RAN-R18-WS-non-eMBB-BBC - Version 0.0.3
RAN

3GPP TSG RAN Rel-18 workshop **RWS-210554**

Electronic Meeting, June 28 - July 2, 2021

Agenda Item: **4.2**

Source: BBC

Title: **Email discussion summary for [RAN-R18-WS-non-eMBB-BBC]**

1 Introduction

This email discussion summary covers the following documents:

RWS-210132 ”MBS Enhancements for Rel-18: Optimal Multiplexing for Broadcast/Multicast and Unicast Superposition Transmission (BMUST)”

2 Comments to the Tdocs - Round 1

Feedback Form 1: Comments to the Tdocs

1 – HUAWEI TECHNOLOGIES Co. Ltd. [Huawei, HiSilicon] Q1 for BMUST scheme, from the network perspective, is the time-freq resources for broadcast/multicast overlapped with one UE’s unicast or can also be overlapped with more than one UEs’ unicast?
2 – Guangdong OPPO Mobile Telecom. For Non-orthogonal multiplexing (superposition) of broadcast/multicast and unicast signals, is it worth to introduce this technology in Rel-18 MBS? The intention is to increasing spectral efficiency, however it brings more complexity to the system design. Rel-17 MBS supporting FDM/TDM/SDM is supposed to be enough.
3 – Sony Europe B.V. Q1. What is the impact of the BMUST on unicast in general and especially URLLC transmissions? Q2. Is BMUST carried in a separate TB or a TB multiplexed with unicast.
4 – MediaTek Inc. Thanks for the nice proposals. We very much support the intention to study the BMUST alike mechanism to support simultaneous transmission between broadcast and unicast. Meanwhile we would like to also

propose to study the simultaneous transmission between two broadcast services. The reference should be ATSC3.0 for NG TV.

5 – CATT

Thanks for the contribution.

A general comment is that CATT supports NR MBS enh. in R18.

A few question for clarification regarding this paper:

1) Will such simutaneous/superposition transmission/reception require PHY layer changes, e.g., impact to coding and multiplexing? Or it is just scheduling and configuration impact?

2) Will this impact legacy UE performance, e.g., when a legacy UE is receviing MBS service while another R18 UE is receving unicast in a superposition manner?

Generally it would be good to understand further the benefit and requirements. thanks!

6 – Spreadtrum Communications

Thanks for the contribution.

SIC is needed in general to cancel the multiple access interference for MUS, which may cause high UE decoding burden especially when the non-orthogonal UE number is large. In addition, a group of MBS UEs receive packets at same time-frequency resource in PTM1 scheme. In this case, can UEs with and without MUST capability receive a PTM1 message simultaneously□

7 – ZTE Corporation

thanks for the contribution, here are our questions:

- Regarding coverage enhancement, do you consider MBSFN to improve the coverage?
- Is it possible for UE to receive FTA and unicast simultaneously?
- Can the requirement of traditional broadcaster (features including FTA/ROM, ATSC3.0 level of efficiency) be met by Rel-16 LTE based 5G Terrestrial Broadcast?
- Market requirement clear (e.g., UEs with both Terrestrial Broadcast and NR, and deployment of both Terrestrial Broadcast and NR from operators)?

8 – Nokia France

Thanks for the proposal. Can you explain which users the SE is shown for when you mention ”consistent throughput for cell-edge users” - is this the broadcast or unicast SE? I would have thought that the unicast superposition can only be scheduled for cell-centre users, for whom the received SIR of the broadcast signal is significantly higher than for the unicast signal.

3 Questions to the Tdocs - Round 1

4 Answers by moderator - Round 1

Comment 1 – HUAWEI TECHNOLOGIES Co. Ltd.

[Huawei, HiSilicon] Q1 for BMUST scheme, from the network perspective, is the time-freq resources for broadcast/multicast overlapped with one UE's unicast or can also be overlapped with more than one UEs' unicast?

BBC reply:

Thank you very much for your question. The time-frequency resources of the broadcast/multicast layer can be overlapped with multiple UE's unicast. An illustration can be found in slide 3 of RWS-210132. Please also note that the unicast messages from various UEs are still themselves orthogonally multiplexed (e.g. TDM/FDM).

Comment 2 – Guangdong OPPO Mobile Telecom.

For Non-orthogonal multiplexing (superposition) of broadcast/multicast and unicast signals, is it worth to introduce this technology in Rel-18 MBS? The intention is to increasing spectral efficiency, however it brings more complexity to the system design. Rel-17 MBS supporting FDM/TDM/SDM is supposed to be enough.

BBC reply:

Thank you very much for your question. From our understanding while TDM between broadcast/multicast and unicast is going to be supported in REL-17 (mandatory across slots and UE capability dependent within slot), SDM is not going to be supported (and neither FDM if our understanding is correct). BMUST may bring more complexity to the system design but it is worth pointing out that it may be introduced in a backwards compatible manner to coexist with Rel-17 NR MBS UEs. Given the significant performance improvements, it can be considered as a potential enhancement for NR MBS. We think a potential approach would be to perform a Study to assess the benefits and impacts followed potentially by standardisation if found beneficial by 3GPP.

Comment 3 – Sony Europe B.V.

Q1. What is the impact of the BMUST on unicast in general and especially URLLC transmissions?

Q2. Is BMUST carried in a separate TB or a TB multiplexed with unicast.

BBC reply:

Thank you very much for your questions.

Regarding Q1: Taking into account the diagram in Slide 3 in RWS-210132, before the UE can decode its scheduled unicast message it first needs to decode the broadcast (or multicast) message (while treating the

unicast messages as noise) and then secondly decode its scheduled unicast message after cancellation of the broadcast (or multicast) message. This is most useful when the UEs are interested in decoding both the broadcast (or multicast) message as well as the unicast message.

We are not experts on URLLC, however, assuming these are transmissions with very stringent requirements (i.e. low BLER and low latency), for such applications the gNB could schedule those unicast messages in slots without any superposition with any broadcast (or multicast) message. We would like to point out that implementing BMUST does not necessarily mean that all unicast transmissions in the cell are forced to first decode broadcast (or multicast) message.

Regarding Q2: as per Fig. 2. in R1-2009238, the broadcast (or multicast) message would be carried in one TB and the unicast message would be carried in another TB. The multiplexing approach for BMUST would be based on superposition (non-orthogonal) of the TB carrying broadcast (or multicast) and the TB carrying unicast.

Comment 4 – MediaTek Inc.

Thanks for the nice proposals. We very much support the intention to study the BMUST alike mechanism to support simultaneous transmission between broadcast and unicast. Meanwhile we would like to also propose to study the simultaneous transmission between two broadcast services. The reference should be ATSC3.0 for NG TV.

BBC reply:

Thank you very much for your comments. We are pleased to see that there is interest in the topic. Some follow up comments are that we have been considering mainly two cases i) superposition transmission of multicast and unicast messages, and ii) superposition transmission of broadcast and unicast messages. Please note that superposition transmission of two broadcast signals was studied in TR 36.776.

Comment 5 – CATT

Thanks for the contribution.

A general comment is that CATT supports NR MBS enh. in R18.

A few question for clarification regarding this paper:

1) Will such simutaneous/superposition transmission/reception require PHY layer changes, e.g., impact to coding and multiplexing? Or it is just scheduling and configuration impact?

2) Will this impact legacy UE performance, e.g., when a legacy UE is receviing MBS service while another R18 UE is receving unicast in a superposition manner?

Generally it would be good to understand further the benefit and requirements. thanks!

BBC reply:

Thank you very much for your comments and questions.

Regarding 1: BMUST would require PHY layer changes. An example of a transmitter and receiver architecture can be found in Fig. 2. in R1-2009238. We think that the specification impact for BMUST would be similar as that for the standardisation of Multi-User Superposition Transmission (MUST) in LTE which superimposed two unicast signals (TR 36.859). However, for BMUST we propose i) superposition of broadcast and unicast signals and ii) superposition of multicast and unicast signals.

Regarding 2: Yes, it could potentially affect legacy UE performance decoding a broadcast (or multicast) signal since the unicast signals would cause additional interference to the main broadcast (or multicast) signal. However, please note that in contrast, with BMUST the broadcast (or multicast) signal could span a larger frequency-time span that can improve the performance. Some simulations can be found in Slide 3 in RWS-210132 where the performance on multicast-only (all time-freq resources are used for multicast), FDM (with 50% RBs used for multicast and 50% RBs used for unicast) and BMUST is compared. Another aspect to study is (as per TR 36.859) the assistance information needed for decoding for BMUST receivers.

Regarding performance improvements: two-layer BMUST is shown to be sum-rate optimal scheme, i.e., maximises cell throughput for SISO, MIMO diversity and multi-layer MIMO techniques [see references in RWS-210132].

Comment 6 - Spreadtrum Communications

Thanks for the contribution.

SIC is needed in general to cancel the multiple access interference for MUS, which may cause high UE decoding burden especially when the non-orthogonal UE number is large. In addition, a group of MBS UEs receive packets at same time-frequency resource in PTM1 scheme. In this case, can UEs with and without MUST capability receive a PTM1 message simultaneously?

BBC reply:

Thank you very much for your comments and questions.

Regarding your comment about SIC. Please note we are proposing a two-layer superposition scheme as per slide 3 in RWS-210132 (i.e., one layer carries the multicast message while another layer carries the orthogonally multiplexed unicast messages). Hence, regardless of the number of UEs served by the gNB, there is only one stage of SIC.

Regarding your comment about PTM1 reception. BMUST receivers would be able to receive the PTM1 message and then access the unicast messages after SIC. Receivers without BMUST capability (no SIC) may still be able to receive the PTM1 message, please see TR 36.859 section 5.3 (potential assistance information) where transmission power allocation can be estimated or may not even be needed. However, we propose a study to verify the underlying assumptions in the context of NR.

Comment 7 - ZTE Corporation

thanks for the contribution, here are our questions:

Regarding coverage enhancement, do you consider MBSFN to improve the coverage? Is it possible for UE to receive FTA and unicast simultaneously? Can the requirement of traditional broadcaster (features including

FTA/ROM, ATSC3.0 level of efficiency) be met by Rel-16 LTE based 5G Terrestrial Broadcast? Market requirement clear (e.g., UEs with both Terrestrial Broadcast and NR, and deployment of both Terrestrial Broadcast and NR from operators)?

BBC reply:

Thank you for your questions. Please see our answers below:

Our thoughts relating to coverage were focussed on unicast rather than broadcast and therefore we don't believe MBSFN is not appropriate in this instance. For those receivers not connected to the network, we would expect that FTA reception was possible. For those handsets that are connected to the network, we would expect to see FTA and unicast operation simultaneously in suitably-equipped handsets. In our contribution, the features and techniques we are proposing are focussed on NR MBS, not LTE-based 5G Terrestrial Broadcast. We believe LTE-based 5G Terrestrial Broadcast meets the relevant requirements (which may be different to ATSC3.0). Today we see Terrestrial Broadcast technologies deployed by Broadcast Network Operators and NR deployed by Mobile Network Operators.

Comment 8 - Nokia France

Thanks for the proposal. Can you explain which users the SE is shown for when you mention "consistent throughput for cell-edge users" - is this the broadcast or unicast SE? I would have thought that the unicast superposition can only be scheduled for cell-centre users, for whom the received SIR of the broadcast signal is significantly higher than for the unicast signal.

BBC reply:

Thank you for your questions.

Our comment "*Consistent throughput to cell-edge users*" refers that BMUST provides similar 5th percentile UE SE (i.e. the cell-edge users SE) regardless of the number of UEs in the cell as it can be seen by the blue doted line. The cell-edge users SE is mainly multicast SE. (In our simulations we have considered superposition of multicast and unicast signals).

Please note that in our proposal we assume the broadcast (or multicast) signal has lower SINR than the SINR of the unicast signals. Typically the transmission parameters of the broadcast (or multicast) signals need to cover the UEs with the worst SINR in the group (i.e. the cell-edge users if the common message targets the entire cell). Only UEs that have higher SINR than that required SINR to decode the broadcast (or multicast) signal would be able to decode a unicast signal after interference cancellation. However, it is worth pointing out that all UEs that are not cell-edge UEs could potentially be scheduled with additional unicast capacity if they have interference cancellation capability.

5 Comments to the Tdocs - Round 2

Feedback Form 3: Comments to the Tdocs - Round 2

6 Questions to the Tdocs - Round 2

Feedback Form 4: Questions to the Tdocs - Round 2

7 Answers by the moderator - Round 2

N/A

8 Summary

In RWS-210554, the BBC presents **Broadcast/Multicast and Unicast Superposition Transmission (BMUST)** as a potential enhancement for **NR MBS**.

Nine companies have provided their comments/questions to this email discussion [Huawei, HiSilicon, OPPO, Sony, MediaTek, CATT, Spreadtrum, ZTE and Nokia]. (Comments from ZTE addressed BBC contribution in RWS-210133.)

Other 3 inputs to the 3GPP RAN Rel-18 WS **have also proposed BMUST**-like approaches **for NR MBS** in:

5G-MAG - tdoc in RWS-210205 and email summary in RWS□210550.

EBU - tdoc in RWS-210077 and email summary in RWS-210564.

MediaTek - tdoc in RWS-210096 and email summary in RWS-210582.

The questions/comments from companies were on: general architecture, network and UE impact on complexity, specification impact, impact on legacy UEs receiving unicast or broacast/multicast, performance benefits, requirements and motivation to be included in Rel-18. There was also a input supporting studying BMUST alike techniques in RAN Rel-18. The BBC provided replies and clarifications posed by different companies. There were no strong objections to continuing discussing BMUST as potential candidate for the RAN Rel-18 package.

Based on the comments and questions to this discussion **it is therefore proposed to continue discussing BMUST as a potential candidate for study for the RAN Rel-18 package**.