1 requirement and potential RAN impact of SA2 slicing in Rel-18 may need to wait for more progress from SA1 and SA2.

5.6 Requirements from Automotive Industry

1 Intel Corporation (UK) Ltd

Comment box in Section 4 [2nd Round] was not active and so we reiterate our question here.

Further Q: Thanks, for Q1 we've placed the question in 2.6 as well. But Q2 was intended for this section. Thus, could you please answer Q2?

Answer:

Sorry, I failed to find your Q2 for Section 2.6 in this email threshold. It seems the Q2 is missing.

6 Reference

[1]RWS-210342 CMCC views on Rel-18 Non-eMBB-driven Functional Evolution CMCC

[2]RWS-210344 New SID on real-time multiple-UE backup CMCC

[3]RWS-210346 Motivation of study for real-time multiple-UE backup CMCC

[4]RWS-210347 Motivation of study for RSU-like network node CMCC

[5]RWS-210348 Study on RSU-like Network node CMCC

[6]RWS-210343 New SID on Inter-UE Handover or Replication for Same User CMCC

[7]RWS-210345 Motivation of study for Inter-UE Handover or Replication for Same User CMCC

[8]RWS-210349 Motivation of further enhancement of RAN slicing for NR CMCC

[9]RWS-210350 Requirements to URLLC, positioning and perception for automotive industry CMCC, BMW Brilliance Automotive, Huawei