

RAN-R18-WS-crossFunc-China_Telecom - Version 0.0.4
RAN

3GPP TSG RAN Rel-18 workshop

RWS-210612

E-Meeting, June 28 - July 2, 2021

Agenda Item: 4.3

Source: China Telecom

Title: Email discussion summary for [RAN-R18-WS-crossFunc-China_Telecom]

Document for: Discussion

1 Introduction

This contribution is a summary of email discussion on cross-functionalities for both eMBB and non-eMBB evolution on [1] - [6].

2 Email discussion (1st round)

2.1 General comments

Companies are invited to provide general comments on contributions [1] - [6].

Feedback Form 1: General comments

2.2 Comments on duplex enhancements (contributions [1][2])

Companies are invited to provide comments on the following contributions.

RWS-210144, “Draft SID on duplex enhancement for NR”.

RWS-210145, “Duplex enhancement for Rel-18”.

Feedback Form 2: Comments on duplex enhancements

1 – CATT

Thanks for the contribution and we have following question for clarification:

Q1. How to understand flexible band in UL/DL spectrum? Is it similar to flexible symbol in TDD UL/DL

configuration? What is the timescale of the change?

2 – Spreadtrum Communications

Thanks for the well-written contribution, but we have a question that needs further explanation. For dynamic FDD, how does UE work in CA case and non-CA case?

- In the CA case

Does UE work as f2(DL)+f3(UL)+f4(DL/UL), like FDD+TDD CA?

- In the non-CA case

f2(DL)+f4(DL/UL) like SDL+TDD?

f3(UL)+f4(DL/UL) like SUL+TDD?

3 – Futurewei Technologies

FUTUREWEI considers that gNB flexible duplex and sub-band full duplex (and the necessary interference handling features) is an interesting topic that deserves RAN1 attention and a very careful study. Among the topic that China Telecom identified under full duplex (static, semi-static, dynamic, sub-band/BWP based full duplex), we would like to know which one should be given a higher priority. Another question we have is if China Telecom prefer some specific frequency bands to be considered or deployment scenarios. Please take a look at our contribution RWS-210036 (https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_AHs/2021_06_RAN_I/210036.zip) and feel free to comment at: <https://nwm-trial.etsi.org/#/documents/4580>

4 – Intel Corporation (UK) Ltd

Q1. Have you considered the significantly added UE complexity (even w/o FD support @ UE) to support ""TDD in FDD bands"" as UE would need to receive in the UL carrier while the applicability may be rather limited considering regulations?

Q2. Also, how to motivate support for UL in DL carrier - especially since it is not clear if regulations allow such and considering adverse impact to UL coverage comparing UL carrier vs. DL carrier for paired spectra?

Q3. Given that basic feasibility of FD @ gNB needs to be determined by RAN4 as a first step, what is your view on managing the studies across RAN1 and RAN4? Specifically, under what assumptions should RAN1 proceed with their study w/o information on isolation and self-, adjacent channel, intermodulation interference effects that would need RAN4 expertise?

5 – Lenovo (Beijing) Ltd

Thanks CTC for the contribution. One question what are the potential benefits of e.g., using full duplex in a FDD DL band over using UL carrier aggregation to boost UL throughput ?

6 – Nokia Corporation

The extend of this SI seems really broad, so we assume it would be desirable to down-scope this study proposal. Conclusions from Rel-16 RAN4 TDD coexistence studies should be taken as the starting point. If that is done, we believe the down-scoped SI could focus on low power gNB cases, and not address FR1 Macro BTS cases. In our view it would also be good to focus on solving more basic gNB-2-gNB CLI problems to better support UL-heavy configurations on TDD bands. In our view RAN4 should also be involved in solutions studies from the beginning.

For full duplex studies are you considering also full duplex support for UEs? What kind of performance impacts especially in DL performance do you foresee if UEs do not support full duplex? How about handling and DL performance of legacy UEs?

7 – Qualcomm Incorporated

Is the Full duplex scope intended for both unpaired and paired spectrum? Also the target full duplex is inband full duplex (UL/DL overlapping)?
On p6, any detailed views on RF requirements? On p10, any detailed views on frame structure for full duplex? is it slot format to support FD?

8 – Samsung Electronics Polska

Question for dynamic FDD: we think that using DL transmission in UL band in FDD might be helpful to enhance resource utilization in FDD spectrum. However, we have question whether regulation in different regions and countries allows this operation. Since bandwidth in UL band is quite narrow in low band, even regulation allows this operation, it is not easy to handle inter-operator cross-link interference between neighboring UL band. Can you share your view on this?

2.3 Comments on network energy saving (contributions [3][4])

Companies are invited to provide comments on the following contributions.

RWS-210152, “Draft SID on NR network energy saving enhancement”.

RWS-210153, “NR network energy saving enhancement for Rel-18”.

Feedback Form 3: Comments on network energy saving

1 – MediaTek Inc.

Thanks for the quality contribution on network energy saving. Below please find our comments/questions:

General comment(s)/question(s):

- We understand the target of network energy saving is to reduce operator OPEX. On the other hand, **user experience should not be compromised in order to avoid impact to user subscription**. In this regard, how can we ensure minimum impact to legacy UEs (R15/R16/R17) in the aspects of coverage, mobility, packet throughput/latency and UE power consumption?
- Answer to the above question can require system-level evaluation with UE metrics included. Since system-level evaluation assumptions for UE power consumption has been developed in TR38.840, it is possible to leverage and extend the methodology to further include network power models and operations so as to optimize overall system energy efficiency.
- While massive MIMO power consumption looks necessary to boost NR spectrum efficiency, system energy efficiency can be improved in parallel by **minimizing non-critical network and UE operations in data inactivity time durations**. This ensures that both network and UE can reduce power consumption and is also necessary since any transmission activity in one side will prevent effective sleep of the other side. In this regard, tight and timely network-UE coordination/cooperation should be considered in developing effective system energy saving schemes.

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Specific comment(s)/question(s):

- On scope item 1, it is suggested to include multi-TRP for FR2 use cases. In addition to identifying use cases of interest, developing the evaluation methodology to quantitatively investigate the critical gap and identify the effective solution(s) is also one important aspect to include.
- On scope item 2, we are supportive to investigate flexible and dynamic enhancements for more opportunities to realize network energy saving. The exploration dimensions can include spatial, time, frequency domains as well as network node on/off. Regarding the UL/DL measurement enhancement, what is the expected usage and benefit for network energy saving?

2 – Spreadtrum Communications

Very instructive contribution. As well known, sometimes network and UE are twin with contradiction; so, we have two general questions. Q1: How to balance Energy efficiency between Network side and UE side? Q2: During network sleep, how to serve the upcoming traffic or emerged data to UE in time?

3 – ZTE Corporation

We also observe that the 5G BS energy consumption contributes a lot in OPEX due to the increased bandwidth, number of RX chains, etc. We agree that network power saving techniques should be considered in Rel-18 to develop a green and sustainable 5G.

We also believe that the solutions such as UE assistance information, network coordination are needed to achieve a better network energy efficiency.

Meanwhile, other methods such as dynamic antenna/beam on-off operation are also beneficial to network power saving. What are your views about considering dynamic antenna/beam on-off operation for network energy saving?

4 – CATT

Thanks for sharing the statistic of gNB power consumption and desire in network energy saving. The network energy saving had been studied in Rel-10 LTE. The study results in Rel-10 showed the most network energy saving solutions would be network implementation solution to shut down part or all RF chain (RRU in LTE or AAU in NR). The network energy saving study also showed that it might have potential impact to the UE service and coverage. Do you have any targets or requirements of NR network energy saving study in Rel-18?

5 – vivo Communication Technology

[vivo]

Thanks very much for the proposal. We have the following questions for clarifications,

- (1) In P7, for potential enhancements for network energy saving, what kind of UL/DL measurement enhancement beyond existing Rel-16 mechanism is expected?
- (2) For ‘gNB information exchange to support beam level operation coordination and transmission power adjustment coordination’, currently RAN3 has studies for network energy saving, would be better to know the differences between this one and RAN3.

6 – China Unicom

Thanks for CT's contribution. Our comments are below.

Q1. UE assistance information report for traffic prediction, what information should be reported?

Q2. Need more clarifications on UL/DL measurement enhancement, reduce the measurement time, frequency and antenna, or other schemes if needed?

7 – Guangdong OPPO Mobile Telecom.

thanks for interesting paper. We think to improve the energy efficiency is very important to save cost for operators. few questions below:

1, Q1: can you elaborate "capability booster cell"? and why it is related to energy saving?

Q2: energy saving is listed as one issue to be addressed in 37.817 (5.1.1). Can you clarify what is the difference solution-wise?

8 – BBC

Sustainability

The BBC supports measures to improve the sustainability of the 5G RAN.

In particular we're keen to see a realistic and standardised methodology for the measurement and modelling of power consumption in networks to help operators to reduce their impact. In addition, as a content provider, the BBC would like the ability to better understand the impact of our content being consumed over these networks to also drive down our impact.

9 – Intel Corporation (UK) Ltd

Q.1 Are you suggesting a SI that could build upon R17 WI on data collection for SON/MDT?

Q.2 Can you elaborate the gNB wake up mechanism mentioned in the description? How is this triggered?

10 – Qualcomm communications-France

Could you please clarify what kind of measurement under "UL/DL measurement enhancement" is targeted to (e.g., RRM, BM or CSI measurement)?

11 – LG Electronics Polska

In potential objectives, you mentioned that "identify the potential energy saving scenario, e.g., capacity booster cell, IAB node/donor, compensation cell". Among these scenarios, is compensation cell based on compensation cell scenario studied in Rel-12?

12 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank you very much for the contribution. Please find some questions for clarification as below:

1. Any specific example for "UL/DL measurement enhancement"? For example, do you consider potential CSI enhancements to reflect the flexible and dynamic TX-RX on-off?

2. In our understanding, for FR2 the impact on legacy UE is not a big problem, thus some enhancements like change of SSB can be considered to achieve more energy saving, what do you think?

13 – LG Uplus

Thanks for very valuable contribution. Please see my comments and questions below.

-The statistics in the background slide was really interesting.(P3)

-The history of this topic in the background slide is instructive. Thanks!! (P4)

Q1)Like other companies said, do you have in mind any specific data/parameters from the UE now?

Q2)For procedure perspective, AI/Data based approach seems promising, then do you want to proceed this item within AI/ML or SON/MDT items or want to proceed with the individual energy saving item with AI/Data aspects ?

Q3)This item is mainly for network(BS), do you think the UE energy saving does not have the room to improve ?

14 – Spreadtrum Communications

Thanks for the quality contribution. we have one additional question to ask. As you mentioned that UL/DL measurement enhancement can help network power saving, could you please elaborate it? Thanks.

15 – NEC Corporation

NEC proposes to have WI in RAN3 as continuation of the current RAN3 SI; to have a new SI in RAN3 as continuation of the current RAN3 SI covering wider scope and use cases; to have a SI for AI/ML for radio interface. We agree that energy saving should be considered within these activities.

16 – Beijing Xiaomi Mobile Software

Thanks for the good contributions, and we would like to discuss the following comments

1 For potential UE assistance information report, e.g., traffic prediction, do we need define some traffic model for prediction?

2 What aspect for UL/DL measurement enhancement, can you give further example for explanation?

2.4 Comments on network sharing (contributions [5][6])

Companies are invited to provide comments on the following contributions.

RWS-210156, “Operator Customizable Network Sharing for Rel-18”.

RWS-210157, “Draft WID on Operator Customizable Network Sharing”.

Feedback Form 4: Comments on network sharing

1 – Ericsson LM

Thanks for the paper. We have the below questions:

Question 1: in slide 4/5, it seems you consider MOCN, have you considered MORAN (i.e. RAN sharing with multiple Cell IDs broadcast)?

Question 2: (in slide 8), there are already legacy mechanisms to handle the case. What are the new requirements?

2 – Intel Corporation (UK) Ltd

Can you expand on the motivation to configure a different set of sidelink configuration? Why would different operators not share the same sidelink config?"

3 – KT Corp.

Thanks for showing interest on this topic, any chance of addressing NR standalone network sharing in the objectives?

2.5 Response to companies' comments/questions

2.5.1 Duplex enhancements

Response to companies' comments/questions

(1) Answers to questions about dynamic FDD

(1.1) Motivation

@Intel: The motivation to support UL in DL carrier is the emergence of uplink centric services (e.g. real-time HD video, AR/VR/MR).

(1.2) UE complexity to support "TDD in FDD bands"

@Intel: We think it will not bring much UE complexity, since the complexity for UE to receive in the FDD UL carrier is more or less similar as supporting TDD.

(1.3) Regulation and inter-operator CLI

@Samsung: About the regulation, there was a SI "Study on regulatory aspects for flexible duplex for E-UTRAN". The study outcome in TR 36.882 shows at least in one country and in some bands, utilizing UL spectrum for transmission from the network to UEs is possible. In addition, in our understanding, technology can go ahead of regulations. After all the technical issues are solved, it's possible that regulation can make some changes. The inter operator cross link interference depends on the deployment scenario. For some scenarios with low power gNB, the interference would be controllable. The coexistence among different operators in adjacent channels should be evaluated for a better understanding of the potential scenarios.

(1.4) Clarifications

@CATT: understanding of the flexible band: Flexible band can be used as UL or DL based on the traffic demands. The transmission direction of all the UEs needs to be the same, i.e. either all UL or all DL on the flexible band for easier handling of the interference. The transmission direction for the flexible band can be changed by RRC or some common DCI, which could be FFS.

@Spreadtrum: understanding of the UE work in CA case and non-CA case: Thank you for the question, but the question is about the dynamic mechanism in time domain or frequency domain? Our figures showing CA case and non-CA case illustrate for the flexible band as the mechanism in frequency domain. Sorry for some misunderstandings.

@QC: About the RF requirements on p6, as there would be CLI, adjacent channel leakage etc. brought by dynamic FDD, new RF requirements should be defined.

(2) Answers to questions about full duplex

(2.1) Benefits

@ Lenovo: The benefit of full duplex in a FDD DL band over using UL carrier aggregation to boost UL throughput is higher spectrum efficiency if the UL DL resource could be overlapped and easier implementation as not requiring UEs to support CA.

(2.2) Scope of the study

@ Futurewei, Nokia, QC: The full duplex scope is intended for both unpaired and paired spectrum. At this stage of full duplex study, we consider only full duplex support at gNB side. We think different full duplex types such as frequency overlapping, frequency non-overlapped should be carefully studied and evaluated. Then based on the outcome, we can determine the feasibility and priority. The potential deployment scenario with priority could be low power gNB with limited number of antennas.

(2.3) Impact if UEs do not support full duplex

@ Nokia: If UEs do not support full duplex, the impact of the UE is mainly the CLI handling. For legacy UEs, gNB should avoid serious CLI with some scheduling mechanisms.

(2.4) Frame structure for full duplex

@ QC: About the frame structure for full duplex on P10, we consider whether simultaneous transmission of different UL DL channels should be allowed by the channel position design. For example, to protect some important channels getting rid of interference, the opposite direction transmission should not be allowed simultaneously with these channels.

(2.5) Managing the studies across RAN1 and RAN4

@ Intel: Thank for the consideration of RAN1 and RAN4 work. We agree both RAN4 and RAN1 groups are involved as RAN4 expertise is needed for feasibility evaluation. RAN1 and RAN4 should cooperate closely on this topic.

Moderator summary of the 1st round email discussion:

In the first round discussion, 8 companies participated in the discussion on duplex enhancements.

For dynamic FDD, motivation to support for UL in DL carrier, UE complexity, regulation and inter-operator CLI, the understanding of flexible band in UL/DL spectrum, the working of UE in CA case and non-CA case, RF requirements were further clarified.

For full duplex, the benefit in FDD band, scope of the study, UE impact, views on frame structure for full duplex, RAN1 and RAN4 cooperation were further clarified.

2.5.2 Network energy saving

Response to companies' comments/questions

Q1: Clarify the difference between this item/objectives and existing NR network energy saving work (VIVO, OPPO, Intel, LG Uplus)

A1: We are suggesting an independent SI, not a part of the R17 WI on data collection for SON/MDT or R17 SI on enhancement for Data Collection for NR and EN-DC. (@Intel, LG Uplus)

Regarding the difference of this item and the related work in R17 WI on data collection for SON/MDT, R17 focuses on the inter-system energy saving because inter-system energy saving is not done in previous NR releases, and it is not clear whether beam level operation coordination/transmission power adjustment coordination will be supported or not. Besides, intra-system energy saving standardized in previous NR releases does not include beam level operation coordination/transmission power adjustment coordination. (@VIVO)

Regarding the difference of this item and the energy saving aspects of R17 SI on enhancement for Data Collection for NR and EN-DC, we understand that the target of the latter is RAN AI framework, workflow, functions and so on, NOT the network energy saving. It's hard to have a comprehensive study of network energy saving and evaluation of the energy saving effect. In addition, we think AI based network energy saving is not the only potential objective for the study of network energy saving. (@OPPO)

Q2: Clarify the scenarios, i.e. objective 1 (OPPO, LGE)

A2: Capacity booster cell can be deployed in the hotspot to provide additional capacity for a cell providing basic coverage. The capacity booster cell can be switched off when its capacity is no longer needed in order to save the network energy. (@OPPO)

YES. (@LGE)

Q3: Clarify the UL/DL measurement enhancement, i.e. bullet 3 of objective 2 (MediaTek, VIVO, China Unicom, Qualcomm, Huawei, XIAOMI)

A3: We think UL/DL measurement enhancement can be used to enable better decision of gNB/module (e.g. TRX) on/off. Potential UL/DL measurements, for example, uplink wake-up signal used for gNB/module wake-up, OR 'potential CSI enhancements to reflect the flexible and dynamic TX-RX on-off' mentioned by Huawei, OR BM mentioned by Qualcomm may be considered. (@MediaTek, VIVO, China Unicom, Qualcomm, Huawei, XIAOMI)

Q4: Clarify the UE assistance information report, i.e. bullet 1 of objective 2 (China Unicom, XIAOMI)

A4: Regarding the UE assistance information report for traffic prediction, we think UE traffic characteristic information which reflects UE traffic volume change in the time domain/space domain, or the UE traffic distribution in some orientation can be used to help the network decide whether or when to open/shut down gNB/beam. (@China Unicom)

It can be studied. (@XIAOMI)

Q5: Clarify the gNB wake up mechanism, i.e. objective 2 (Intel)

A5: For example, one way is UE triggered gNB wake-up, such as network wake-up signal; another way is

triggered by the neighbor gNB of the sleeping gNB, based on the UE assisted traffic prediction information.

Q6: What's our views of potential objectives not mentioned in our paper (ZTE, Huawei, MediaTek)

A6: We agree that dynamic antenna/beam on-off operation are also beneficial to network energy saving. We would like to list it as a potential objective. (@ZTE)

We have similar views. (@Huawei)

We think multi-TRP for FR2 is a useful case, and developing the evaluation methodology is critical. We would like to add them. (@MediaTek)

Q7: What's our views of UE power saving consideration (Spreadtrum, LG Uplus)

A7: We think the impact to UE power saving can be considered when developing/selecting network energy saving solution. (@Spreadtrum)

We are open to do UE energy saving enhancement. (@LG Uplus)

Q8: Other questions (CATT, Spreadtrum)

A8: It's hard to say the network energy saving effect, we think we can start with developing the evaluation methodology and power consumption model. (@CATT)

Traffic prediction, UE assistance information and UE triggered can be used to resolve this. (@Spreadtrum)

Moderator summary of the 1st round email discussion:

Thanks very much for all the participated 15 companies (MediaTek, Spreadtrum, ZTE, CATT, VIVO, China Unicom, OPPO, BBC, Intel, Qualcomm, LGE, Huawei, LG Uplus, NEC, XIAOMI). Many valuable opinions, questions and suggestions have been received, which are highly appreciated.

We classify the received 22 questions and the response can be briefly summarized as follows.

Firstly, we suggest an independent SI for NR network energy saving to have a comprehensive study of NR network energy saving as we said in the answer to Q1. Then, we make some clarifications for questions about objectives in our paper and provide our views of potential objectives not mentioned in our paper. Furthermore, we would suggest to extend the potential objectives of our paper to include the following bullets as suggested by some companies:

- 1) Include multi-TRP for FR2 as one of the potential scenarios;
- 2) Study the NR network power consumption evaluation methodology;
- 3) Dynamic antenna/beam on-off operation.

2.5.3 Network sharing

Response to companies' comments/questions

Question 1: in slide 4/5, it seems you consider MOCN, have you considered MORAN (i.e. RAN sharing with multiple Cell IDs broadcast)? (@Ericsson)

Answer 1: Based on our understanding, the RAN sharing with multiple Cell IDs broadcast is the function of MOCN, MORAN means the RAN independent across operators.

Question 2: (in slide 8), there are already legacy mechanisms to handle the case. What are the new requirements? (@Ericsson)

Answer 2: The current mechanism of network sharing cannot restrict legacy LTE UE to only access legacy LTE network, now the legacy UE can also access to NSA network. However, in some cases such as the NSA network is a sharing network but legacy LTE network is not, operators want the legacy LTE UE to only access the legacy LTE network and let 5G NSA UE use the NSA network.

Question 3: Can you expand on the motivation to configure a different set of sidelink configuration? Why would different operators not share the same sidelink config? (@Intel)

Answer 3: operators may have different frequency and strategies for sidelink operation in order to establish their own advantages in the vertical industry although they were willing to share their public network.

Moderator summary of the 1st round email discussion:

Thanks very much for all the participated 2 companies (Ericsson and Intel). Based on their input, the motivation and use cases of network sharing enhancement were clarified.

3 Email discussion (2nd round)

3.1 Duplex enhancements

Companies are invited to provide questions and comments to the follows:

1. Any further questions and comments to moderator's response and summary for 1st round in section 2.5.1

Feedback Form 5:

1 – KT Corp.

Interesting to see operator's interest in Full Duplex in FDD band. We are fully supportive on this as this could be useful when FDD low band which is currently used as LTE needs refarming at a certain period. Is there any particular band you have interest in supporting full/flexible duplex in FDD low band (e.g. Band 1, Band 3, Band 8, etc.)?

2 – Futurewei Technologies

We would like to thank China Telecom for addressing our first round comments. It seems to be a majority view from the workshop that the frequency non-overlapped full duplex at gNB is a more feasible initial stage. We think it can be better if some further detail is revealed on the potential benefits of applying this particular full-duplex scheme to each frequency band.

3 – Intel Corporation (UK) Ltd

Follow-up to round #1:

On UE complexity, to clarify our previous question further, we expect that, for support of “TDD in FDD” a FDD UE would need to have RF support for reception in the UL bands and/or transmission in the DL bands respectively, which call for additional implementation efforts. In addition, as also observed by you, there would be likely additional requirements on emissions, ACLR for UL transmissions in DL bands, etc. On the other hand, the applicability remains very limited – from regulations as well as practical use-cases. Additionally, we are also wondering on impact to legacy UEs (or UEs not supporting flexible duplex) in such FDD systems – e.g., how does such a UE account for potential UL transmissions within the DL carrier? We note your response to Nokia alluding to gNB scheduling-based solutions, but are not sure if this may further lead to resource wastage due to the scheduling restrictions.

4 – Spreadtrum Communications

Thanks for the detailed clarifications. We notice that in your response, you mentioned that “The transmission direction of all the UEs needs to be the same, i.e. either all UL or all DL on the flexible band for easier handling of the interference”. “all the UEs” here means UEs in a single cell or UEs in all the cells?

5 – Samsung Electronics Polska

Thanks for your reply, we also agree that regulation can be changed if technology can solve problems we have. Also, for low power gNB, inter-operator issue can be not big. However, since one operator is not sure whether neighboring operators use their network for macro or small power gNB, it is not easy to deploy with any coordination between operators.

2. Any further questions and comments to proposal [1][2]

Feedback Form 6:

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3.2 Network energy saving

Companies are invited to provide questions and comments to the follows:

1. Which of the following potential objectives/examples are worth pursuing in R18? **(The bold font means the possible extension to our initial potential scope description)**

1) Identify all possible energy saving scenarios, e.g. capacity booster cell, IAB node/donor, compensation cell, **multi-TRP for FR2, DC/CA;**

2) Study the evaluation methodology to evaluate the network power consumption;

3) Study the potential enhancement to enable more efficient gNB/**module level** wake-up mechanism and

energy saving strategy decision **and action, such as:**

3.1) Potential UE assistance information report, e.g., traffic prediction, **DC/CA adaptation;**

3.2) Inter-gNB information exchange to support beam level operation coordination and transmission power adjustment coordination;

3.3) UL/DL measurement enhancement, **e.g. CSI measurement enhancements**

3.4) Dynamic antenna/beam on-off operation;

3.5) Enhanced scheduling, power, BWP operation, spatial and mobility management in energy saving modes;

4) Other potential enhancements to reduce gNB power consumption, such as:

4.1) Reduce the power consumption of broadcast signals/channels, e.g. extend periodicity;

4.2) Techniques to improve improving PA power efficiency in gNB.

Feedback Form 7:

1 – CATT

Thanks for further details on potential gNB energy saving schemes. The potential gNB energy saving schemes in bullet (3) and its sub-bullet seems to set the limitation of network energy saving in restricted domains, which is not necessary. We would like to clarify the gNB wakeup mechanism. Our understanding is that gNB wakeup (gNB ON/OFF) is controlled by the network and has the impact of UE service and coverage. The gNB wakeup is very confused terminology since it is the choice of network implementation. Some of the potential gNB energy saving mechanism in the sub-bullet items did not seem to be the power saving. It might be better to leave the potential gNB energy power saving schemes to be determined during study item.

2 – Beijing Xiaomi Mobile Software

Thanks for the further discussion, we suggest the impact on UE power saving should be take into consideration in the study of network power saving schemes, for instance as in 4.1, if the periodicity of broadcast signal/channel is extended, UE power consumption may increase.

3 – ZTE Corporation

Thanks for the detailed clarifications. Regarding the sub-bullet (3.1) (3.5), it is understood that these are solutions to reducing network power consumption and some potentially relevant impacts. As a proponent of network power saving, we are open to discuss them. However, we are not sure whether it is proper to categorize them into “network wake-up mechanism”. Some other terminology can be considered.

4 – HUAWEI TECHNOLOGIES Co. Ltd.

In addition to CSI enhancement, we also think some uplink wake-up signal is a good direction to study also.

5 – Beijing Lenovo Software Ltd.

Thanks for further details on network power saving. We have the similar view as other UE vendor, the potential solutions in UE sides, such as the assistant information reporting and enhanced measurement, are desired to be not complex and concise.

6 – VODAFONE Group Plc

We are supportive of work on energy saving. As booster cells may also add some coverage, have you considered whether there is a need for extra UE SON/MDT reports that could report when a stationary UE is losing coverage due a booster cell being turn off?

2. Any further questions and comments to moderator’s response and summary for 1st round in section 2.5.2

Feedback Form 8:

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3. Any further questions and comments to proposal [3][4].

Feedback Form 9:

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3.3 Network sharing

Companies are invited to provide questions and comments to the follows:

1. Any further questions and comments to moderator’s response and summary for 1st round in section 2.5.3

Feedback Form 10:

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2. Any further questions and comments to proposal [5][6]

Feedback Form 11:

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3.4 Response to companies’ comments/questions

3.4.1 Duplex enhancements

Response to companies’ comments/questions

(1) overall question on supporting full/flexible duplex in FDD

@KT: Thank KT for your fully supporting. We do not have priority on the supporting band. It depends on the regulatory which could be further investigated.

(2) Answers to follow up questions about dynamic FDD

(2.1) Applicability and impact to legacy UEs

@Intel: Thank you for further clarification on UE complexity. For the applicability, dynamic FDD applies whenever FDD is deployed. In our understanding, after all the technical issues are solved, it's possible that regulation can make some changes. Regarding the impact on legacy UEs for dynamic FDD, yes, legacy UEs should not be scheduled on the resource in which the transmission direction is changed. We do not think this is resource waste as the resource serves for other UEs in a different transmission direction.

(2.2) inter-operator CLI

@ Samsung: Thanks for the comments. The coexistence issue among different operators could be one study objective. Based on the study outcome, the potential scenarios could be suggested.

(2.3) Clarifications

@ Spreadtrum: Thank you for the follow up question. "All the UEs" here means UEs scheduled on the flexible hand.

(3) Answers to follow up questions about full duplex

(3.1) Benefits

@ Futurewei: Thanks for the reply. For TDD band, the benefit of the frequency non-overlapped full duplex at gNB is improved UL coverage/capacity, reduced latency.

For FDD band, the benefit of the frequency non-overlapped full duplex at gNB is flexible UL DL resource split to adapt to the traffic with asymmetric UL DL.

Moderator summary of the 2nd round email discussion:

5 companies participated in the second round discussion on duplex enhancements. One operator fully supports full duplex in FDD band.

On the supporting of full/flexible duplex in FDD low band, question regarding the interested particular band was addressed.

For dynamic FDD, follow up questions on applicability and impact to legacy UEs, inter-operator CLI, further concept clarification were addressed.

For full duplex, follow up question on the benefit was addressed.

3.4.2 Network energy saving

Response to companies' comments/questions

Q1: Clarify the description of revised potential scope (CATT, ZTE)

A1: Thanks for the comments. We also think the potential network energy saving enhancements are not limited to the listed objectives, and we think they are examples. We will change ‘such as’ to ‘for example’ and add a NOTE to resolve it. Besides, we also agree the potential network energy saving schemes to be determined during study item.

Regarding the possible confusion caused by the terminology ‘gNB wakeup’, we think it can be replaced by gNB on/off. (@CATT, ZTE)

Q2: Clarify the consideration of UE impact in the network energy saving study (XIAOMI, LENOVO)

A2: We agree that the impact to UE power consumption need to be considered when we study the network energy saving. We will add a NOTE. (@XIAOMI)

We agree that the impact to UE complexity need to be considered when we study the network energy saving. We will add a NOTE. (@LENOVO)

Q3: Others (HUAWEI, VODAFONE)

A3: Thanks for your support. (@HUAWEI)

Thanks for the support of network energy saving and bringing up a good question. We think it is better to take measure to avoid UE losing coverage due to a booster cell being turn off. But UE SON/MDT report is a remedial measure after UE losing coverage due to a booster cell being turn off. (@VODAFONE)

Moderator summary of the 2nd round email discussion:

Thanks very much for all the participated 6 companies (CATT, XIAOMI, ZTE, Huawei, Lenovo, VODAFONE) in the 2nd round email discussion. Some further opinions, questions and suggestions have been received, which are highly appreciated.

We make some further clarifications for the extended scope description according to some companies’ comments and answer the further questions. Furthermore, we would suggest to further modify the scope description according to companies’ comments as the following:

1. Identify all possible energy saving scenarios, e.g. capacity booster cell, IAB node/donor, compensation cell, multi-TRP for FR2, DC/CA;
2. Study the evaluation methodology to evaluate the network power consumption;
3. Study the potential enhancement to enable more efficient gNB/module on/off decision and action, for example:
 - 3.1 Potential UE assistance information report, e.g., traffic prediction, DC/CA adaptation;
 - 3.2 Inter-gNB information exchange to support beam level operation coordination and transmission power adjustment coordination;
 - 3.3 UL/DL measurement enhancement, e.g. CSI measurement enhancements;

3.4 Dynamic antenna/beam on-off operation;

4. Other potential enhancements to reduce gNB power consumption, such as:

4.1 Reduce the power consumption of broadcast signals/channels, e.g. extend periodicity;

4.2 Techniques to improve improving PA power efficiency in gNB.

NOTE: The UE impact (e.g. power consumption, complexity) need to be considered.

4 Summary

4.1 Duplex enhancements

Totally 9 companies participated in the two rounds discussion on duplex enhancements for Rel-18.

Based on 2 rounds discussion, moderator propose to have a SI on duplex enhancement in Rel-18. RAN1 and RAN4 should cooperate tightly during the study.

For the study on dynamic FDD, the regulation and prior bands, necessary RF requirements, coexistence issues among operators, backward compatibility to accommodate legacy UEs attract companies interest and could be studied.

For the study on full duplex, different full duplex types such as frequency overlapping and frequency non-overlapped, full duplex for unpaired and paired spectrum, backward compatibility to accommodate legacy UEs could be studied.

4.2 Network energy saving

Totally 17 companies (MediaTek, Spreadtrum, ZTE, CATT, VIVO, China Unicom, OPPO, BBC, Intel, Qualcomm, LGE, Huawei, LG Uplus, NEC, XIAOMI, Lenovo, VODAFONE) participated in the 2 rounds email discussion on network energy saving. Many valuable opinions, questions and suggestions have been received, which are highly appreciated.

From the moderator's point of view, we have two proposals as below:

Proposal 1: have a dedicated SI for the network energy saving in R18.

Proposal 2: the following potential scope can be the start point of the study:

1. Identify all possible energy saving scenarios, e.g. capacity booster cell, IAB node/donor, compensation cell, multi-TRP for FR2, DC/CA;
2. Study the evaluation methodology to evaluate the network power consumption;
3. Study the potential enhancement to enable more efficient gNB/module on/off decision and action, for example:

- 3.1 Potential UE assistance information report, e.g., traffic prediction, DC/CA adaptation;
- 3.2 Inter-gNB information exchange to support beam level operation coordination and transmission power adjustment coordination;
- 3.3 UL/DL measurement enhancement, e.g. CSI measurement enhancements;
- 3.4 Dynamic antenna/beam on-off operation;
- 4. Other potential enhancements to reduce gNB power consumption, such as:
 - 4.1 Reduce the power consumption of broadcast signals/channels, e.g. extend periodicity;
 - 4.2 Techniques to improve improving PA power efficiency in gNB.

NOTE: The UE impact (e.g. power consumption, complexity) need to be considered.

4.3 Network sharing

From the moderator's point of view, we propose to continue to refine the scope of network sharing WID and work on agreement on network sharing enhancement work in Rel-18.

5 Reference

- [1] 3GPP RWS-210144, "Draft SID on duplex enhancement for NR", China Telecom, Rel-18 workshop, June 28 – July 2, 2021.
- [2] 3GPP RWS-210145, "Duplex enhancement for Rel-18", China Telecom, Rel-18 workshop, June 28 – July 2, 2021.
- [3] 3GPP RWS-210152, "Draft SID on NR network energy saving enhancement", China Telecom, Rel-18 workshop, June 28 – July 2, 2021.
- [4] 3GPP RWS-210153, "NR network energy saving enhancement for Rel-18", China Telecom, Rel-18 workshop, June 28 – July 2, 2021.
- [5] 3GPP RWS-210156, "Operator Customizable Network Sharing for Rel-18", China Telecom, Rel-18 workshop, June 28 – July 2, 2021.
- [6] 3GPP RWS-210157, "Draft WID on Operator Customizable Network Sharing", China Telecom, Rel-18 workshop, June 28 – July 2, 2021.