[RAN94e-R18Prep-09] Network energy savings - Version 0.0.4
RAN

3GPP TSG RAN Meeting #94-e **RP-212669**

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Title: Moderator's summary for [RAN94e-R18Prep-09] Network energy savings

Agenda item: 8A.1

Document for: Discussion and decision

1 Introduction

Proposals on network energy savings were provided to the 3GPP RAN Rel-18 workshop in June 2021. Network energy savings was subsequently identified as a topic for further email discussions in RWS-210659. Further discussion on NWM took place before RAN#93-e under thread [RAN93e-R18Prep-13], with final summary in RP-211663. The final summary was not endorsed but it is copied in section 2 as a starting point for the discussion. Network energy savings was included as a potential RAN1-led item in the RAN Chair's Summary for RAN Release 18 (RP-212608).

The goal of this second email discussion is to collect views on how 3GPP RAN could proceed with a study or/and work item on network energy savings in Rel-18, assuming such item might be agreeable at RAN#94.

Towards this goal, we will aim to

1. Refine potential objectives on
    a) network energy consumption model
    b) evaluation methodology and KPIs
    c) potential techniques and features for study
2. Identify a prioritization of scenarios and target network load (i.e. power consumption states), if possible
3. Identify possible milestones of SI+WI in Rel-18
4. Identify the responsibility for each WG
5. Identify potential impact to/from SA and CT

For that purpose, a number of proposals and questions are formulated by the moderator, starting in section 3 (initial phase).

Companies' feedback on the proposals for the initial phase is requested by 23:59 UTC on Friday October 22nd.

Companies' feedback on the proposals for the intermediate phase is requested by 12:00 UTC on Wednesday October 27th.

Companies' feedback on the proposals for the final phase is requested by 12:00 UTC on Friday October 29th.

2 Summary from RP-211663

Potential scope of a study on network energy savings

1. Definition of a network energy consumption model

   - Note 1: it is suggested to adapt the framework of the power consumption methodology of TR38.840 to the network side, utilizing information from known models / external references and other relevant information, including relative energy consumption for DL and UL (considering factors like PA efficiency, number of TxRU, etc), sleep states and the associated transition times, and one or more reference parameters/configurations
   - Note 2: an absolute power consumption model could also be studied in addition to the relative power consumption model, or a method could be studied for allowing to derive absolute power consumption metric from the relative power consumption metric and additional information available outside 3GPP

2. Definition of an evaluation methodology, including studying potential KPIs

   - Note: evaluation methodology should not focus on a single KPI, but allow evaluating how to enable system-level network energy savings while balancing impact to network/user performance (e.g. spectral efficiency, capacity, UPT, latency) and UE power consumption/complexity

3. Study techniques and features to enable network energy saving

   - Note 1: the focus areas include how to achieve more efficient dynamic and/or semi-static and finer granularity adaptation of transmissions and/or receptions in one or more of time, frequency, spatial, and power domains, with potential support/feedback from UE. Additional areas of the study may include UE assistance information and intra-network information exchange/coordination.
   - Note 2: legacy UEs should be able to continue accessing a network implementing Rel-18 network energy savings techniques, with the possible exception of techniques developed specifically for greenfield deployments.

RAN1 would be the leading WG of such study, with at least RAN3 and RAN4 as secondary WGs and possibly also RAN2. Some companies mentioned a potential need for alignment with SA5 activities on enhancements

on energy efficiency for 5G network. Several companies propose to plan the study in order to ensure normative work in Rel-18.

As a starting point, the following scenarios can be considered as targets for system-level studies on network energy savings:

- Urban micro in FR1, including TDD massive MIMO
- FR2 beam-based scenarios with massive MIMO
- Urban/Rural macro in FR1 with/without DSS (no impact to LTE expected in case of DSS)
- EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency
- Other scenarios, e.g., small cell deployment, can be considered

General note: new features studied or specified in other WI/SI should consider network energy consumption as a criterion in the study and design of new features when relevant.

3 Initial Phase

3.1 General comments

Companies are invited to provide general comments on the topic of network energy savings in the context of Rel-18. You may use this feedback form for comments on the potential impact to/from SA and CT, noting that a potential need for alignment with SA5 activities was mentioned in earlier discussions.

Feedback Form 1: General Comments

1 – Beijing Xiaomi Mobile Software Implementing R18 energy saving techniques should not, or at least not obviously, cause the power consumption rise for UE.
2 – BBC BBC believes that any model of energy saving should be holistic and that the total energy consumption of the system, including for example UEs, should be taken into account with the aim to reduce the impact overall. It may be helpful for organisations that provide content over third-party mobile networks to be able to identify energy consumption or ways to understand and reduce the impact of their specific services and to facilitate ways of working with the network operators to realise improvements.
3 – vivo Communication Technology vivo UE backward compatibility is also important for consideration. For new solutions with the same conditions for network energy saving, which have less impact / complexity / power consumption to UE

side is taken first priority for consideration.

4 – MediaTek Inc.

Our general expectation is that the time occasions UE can save power can be utilized for network energy saving, and those network can save energy can also be exploited for UE power saving. In this regard, NR system can evolve to optimize the overall system energy efficiency.

5 – CATT

For network energy saving, the consideration of gNB power consumption would not only consider the power consumption of Tx/Rx at Uu interface but also that in the backhaul.

3.2 Initial Proposals

Q1: question on study objective for the definition of a network energy consumption model: do you agree to focus this study item objective on the definition of a relative power consumption model, as formulated below in draft objective 1? You may also provide your views on the expected responsibilities for each WG for draft objective 1.

Draft objective 1: Definition of a network energy consumption model [RAN1]

- *a) Adapt the framework of the power consumption methodology of TR38.840 to the network side, utilizing information from known models, external references and other relevant information, including relative energy consumption for DL and UL (considering factors like PA efficiency, number of TxRU, etc), sleep states and the associated transition times, and one or more reference parameters/configurations.*

Feedback Form 2: Responses to Question 1

1 – Nokia France

We agree with the draft objective above.

2 – LG Electronics France

We are fine with the objective above, focusing on relative energy consumption

3 – Spreadtrum Communications

We are fine for it, since it can simplify the evaluations.

4 – TELECOM ITALIA S.p.A.

agree

5 – Telia Company AB

Agree with draft objectives.

6 – Orange

agree

7 – Futurewei Technologies

We also agree with this objective.

8 – Apple Italia S.R.L.

We are fine with this objective.

9 – AT&T

ok

10 – China Telecom Corporation Ltd.

We are fine to use the relative power consumption model for evaluation and agree with the draft objective 1. And we also suggest some metrics and factors in known absolute models such as in TS38.910 can be used as references for enriching the power consumption model.

11 – CATT

We are OK with moderator's proposed objective

12 – Guangdong OPPO Mobile Telecom.

The adaptation would be based on mostly 38.840. Note that it was mainly for UE side and we may have more works on convert it to UE side. The sleeping state in gNB side is not defined yet. But generally this bullet is open enough.

13 – Intel

agree

14 – Samsung Electronics Co.

Agree with the draft objective 1

15 – SHARP Corporation

We agree with draft objective 1.

16 – China Mobile Com. Corporation

We support the drat objective 1.

17 – Beijing Xiaomi Mobile Software

Agree with the draft objective 1

18 – HUAWEI TECHNOLOGIES Co. Ltd.

We agree with the draft objective 1

19 – LG Uplus

Agree

20 – Panasonic Corporation

We support the proposal.

21 – Rakuten Mobile

We agree with the proposal.

22 – NEC Telecom MODUS Ltd.

We agree with this proposal.

23 – Fujitsu Limited

Agree with the draft objective 1

24 – KDDI Corporation

Agree with draft objectives.

25 – ZTE Corporation

We agree that a relative power consumption model is a better choice considering the varied base station implementation and deployment scenarios, etc.

As to the factors to be considered in the power consumption model, we think the current elements are quite comprehensive. In addition, we also need to consider power consumption scaling for adaptation in the study phase.

26 – CEWiT

We agree with the draft objective above. But it will be easier if we have some additional absolute parameters in the model for reference and comparison.

27 – vivo Communication Technology

vivo relative power consumption model is preferred similar to what has being used for UE power saving study in TR38.840. Similar approach as used in TR38.840 could be used as the starting point for the power model of network component.

28 – Deutsche Telekom AG

We agree with the proposal as an initial step. But we see also the need to consider a method to derive absolute power consumption metrics as based on only relative metrics it will be hard to compare absolute gains for energy saving features against each other.

29 – VODAFONE Group Plc

Agree with Deutsche Telekom

30 – Ericsson LM We are fine with the proposal. It is good to change "*the power consumption methodology*" to "*the power consumption modelling and evaluation methodology*". Furthermore, the impact of NW load on energy consumption should be reflected in the model. This can be added to "*considering factors like PA efficiency, number of TxRU, NW load, etc*".
31 – Fraunhofer IIS We are fine with the draft objective 1.
32 – MediaTek Inc. We agree the direction for establishing network power consumption model. In principle, there will require modeling power consumption of basic gNB/network node operations as well as various scaling factors that can reflect the power consumption difference of different adaptation schemes. The operation of "unit" power consumption (which is deep sleep in UE power saving) would be challenging to define when different gNB/network node types are considered. But this is the fundamental factor companies need to investigate and align for network energy saving.
33 – InterDigital Belgium. LLC We support the draft objective
34 – Motorola Mobility UK Ltd. Fine with the draft objective 1 above.
35 – Verizon UK Ltd We support the objective.
36 – Qualcomm Incorporated We propose to change "*network energy consumption model*" to "*network energy efficiency model*" where energy efficiency is measured as power consumed per communicated bit. We agree with the rest of the draft objective 1.
37 – Telstra Corporation Limited we support the draft proposal

Q2: question on study objective for the definition of an evaluation methodology and KPIs: do you agree that one study item objective is to define an evaluation methodology with associated KPIs, as formulated below in draft objective 2? You may also provide your views on the expected responsibilities for each WG for draft objective 2.

Draft objective 2: Definition of an evaluation methodology and KPIs [RAN1]

- *a) The evaluation methodology should not focus on a single KPI. The evaluation methodology should allow evaluating how to enable system-level network energy savings while balancing impact to network*

and user performance (e.g. spectral efficiency, capacity, UPT, latency) and UE power consumption/complexity.

Feedback Form 3: Responses to question 2

1 – Nokia France

In order to keep this objective well focused, it would be good to add that **existing KPIs should be reused as much as possible** (e.g. leveraging the existing RAN3 gNB-level EE KPI and ETSI metrics), and the set of KPIs adopted should be kept as small and simple as possible.

2 – LG Electronics France

We are fine with the proposal

3 – Spreadtrum Communications

The listed conventional KPIs in SLS can be reused, e.g. *spectral efficiency, capacity, UPT, latency*, in addition to power saving gain. As some companies found the typical scenario for network energy savings is light-load scenario, the KPI of spectral efficency, capabity, UPT and latency can be relaxed in light-load scenario.

4 – TELECOM ITALIA S.p.A.

support Nokia revision

5 – Telia Company AB

Support Nokia proposal to use already existing KPIs eg. defined in ETSI TS 102 706-1 and ETSI TS 102 706-2.

6 – Orange

we also support Nokia's proposal to re-use existing KPIs, but also develop additional KPIs adapted to the obejctives of having a finer granularity for network power saving in RAN (e.g. CU, DU, MIMO layer, beam levels)

7 – Futurewei Technologies

We are ok with the proposed objective. Re-using existing KPIs and developing additional KPIs should both be considered but it is business as usual and no need to specify in the WID.

8 – Apple Italia S.R.L.

We are fine with this objective.

We are also fine with the general principle of reusing existing KPIs when possible, as proposed by Nokia. But we do not think it is necessary to add such a phrase in the objective because it is what we have always been doing, leveraging what we already have. If we really want to add a phrase along this line, either we need to be more specific on what we intend to reuse, or we soften the tone to something like "reuse existing KPIs when appropriate" to allow closer check later.

9 – AT&T

fine with proposal incl Nokia's suggestion

10 – China Telecom Corporation Ltd.

The KPIs should definitely evaluate the power consumption and network performance at the same time, and multiple KPIs can be considered. We agree with Nokia that the existing KPIs such as energy efficiency in bits/Joule mentioned in 3GPP/ITU-T/ETSI can be firstly considered reused.

11 – CATT

We are OK to reuse existing KPI as well as those KPI in TR38.840, such as latency/user perceived throughput. We also need to define the impacts to the system capacity and UE power consumption too.

12 – Guangdong OPPO Mobile Telecom.

The wording is fine. We understand there should not be significant impact to UE power consumption and complexity.

13 – Intel

agree

14 – Samsung Electronics Co.

Fine with the draft objective 2

15 – SHARP Corporation

We agree with draft objective 2 and also the suggestions from Nokia.

16 – China Mobile Com. Corporation

We generally support draft objective 2 and the intention of balancing both network energy savings and UE performance but have one comment about UE complexity. The motivation of taking account of UE complexity in the evaluation methodology and how to evaluate it are unclear to us. Currently in NR, only Rel-17 RedCap touches the UE complexity reduction evaluation, e.g., BW and Rx antenna reduction, but the UE complexity are not considered in the evaluation of Rel-16/17 UE power saving WI. Whether to evaluate UE complexity aspect and how to evaluate it need more discussion and clarification.

17 – Beijing Xiaomi Mobile Software

Agree. And also agree to reuse existing KPIs when applicable.

18 – HUAWEI TECHNOLOGIES Co. Ltd.

We are basically fine with the above draft objective 2. The focus of this SI aims for identifying the potential techniques for network side energy saving, and thus the main target metrics should be network energy saving gain and balanced network/user performance (e.g. spectral efficiency, capacity, UPT, latency). Other metrics can be considered if applicable. Some editorial change on objective 2 as below:

a) The evaluation methodology should not focus on a single KPI. The evaluation methodology should target for ~~allow~~ evaluating ~~how to enable~~ system-level network energy savings ~~while balancing~~ and impact to network and user performance (e.g. spectral efficiency, capacity, UPT, latency), and consider UE power consumption/complexity if applicable.

Regarding the existing KPIs for energy efficiency raised by Nokia, it can be considered if needed. However, we also think it is not good/necessary to explicitly describe it in the objective. During the study, we can double check whether these kind of KPI is appropriate/needed from physical layer evaluation or not.

19 – LG Uplus

We are OK with the proposal.

20 – Panasonic Corporation

We support the proposal,

21 – Rakuten Mobile

We support draft objects 2.

22 – NEC Telecom MODUS Ltd.

We agree that the evaluation methodology should focus on more than one KPIs. And reusing some of the existing KPIs will help to simplify the evaluation work.

23 – Fujitsu Limited

Agree with draft objective 2.

24 – ZTE Corporation

We agree that we should not focus on a single KPI. The metrics such as UPT, latency, etc which have also been considered in Rel-16 UE power saving SI can be also considered in NW energy saving study. In general, we think the listed metrics can be taken as a good starting point.

25 – CEWiT

The objective is fine to us. We share similar view with Nokia France about the no. of KPIs adopted.

26 – vivo Communication Technology

vivo we are in principle fine. System level simulation (monte carlo) is needed. UE level impact should be also provided as a simulation results as describe in the objective.

27 – Deutsche Telekom AG

The objective is fine with us; we also support Huawei's text modification.

We may start with existing KPIs, but this should not restrict to add further metrics. Those can be evaluated during the SI phase; there is no need to fix them already in the SID.

28 – VODAFONE Group Plc

The objective is fine with us; we also support Huawei's text modification. and Nokia's proposal

29 – Ericsson LM

The proposal is generally fine. It is better though to change "*system-level network energy savings*" to "*system-level network energy consumption and savings gains*". Furthermore, we think Objectives 1 and 2 are related and thus can be integrated in one objective with current Objective 1 as "a" and Objective 2 as "b".

30 – Fraunhofer IIS

We are fine with this objective and agree with Apple to add "reuse existing KPIs when appropriate" and revisit the details later.

31 – MediaTek Inc.

- Evaluation methodology: We expect the evaluation methodology should base on system-level simulations with different DL/UL traffic models. The traffic models can cover video/ftp, instant message and VoIP for better understanding on the potential impact to user experience.

  The simulation should also include UE power saving schemes so that the evaluation can observe the interactions and potential cooperation between network and UE power saving schemes, which is fundamental factor to achieve better "system" energy efficiency.
- KPIs: We are open to reuse existing network KPIs. The KPIs used for UE power saving, including average power saving gain and average packet latency increment are also intuitive and useful. Collection of both network and UE KPIs are necessary for balanced design, and identifying the designs that can improve KPIs of both network and UE should be targeted.

32 – InterDigital Belgium. LLC

Support objective and also fine with Nokia's proposed addition.

33 – Motorola Mobility UK Ltd.

Fine with the proposed draft objective 2 above in principle. Can add a note "Reuse existing KPIs as much as possible to simplify the evaluation".

34 – Verizon UK Ltd

Fine with the proposal.

35 – Qualcomm Incorporated

Energy efficiency (measured as power consumed per communicated bit) should be one of the KPI's. We propose to make the following update to the objective 2:

- *The evaluation methodology should not focus on a single KPI. The evaluation methodology should allow evaluating how to enable system-level network energy savings while balancing impact to network, ~~and~~ user performance (e.g. spectral efficiency, capacity, UPT, latency), ~~and~~ UE power consumption/-complexity, <u>and energy efficiency</u>.*

36 – Telstra Corporation Limited

Ok with the proposal in general, as well as Huawei wording and re-use of KPIs as possible

Q3: question on study objective on techniques for network energy saving: do you agree that one study item objective is to study potential techniques to improve network energy savings, as formulated below in draft objective 3? Suggestions for clarifying objectives on UE assistance information and intra-network information exchange/coordination are welcome. You may also provide your views on the expected responsibilities for each WG for draft objective 3.

Draft objective 3: Study techniques to improve network energy savings, including

- *a) How to achieve more efficient dynamic and/or semi-static and finer granularity adaptation of transmissions and/or receptions in one or more of time, frequency, spatial, and power domains, with potential support/feedback from UE, and potential UE assistance information [RAN1, RAN2]*
- *b) Intra-network information exchange/coordination [RAN3]*

Note: legacy UEs should be able to continue accessing a network implementing Rel-18 network energy savings techniques, with the possible exception of techniques developed specifically for greenfield deployments.

Feedback Form 4: Responses to question 3

1 – Nokia France The main bullet is OK. The sub-bullets (a) and (b) are so all-encompassing that they do not really help to focus the main bullet at all. If the scope cannot be narrowed, the two sub-bullets might as well be deleted.
2 – LG Electronics France We are fine with the proposal. However identification of the potential techniques to be studied should be a part of the study itself.
3 – Spreadtrum Communications For the objectives of possible techniques, we think it should be general enough before the study. Does the text "*with potential support/feedback from UE, and potential UE assistance information*" imply the new UE feedback is must for network energy savings? How about the additional power consumption of the new UE feedback? We suggest removing it currently.
4 – Telia Company AB In general we agree, but maybe there could be a bit more guidance and information about the practical potential techniques and related objectives as sub-bullets.
5 – Futurewei Technologies We are fine with the proposed objective. Further narrowing down and identification is part of the study.
6 – Apple Italia S.R.L. We are generally fine with this objective, and agree that the narrow-down of the solutions should be part of the study. Two comments:

1. It seems bullet b) should also be part of bullet a), on the same level as UE feedback and UE assistance info. It is one kind of information exchanges that allows network power adaptation. With this, we would like to suggest:

Study techniques to improve network energy savings, in terms of how to achieve more efficient dynamic and/or semi-static and finer granularity adaptation of transmissions and/or receptions in one or more of time, frequency, spatial, and power domains, with

a) Potential support/feedback from UE, and potential UE assistance information [RAN1, RAN2]

b) Potential intra-network information exchange/coordination [RAN3]

2. On ”intra-network information exchange/coordination”, does ”intra-network” imply that this can only occur within the same operator, not between different operators? Is there a particular reason to impose such restriction?

7 – AT&T

Agree with LG

8 – China Telecom Corporation Ltd.

We are fine with the draft objective 3 in principle. However, in our understanding, the current expression of sub-bullet(a) is a little detailed that may narrow down the potential techniques now. Any solutions related to time/frequency/spatial/power domain can be considered at first and be narrowed down in the study phase.

9 – CATT

We are OK with the principle of the objective. For sub-bullet (b), the network energy saving would also require RAN3 works not only in the intra-network information exchange/coordination but also the gNB energy saving in the backhaul transport.

10 – Guangdong OPPO Mobile Telecom.

We also agree to LG, that the enhancement should be dependent to the study results.

11 – Intel

Agree, with one more addition. In the September email discussion, the following power domain enhancements were listed:

- Improving PA efficiencies at gNB and related processing at gNB/UE
- Improving PA efficiencies at UE
- Dynamic DL power control

In case PA efficiency improvements are considered, then then RAN4 involvement can be required. Therefore, we suggest to add RAN4 as a responsible group for such kind of work.

12 – SHARP Corporation

We agree with draft objective 3 in general.

13 – China Mobile Com. Corporation

We generally support draft objective 3, but one minor comment about "finer granularity" since there is no clear definition on it and may cause confusion to companies.

14 – Beijing Xiaomi Mobile Software

Agree with LG.

15 – HUAWEI TECHNOLOGIES Co. Ltd.

We are generally fine with the draft objective 3 above. However, we are still wondering how UE assistance information and intra-network information exchange/coordination can help save the network energy consumption. If proponents of these techniques can clarify more, then it would be helpful to judge whether/how to adjust the objective 3. In addition, if possible we still think that it would be better to provide some directions to give guidance for the following study, thus keep sub-bullets would be better compared to only keep the main bullet.

16 – LG Uplus

Fine with the proposal

17 – Samsung Electronics Co.

The elaborations in a) and b) would provide the outline of studying potential techniques.

Couple of comments for clarity:

- a): "Potential support/feedback from UE" and "potential UE assistance information", seem same. We can delete one of them.
- b): 'inter-network' is confusing. Suggest to update as "Information exchange/coordination over network interfaces".

18 – Panasonic Corporation

We support the proposal.

19 – NEC Telecom MODUS Ltd.

We are fine with discussing the techniques to improve network energy saving. However, the detailed techniques given in bullet a) may need further consideration and evaluations.

20 – Fujitsu Limited

We are generally fine with draft objective 3 and agree with LG's comments.

21 – KDDI Corporation

We are generally fine with draft objective 3, but also we need to be careful for increasing UE implementation complexity and UE power consumption caused by UE assistance information.

22 – ZTE Corporation

We are okay with the main bullet and two sub-bullets, which are sufficiently generic. We also agree that we should leave the detailed schemes to be discussed in the study phase.

As to the UE assistance information, we think it will be helpful to be aware of the traffic/UE population information if some information such as UE mobility, traffic, etc can be reported to NW, so that NW can apply an appropriate adaption for energy saving. And we think more detailed UE assistance information can be discussed in SI. Regarding to the concern about additional UE power consumption, we think it has already been captured as one of the potential KPI, we think it is better to keep it as it is for further study.

For the information exchange between NW, we think as it was suggested by other companies, information such as UE population, sleep mode, beam information ,etc. will be helpful, which can be further discussed in SI.

In general, we are okay with the current objective. We think the listed sub-bullets are also helpful which provide an insight into to study areas.

23 – CEWiT

The objective 3 is fine to us. We share similar view with LG regarding narrowing down the scope in SI. The assistance information or some feedback from UE will be an aid for the BS to get information on impacts and condition of UE for adopting energy saving schemes. Inter BS co-ordination will further provide one more means of power saving with reduced impacts on user experience

The information exchange/coordination may be required based on change and impacts on RAN1 related processes, thus RAN1 should be made as secondary WG for sub bullet b.

24 – Deutsche Telekom AG

We are generally fine with the objectives, but we would like to support Apple's proposal to change the text as to highlight that UE feedback/assistance information and network info exchange are potential methods on top to improve the energy consumption.

25 – vivo Communication Technology

vivo the note, we would be like to know the scenario for only new Rel-18 UEs are accessible to the network for network power saving purposes. We think the backward compatibility should be carefully kept in order to ensure the legacy UEs are not impacted and make a health ecosystem.

26 – VODAFONE Group Plc

OK

27 – Ericsson LM

The proposal is good. We think however, in later stages, particularly for deciding about the related AIs, it would be good to separate Objective 3a to more sub-items, e.g., time, frequency, spatial, power domains and UE assistance information can be separate sub items.

28 – Fraunhofer IIS

We are generally fine with this objective and agree with LG. But we also agree with the new formulation proposed by Apple.

29 – MediaTek Inc.

- On a), we suggest to prioritize dynamic schemes since it is more universal solution. Regarding power saving adaptation, time-domain and frequency-domain power saving adaptations are also suggested to be prioritized since the corresponding UE power saving design (including signaling) can possibly be reused or extended. This brings the benefit of UE support. UE feedback schemes are also recommended since leverage UE knowledge in user application requirements can be the best way to minimize the impact to user experience.
- On b), we are open for intra-network information exchange/coordination. But some specific example will be useful for us to understanding how this enhancement can bring good network energy saving gain?

30 – InterDigital Belgium. LLC

Support objective 3. We see no reason to narrow the scope before the evaluation is done.

31 – Motorola Mobility UK Ltd.

We prefer to remove "with potential support/feedback from UE, and potential UE assistance information", since this is a part of technical discussion points to answer the question "how to achieve more efficient dynamic and/or semi-static and finer granularity adaptation of transmissions and/or receptions in one or more of time, frequency, spatial, and power domains".

32 – Verizon UK Ltd

Agree with LG.

33 – Qualcomm Incorporated

Regarding (b): we believe reconfiguration of one cell (to do energy saving) may impact the whole network; hence network energy saving is important to be done in a coordinated manner.

34 – Telstra Corporation Limited

Ok with the bullets

Q4: additional questions on potential objective 3: *Would you agree to focus objective 3 on the base station transmission side in Rel-18?*

Feedback Form 5: Responses to question 4

1 – Apple Italia S.R.L.

The question is not clear to us. Does it mean for network power consumption, we only consider DL transmission, not UL reception? If this is the intention, we think it is too early to conclude right now. We should wait after we have better understanding on network power modeling and whether UL reception consumes a significant amount of power or not.

2 – China Telecom Corporation Ltd.

The motivation of this question needs to be clarified. Since the energy consumption of base station in downlink transmission dominates the total energy consumption and has large potential to be reduced, we agree to focus on the base station transmission side in Rel-18 from the prospective of scenario. But we do not agree to only consider the potential solutions on the base station side, all the potential techniques help to reduce the power consumption on the base station transmission side should not be excluded for now.

3 – Huawei Tech.(UK) Co.. Ltd

Moderator Answers to Apple and China Telecom for clarification. The intention of this question is to try and see if the scope of the study could be more focused in order to facilitate the completion of the study within the proposed time plan. The assumption, as summarized by China Telecom, is that the BS transmission dominates the total BS energy consumption. If companies agree with that observation then objective 3 could focus on techniques that reduce the BS energy consumption due to BS transmissions. This is not implying that BS energy consumption due to BS reception cannot be reduced, but it would not be the focus on the study in Rel-18. That being said, as moderator I would still propose that the network energy consumption model defined in objective 1 should be complete and provide a model for both BS transmission and BS reception, as the model will be used for future releases as well.

4 – Guangdong OPPO Mobile Telecom.

We are not clear for the focus on DL. It could be also useful if deem to be beneficial for network power saving with little cost of UE complexity/power. May be we can start without the bullet.

5 – Intel

Power consumptions for base stations get impacted not only by transmission but also reception. There are potential signals that needs to be exchanged as part of communication procedures. We are not entirely sure how we can only focus on the transmission side, when discussing potential network energy savings as a whole.

We expect many clarifications will be needed if the objective 3 is limited to Tx only.

Given that this is a study, we think leaving objective 3 as the draft states is preferred (as it already states "… adaptation of transmission and/or receptions …")

6 – CATT

For network energy saving, the base station transmission side and reception side are equally important, which is different to those in UE power saving study in Rel-16. gNB is in the control of both DL transmission and UL reception at the air interface. In the mean time, gNB does not have control of the backhaul incoming traffic from the CORE network and other gNB. It is important to have all components, such as radio, baseband processing, and backhaul connection in the gNB to take into consideration in the network energy saving.

7 – Samsung Electronics Co.

As moderator clarified, above objective 1 (and 2 as well) are for both DL and UL.

Along the same line, objective 3 should also include both base station reception and transmission side.

8 – China Mobile Com. Corporation

We are fine to focus objective 3 on BS transmission side, since DL accounts for a higher energy consumption proportion due to PA and more DL slots in TDD.

9 – Beijing Xiaomi Mobile Software

The reception side of gNB also has a important impact on gNB energy saving, and should be studied as well.

10 – HUAWEI TECHNOLOGIES Co. Ltd.

We agree to focus on study how to save network energy consumption from base station transmission perspective, since the power consumption from data/signal transmission is much larger than the power consumption of data/signal reception at the gNB side.

11 – LG Uplus

We are generally fine with the proposal as many companies indicated the transmission of base station is dominant part for energy consumption but open to discuss reception part as well if time allows.

12 – Fujitsu Limited

We agree to focus objective 3 on the BS transmitter side in Rel-18.

13 – ZTE Corporation

We think we don't need to restrict the scope as base station transmission side at this very first beginning, techniques that aim to reduce to power consumption of the reception side are also helpful and can be also considered in this study.

14 – KDDI Corporation

We think it is too early to conclude right now. We should wait after we have better understanding on network power modeling and whether UL reception consumes a significant amount of power or not even though DL transmission is major factor of the power consumption.

15 – CEWiT

Network energy saving in transmission side of BS can be prioritized, but the reception should not be precluded. The energy saving should be done at BS considering any power dominating process irrespective of transmission or reception. Therefore, we suggest to add "however, reception side is not precluded" in the focus of the objective

16 – Deutsche Telekom AG

The scope of NW energy savings SI/WI should consider both transmission directions. It is important that evaluation methodology and KPIs are initially defined in the SI for both directions. If during further discussion it may be become visible that prioritization is needed to keep the Rel-18 timeline, the initial focus of evaluations could be on DL direction.

17 – Nokia France

The uplink reception should also be considered.

18 – Ericsson LM

We do not agree with that. The reason is that transmission and reception at the NW side, i.e., DL and UL are quite entangled particularly in TDD scenarios: Indeed in idle mode, reception consumes quite a significant amount of energy at the base station. Therefore, both transmission and reception (e.g., PRACH reception) should be considered.

19 – VODAFONE Group Plc

We should focus on where the biggest energy savings can be made. We anticipate these to be on techniques that reduce base station transmissions, but we could use some of the study item time to verify this.

20 – Fraunhofer IIS

As feedback from UE can impact the power consumption on the network side, we prefer to do a complete study phase without narrowing down the scope initially.

If the outcome of the study phase proves that a focus on DL Tx is warranted, that priority could be given in the work item phase.

21 – MediaTek Inc.

Maximizing the opportunity for gNB/network node to ”sleep” is expected to be the fundamental target for network energy saving. If receiving UE UL will prevent gNB/network node to go sleep, we would suggest the scope should not be restricted, at least, for study phase.

22 – InterDigital Belgium. LLC

No. NR already does not transmit much ”always-on” signals so it is not clear that this is where the most potential gains would come from.

23 – Motorola Mobility UK Ltd.

We are open to consider both transmission and reception sides during the Study Item phase.

24 – Verizon UK Ltd

Both Tx and Rx should be considered.

25 – Qualcomm Incorporated

We believe we should not limit the focus of the objective to “transmissions”. As part of objective 3, techniques will be studied/specified to do network energy saving (NES) in different domains. Especially regarding time and frequency domains, the related NES features may be agnostic to Tx/Rx mode of the base station. For example, in the time domain, the base station can save energy by enabling idle periods (i.e., no Tx and/or Rx) and sleep modes.

26 – Telstra Corporation Limited

Agree with Vedofone & Verizon comments - both Tx & Rx should be considered and a focus on areas that will provide the greatest benefit.

Q5: questions on potential prioritization of scenarios and network power consumption states: please provide your views on the priority of the scenarios below. Please provide your views on the associated target

network load(s) assumption (e.g. high load, medium load, low load with only a few connected UEs, idle load with no connected UE).

- Urban micro in FR1, including TDD massive MIMO
- FR2 beam-based scenarios with massive MIMO
- Urban/Rural macro in FR1 with/without DSS (no impact to LTE expected in case of DSS)
- EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency
- Other scenarios, e.g., small cell deployment, can be considered

Feedback Form 6: Responses to question 5

1 – Nokia France

The greater potential for energy saving is likely to come in the emptier system scenarios, so one priority would be the Urban/Rural macro in FR1. Another priority should be small cell deployments.

We should certainly aim to reduce the number of scenarios considered, in order to manage the work better.

2 – Spreadtrum Communications

Medium load to idle load seems more possible for network energy savings.

We are not sure the scenarios are too specific. Could we use some ”models” of the scenarios for simplification, e.g. Macro/Micro/Urban/Suburban? Maybe we can revisit them in study item. We are fine for the current listed scenarios.

3 – TELECOM ITALIA S.p.A.

in principle agree with Nokia (focus on more ”empty” scenarios: Urban/Rural macro in FR1 and EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency

4 – Telia Company AB

Idle/Low and Medium load levels should be focused in urban micro&macro and rural macro in FR1 mMIMO.

5 – Orange

the main target should be macro in FR1, in both FDD and TDD, with idle to medium load (urban/rural alike)

6 – Futurewei Technologies

In general, lower load of the system benefits more from the power savings. However, the study may not be limited to that scenario. At least unevenly loaded system should be considered as well.

7 – AT&T

We support all the proposals in Q5

8 – Apple Italia S.R.L.

We think idle/low load should be the main focus. Medium load can be potentially considered, but we assume this is not the main target use case. Which scenarios should be prioritized or whether we need to prioritize certain scenarios need to be further discussed, which also depend on the evaluation methodology (e.g. whether a system-level simulation will be performed or some modeling will be used).

9 – China Telecom Corporation Ltd.

We are fine with the listed scenarios and the typical massive MIMO scenarios such as sub-bullet 1/2/3 can be considered with a relative higher priority.

The target network loads should be related to the specific potential techniques since the impact can be different. For example, the dynamic TRX/beam on-off can be helpful in medium load network, while dynamic symbol on-off can be more useful in low load network.

10 – Guangdong OPPO Mobile Telecom.

Generally fine. Small cell can be also listed. One example is the small cell deployment may matter in case of dense deployment, when you exit / enter different rooms

11 – Intel

While we do not object to any of the proposed scenarios as part of the study, Urban micro in FR1 and Urban/Rural macro in FR1 are good starting points for focus of the study.

12 – CATT

We also believe that Network energy saving will mainly come from low/medium load scenarios. Dynamic adaptation of Tx/Rx in spatial/time/frequency domain during high load would have potential impact to the user perceived throughput and system capacity. Urban micro in FR1 and Urban/Rural macro in FR1 without DSS should be prioritize as the scenarios for evaluation.

13 – Samsung Electronics Co.

Urban/Rural macro in FR1 is our higher priority scenario. In addition, FR2 scenario should not be overlooked.

14 – China Mobile Com. Corporation

Regarding the priority of scenarios, network energy saving should aim for more realistic and extensive deployment scenario among operators. From CMCC's perspective, our preference is FR1 Urban micro/macro scenario including both homogeneous network and heterogeneous network. We also think the network energy saving techniques should be applicable to as more scenarios as possible, techniques only used in limited scenarios can be deprioritized in the SI phase discussion.

Regarding the target network load(s) assumption, medium load, low load and idle load can be included, and these three load assumptions are enough in the study to limit the workload. As high load assumption, the network energy saving techniques may have none or limited energy saving gain and we should not pay much time on it.

15 – Beijing Xiaomi Mobile Software

For the target network loads, idle to low traffic load may be more potential to achieve network energy saving. and scenarios with idle to low traffic, or with very regular and tidal flow traffic should be studied. for the current being, we see the proposed scenarios can all be considered.

16 – HUAWEI TECHNOLOGIES Co. Ltd.

We consider the main targeting assumptions would likely be low load with only a few connected UEs and idle load with no connected UEs. For the scenarios, we think at least the first 3 should be studied. Massive MIMO is key for NR and used often in NR deployment scenarios, which is well know that it will increase the network energy consumption a lot, especially for FR2 with Massive MIMO, therefore the first two should be studied. In addition, we also agree that Urban/Rural macro in FR1 should be a prioritized scenario also, especially for FDD. So if we want to further restrict the scenario for the third bullet, we prefer to restrict to "Urban/Rural macro in FR1 with FDD". Regarding the last two bullets, we think DC can be deprioritized since it is kind of combination of the scenarios given by the first three bullets, and small cell defined by the last bullet to some extent already cover by the scenario given by the first two bullets, e.g. micro is one type of small cell.

17 – Panasonic Corporation

We support basically above listed scenarios. Small cell deployment especially for FR2 regardless of massive MIMO should be also prioritized. We also see the need to study the case where the certain location is supported by the multiple bands instead of just to study single cell/carrier operation.

18 – LG Uplus

For the target load(s), ss many companies indicated, low or a few connected UEs case should be prioritized. Regarding the scenarios, "Urban/Rural Macro in FR1" and "EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency" are the highest priority as they are the most popular deployment scenarios over most regions.

19 – NEC Telecom MODUS Ltd.

We also agree to prioritise the study on low/idle load scenarios. In detail, the urban micro, urban macro and rural scenarios in FR1 should be evaluated respectively. '*DSS*' can be considered as optional scenario of Urban/Rural macro in FR1.

Furthermore, considering the significant energy consumption of massive MIMO techniques, we suggest that the beam-based scenarios in FR2 should be also prioritised.

20 – ZTE Corporation

We think the NW systems with medium, low, and idle load can be considered for the study. For the scenarios, we can consider Urban micro in FR1, Urban/Rural macro in FR1, and small cell deployment.

21 – KDDI Corporation

We support the priority of the scenarios proposed by the moderator.

22 – CEWiT

The potential of energy enhancement is high in low load with only a few connected UEs and idle load with no connected UE The priority should be in following order as:

Urban/Rural macro in FR1 with/without DSS (no impact to LTE expected in case of DSS)

Other scenarios, e.g., small cell deployment, can be considered

FR2 beam-based scenarios with massive MIMO

Urban micro in FR1, including TDD massive MIMO.

23 – vivo Communication Technology

vivo

For small cell scenario, LTE Rel-13 has studied small cell on/off. It can be assumed that only a few connected UEs, the average traffic load could be medium.

24 – Deutsche Telekom AG

Energy saving gains are primarily only expected in case of lower load scenarios, i.e, covering idle and low to medium load should be initially sufficient.
We would prefer to focus initially on scenarios "Urban/Rural macro in FR1" and "EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency" plus "Urban micro in FR1, including TDD massive MIMO" which represent the most important use cases for wide area broadband connectivity. For hot spot scenarios (FR2, small cells) timely switch-off/on of such cells is already feasible, therefore the higher pressure on energy savings is on the other scenarios.

25 – Ericsson LM

We think the initial list is good. Also we agree that all the load scenarios including high, medium and low load should be considered in the SI. We are fine with the initial list of scenarios, however if some prioritization is needed at this stage, we would like to keep the first three scenarios as they reflect the load scenarios discussed above. Massive MIMO is a source of significant power consumption and thus the first two scenarios should be kept (at least one FR2 scenario should be considered). The third scenario also reflects the macro scenario with low or medium load and also including DSS which covers other prioritized scenarios. From our side, we can down scope EN-DC and small cell deployments.

26 – VODAFONE Group Plc

We also expect the gains to be most likely on idle/low/medium load scenarios and we would prioritise these 2 scenarios:

Urban/Rural macro in FR1 with/without DSS (no impact to LTE expected in case of DSS)

EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency

Ensuring that DSS still operates is important,

The *Urban micro in FR1, including TDD massive MIMO* is also an important scenario but the "learnings" might not be greatly different to the second scenario above. If there is extra time available, and as small cells might "just be turned off" in low load, studying FR2 might bring new knowledge into 3GPP.

27 – Fraunhofer IIS

We think that small cell deployment should be prioritized.

As a second priority we see rural/urban macros in FR1.

We assume that cells with no (idle) or low load in dense deployment might have a high potential to save energy.

28 – MediaTek Inc.

We expect macro gNB and small gNB should apply different power saving schemes. To restrict the scenarios a bit, we can consider FR1 macro cell case and FR2 smaller cell case.

29 – InterDigital Belgium. LLC

It would be good to reduce the number of scenarios. At least if simulation effort is undertaken, there should be a small number of representative scenarios.

30 – Motorola Mobility UK Ltd.

Given that beam sweeping of broadcast signals/channels and corresponding RACH occasion monitoring is one of major sources for high energy consumption at a network node, we think that solutions should be able to address any TDD massive MIMO deployment scenario. For an evaluation purpose, FR2 beam-based scenarios with massive MIMO and EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency can be prioritized. Regarding the network load assumption, instead of high, medium, low, focus should be non-uniform user distribution scenarios.

31 – Verizon UK Ltd

There are all important - not sure why FR1 should be prioritized over e.g., FR2 - FR2 gNBs could be even more power hungry and climate impacting.

32 – Qualcomm Incorporated

FR1 with massive MIMO and FR2 with massive MIMO scenarios are our first priorities.

33 – Telstra Corporation Limited

Top scearios are;

- Urban/Rural macro in FR1 with/without DSS (no impact to LTE expected in case of DSS)
- EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency

Focus should be on low load with only a few connected UEs, this is a common scenario in commercial networks.
Network energy consumption per UE is highest in this scenario.

Q6: Question on the possible time plan for SI+WI in Rel-18: 9 months SI followed by 9 months WI. Please provide your views on this suggested time plan, where the SI would handle objectives 1/2/3 above assuming a proper prioritization on scenarios and associated target network load(s), and potentially some focus on the candidate techniques.

Feedback Form 7: Responses to question 6

1 – Nokia France

This timeplan is probably reasonable. Certainly the SI part should not be shorter than 9 months. The finalisation of the network energy model should be done first, e.g. within the first 3 months, so that it can be used in other parts of the study and in other Rel-18 WIs/SIs.

2 – LG Electronics France

We are fine with starting the item as SI with a reasonable time schedule.

3 – Spreadtrum Communications

Fine for it.

4 – TELECOM ITALIA S.p.A.

in principle ok, but it would be good to consider spin off Work Items of some features before the completion of the SI

5 – Telia Company AB

Time plan seems fine. We agree with TIM on the spin off Work Items.

6 – Orange

we are fine

7 – Futurewei Technologies

We are fine with the proposed plan.

8 – AT&T

fine

9 – Apple Italia S.R.L.

We are slightly concerned whether 9-month (4 meetings) is sufficient for the study item, considering that we need to agree on the power modeling/evaluation methodology, and companies need to perform evaluations based on the outcome. But if the target is to complete the WI in R18, this can be a good starting point to consider.

10 – China Telecom Corporation Ltd.

We agree with the timeline plan.

11 – Guangdong OPPO Mobile Telecom.

We think longer SI phase could be necessary. We don't have existing model for Network. But We can accept moderator's proposal.

12 – Intel

We think that to perform a really meaningful study of this topic it is important for companies to start the work with open minds and not pre-conceived ideas of potential solutions. We think it will take at least 12 months to conduct such a study in RAN1. Hence we would suggest that at this time we plan for a 12 month SI and 6 month WI. If any specific solutions for standardization are identified before the 12 months then it would be possible to initiate a WI earlier.

13 – CATT

We are OK with the proposed time frame. We are OK to have study item longer than 9 months since the standardization for the work should be relative lower in load once the network energy saving techniques are well identified.

14 – Samsung Electronics Co.

One clarification question is, given the 3-month staggering between RAN1 and other WGs, how to manage the study item completion. Work Item would start from RAN1 first leaving Study Item conclusion from other WGs behind?

15 – SHARP Corporation

We agree with the proposal.

16 – China Mobile Com. Corporation

We support the timeline proposed by moderator. Regarding the detailed work plan, we can refer to the timeline of Rel-16 UE power saving SI/WI, which the first quarter (including two normal meetings) is focused on power saving model and evaluation methodology and the second quarter (including one Ad-hoc meeting and one normal meeting) is focused on potential techniques and evaluation results to conclude the SI phase. Considering there is only one e-meeting in 2022 Q2 and the evaluation should take into account of both network and UE KPIs, the network energy model and evaluation methodology part (objective 1 and 2) can be finished in 6 months with some initial discussion of potential energy saving techniques in parallel. The final evaluation results and the conclusion are finished in 9 months.

17 – Beijing Xiaomi Mobile Software

Fine with the time plan.

18 – HUAWEI TECHNOLOGIES Co. Ltd.

We are fine with the time plan above.

19 – Panasonic Corporation

We support the proposal.

20 – LG Uplus

Fine with the proposal.

21 – Rakuten Mobile

We support the proposal.

22 – NEC Telecom MODUS Ltd.

Fine with this.

23 – Fujitsu Limited

Fine with the proposal.

24 – ZTE Corporation We think the proposed time plan is okay.
25 – KDDI Corporation We support the proposal.
26 – CEWiT The time plan is OK for us. We agree with Nokia France regarding the minimum duration of SI.
27 – vivo Communication Technology Support
28 – Deutsche Telekom AG We are fine with the proposed time plan even if there is a risk that the SI may need an additional quarter to achieve final results and conclusions.
29 – Ericsson LM The proposed time-plan looks reasonable as a starting point.
30 – VODAFONE Group Plc OK, but we suspect that Intel is correct.
31 – Fraunhofer IIS We are fine with the time plan.
32 – MediaTek Inc. We also agree the time plan is reasonable.
33 – InterDigital Belgium. LLC Fine with this plan.
34 – Motorola Mobility UK Ltd. Fine with the proposal.
35 – Verizon UK Ltd Fine with the proposal
36 – Qualcomm Incorporated We agree with the proposed time plan.

37 – Telstra Corporation Limited

Ok with the proposed plan

3.3 Initial Summary

5 companies provided general comments. Some comments were provided to emphasize that network energy savings should consider impact to the UE power consumption as well as backward compatibility. Other comments highlighted the fact that energy consumption also occurs in the backhaul, and that network energy consumption is also impacted by content provided over specific services. While the last two points are certainly valid, the moderator feels that no specific action is needed when defining the scope of a RAN-led study item. The points on UE power consumption and backward compatibility are also discussed under the proposed objectives.

Summary of Q1: question on study objective for the definition of a network energy consumption model

35 companies supported draft objective 1 without any change, while 2 companies proposed some update.

3 companies suggested to consider a method to derive absolute power consumption metrics. This was discussed in previous email discussions where it was clear that at least a relative power consumption model should be defined. Judging from the comments received in the initial round, the moderator's assessment is that the situation has not changed. As noted in the final summary in RP-211663, "an absolute power consumption model could also be studied in addition to the relative power consumption model, or a method could be studied for allowing to derive absolute power consumption metric from the relative power consumption metric and additional information available outside 3GPP". However, given the short amount of time available for the RAN1 study if normative work is also expected in Rel-18, it seems unrealistic to task RAN1 to develop both a relative model and an absolute model. Therefore, the moderator's suggestion is to stay with tasking RAN1 to develop only a relative model.

The revisions proposed by Ericsson seem straightforward and are not expected to be controversial, therefore they will be reflected in rev1 of draft proposal 1 for comments in the intermediate round.

Qualcomm proposed to change the main bullet description of "*network energy consumption model*" into "*network energy efficiency model*", where energy efficiency is measured as power consumed per communicated bit. This proposal might be more controversial as this was also discussed in previous email discussions, where the detailed KPIs were being left for discussion in RAN1. Companies will be asked to comment on Qualcomm's proposal in the intermediate round.

The proposed revisions of objective 2 are shown below:

Draft objective 1 (rev1): Definition of a network energy consumption model [RAN1]

- *Adapt the framework of the power consumption* ***modelling and evaluation*** *methodology of TR38.840 to the network side, utilizing information from known models, external references and other relevant*

information, including relative energy consumption for DL and UL (considering factors like PA efficiency, number of TxRU, ***network load****, etc), sleep states and the associated transition times, and one or more reference parameters/configurations.*

Summary of Q2: question on study objective for the definition of an evaluation methodology and KPIs

All companies supported draft objective 2, there were a few suggestions for clarifications.

Several companies supported to clarify that existing KPIs should be reused as much as possible, that developing additional KPIs should also be considered, and that both aspects are business as usual. The moderator proposes a corresponding clarification to objective 2 for review in intermediate round.

Some additional suggestions for clarifications were provided by Ericsson, Huawei and Qualcomm. Ericsson proposed to clarify that both energy consumption and savings gains should be evaluated. Huawei proposed to make it clearer that the main target metrics are network energy saving gain and balanced network/user performance. Several companies supported the clarifications proposed by Ericsson and Huawei. Qualcomm proposed to explicitly mention energy efficiency in addition to energy consumption. The moderator proposes corresponding clarifications to objective 2 for review in intermediate round.

Ericsson additionally proposed that Objectives 1 and 2 are related and thus can be integrated in one objective with current Objective 1 as "a" and Objective 2 as "b". The moderator's feeling on this proposal is that it doesn't make a big difference so it is suggested to keep the two objectives separate.

CMCC commented that it is unclear why UE complexity needs to be taken into account, and whether there is any relation with RedCap. The moderator's understanding is that this is a generic statement on UE complexity, without relation to UE complexity reduction such as RedCap. Given several comments on UE power consumption and UE complexity, it is suggested to clarify the wording of the objective in the sense that UE power consumption and complexity may be considered when appropriate.

The proposed revisions of objective 2 are shown below:

Draft objective 2 (rev1): Definition of an evaluation methodology and KPIs [RAN1]

- ~~*The evaluation methodology should not focus on a single KPI.*~~ *The evaluation methodology should* ***target for*** ~~*allow*~~ *evaluating* ~~*how to enable*~~ *system-level network* ***energy consumption and*** *energy savings* ***gains****,* ~~*while balancing and*~~ ***as well as assessing*** *impact to network and user performance (e.g. spectral efficiency, capacity, UPT, latency),* ***energy efficiency****, and* ***consider*** *UE power consumption/complexity* ***when appropriate. The evaluation methodology should not focus on a single KPI, and should reuse existing KPIs or develop new KPIs when appropriate.***

Summary of Q3: question on study objective on techniques for network energy saving

Comments were in majority going in the direction to leave the identification of the potential techniques to the study phase in the WGs, and thus to delete the sub-bullets and keep only the generic main bullet of objective 3. It was pointed out by several comments that the sub-bullets of objectives 3 are very generic and don't provide a real focus, and several aspects may even require clarification, e.g. whether "intra-network" information exchange/coordination imply that this can only occur within the same operator, not between different operators, whether "support/feedback from UE" and "UE assistance information" are the same or different

things, what is the exact meaning of finer granularity, etc. A few comments were in the direction to keep the sub-bullets and potentially clarify them and split them further, or to re-group bullets a) and b). At this stage, it seems that the main objective might already provide a clear enough scope for a study, especially since there doesn't seem to be a common direction from the comments received on how to narrow-down the potential techniques.

It was generally acknowledged that RAN1, RAN2 and RAN3 would be responsible for objective 3. It was also suggested to add RAN4 as a responsible WG for objective 3, in relation to possible power domain enhancements.

The proposed revision of objective 3 is shown below:

Draft objective 3 (rev1): Study techniques to improve network energy savings~~, including~~ [RAN1, RAN2, RAN3, RAN4]

1. ~~*How to achieve more efficient dynamic and/or semi-static and finer granularity adaptation of transmissions and/or receptions in one or more of time, frequency, spatial, and power domains, with potential support/feedback from UE, and potential UE assistance information [RAN1, RAN2]*~~
2. ~~*Intra-network information exchange/coordination [RAN3]*~~

Note: legacy UEs should be able to continue accessing a network implementing Rel-18 network energy savings techniques, with the possible exception of techniques developed specifically for greenfield deployments.

Summary of Q4: additional questions on potential objective 3: Would you agree to focus objective 3 on the base station transmission side in Rel-18?

The answers to question 4 pointed to a need to clarify the potential focus on BS transmissions. It is clear from the responses that objectives 1 and 2 should anyway apply to both BS transmission and reception, and the majority of responses preferred to include both BS transmission and reception as part of objective 3. It was suggested that a possible prioritization for reducing energy consumption of BS transmissions could be decided later in the study phase if needed.

Conclusion to question 4: at this time, the majority of companies don't agree to prioritize studying solutions for the BS transmission side.

Summary of Q5: questions on potential prioritization of scenarios and network power consumption states

The large majority of responses proposed to focus on idle/empty and low load scenarios, while medium load was also mentioned by several companies. It is possible that several companies did not have a common definition of low vs. medium load, so it is suggested to consider low/medium load as one state of network load for the time-being.

Not many responses provided views on the possible association of network loads and deployment scenarios, although it was generally assumed that Urban/Rural macro would likely be more relevant for studying low/medium loads, and Urban micro and small cells would be more relevant for studying idle-empty and high loads. Non-uniform loads was mentioned by two companies without much details but the moderator assumes this means non-uniform load across neighbour cells.

In terms of scenarios prioritization, views were rather mixed. A majority of companies expressed more interest on Urban/Rural macro in FR1, then Urban micro in FR1 (including TDD massive MIMO), then FR2 beam-based scenarios with massive MIMO (including small cells), and finally EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency, although it appeared there is some overlap among the scenarios. A smaller number of companies proposed that small cells should be considered with priority, and again it may be the case that small cell scenario could be sufficiently well studied based on Urban micro in FR1 and FR2 beam-based scenarios. A few companies suggested saving energy in small cells is well-understood and effective, i.e. a small cell can easily be turned off.

One possibility for consolidating the various scenarios into a smaller number of cases would be to recognize that EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency is a combination of Urban micro in FR1 (including TDD massive MIMO) and Urban/Rural macro in FR1 with FDD, and the TDD part can cover some types of small cells, and that FR2 beam-based scenarios can cover some other type of small cells.

- Urban micro in FR1, including TDD massive MIMO **(note: this scenario can also model small cells)**
- FR2 beam-based scenarios ~~with massive MIMO~~ **(note: this scenario can also model small cells)**
- Urban/Rural macro in FR1 **with FDD** with/without DSS (no impact to LTE expected in case of DSS)
- ~~EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency~~
- ~~Other scenarios, e.g., small cell deployment, can be considered~~

Summary of Q6: Question on the possible time plan for SI+WI in Rel-18: 9 months SI followed by 9 months WI

Responses agreed with planning for SI+WI within Rel-18. Most responses agreed with planning for a 9-month study, at least as a starting point assuming 4 RAN1 meetings, with the possibility to extend the study if needed for one quarter, in which case the follow-up WI would be reduced to 6 months (and would require a better focus on the targeted solutions). Regarding the study, it was understood that objective 1 (modelling) and objective 2 (methodology, KPIs) would be able to proceed in parallel.

Conclusion to question 6: 9 months SI followed by 9 months WI, with a possibility to extend the study to 12 months if needed.

4 Intermediate Phase

4.1 Intermediate Proposals

Round2Q1: do you agree with rev1 of study objective 1 for the definition of a network energy consumption model?

Draft objective 1 (rev1): Definition of a network energy consumption model [RAN1]

– Adapt the framework of the power consumption **modelling and evaluation** methodology of TR38.840 to the network side, utilizing information from known models, external references and other relevant information, including relative energy consumption for DL and UL (considering factors like PA efficiency, number of TxRU, **network load**, etc), sleep states and the associated transition times, and one or more reference parameters/configurations

Feedback Form 8: Comments on Round2Q1

1 – SHARP Corporation We support the rev1 of study objective 1.
2 – Beijing Xiaomi Mobile Software Agree with rev1 of study objective 1
3 – VODAFONE Group Plc We support rev1 of objective 1.
4 – Nokia France We agree.
5 – MediaTek Inc. We support *Draft objective 1 (rev1)*.
6 – Apple Italia S.R.L. Agree
7 – CATT We support the proposed objective 1
8 – Futurewei Technologies Support
9 – Motorola Mobility UK Ltd. Fine with the proposal.
10 – InterDigital Belgium. LLC Agree
11 – vivo Communication Technology We support

12 – Samsung Electronics Co.

Agree

13 – Intel

Ok with changes

14 – AT&T

Agree

15 – ZTE Corporation

We support the revised objective 1 .

16 – Qualcomm Incorporated

We agree with the rev1 of study objective 1.

17 – China Mobile Com. Corporation

We are fine with *Draft objective 1 (rev1)*.

18 – NEC Telecom MODUS Ltd.

We are fine with rev1 of Draft objective 1.

19 – Ericsson LM

Thanks for the revision. We have one additional comment on wording.

We suggest deleting or rephrasing of "utilizing information from known models, external references and other relevant information" – it does not add much to the objective and can trigger unnecessary discussions during the SI. The work would be contribution-driven, and companies should be free to bring proposals based on insights from current state-of-the-art implementations. We prefer to avoid discussions such as something is relevant information or not solely due to the wording in the SI objective.

20 – CEWiT

We are ok with the draft objective

21 – Telia Company AB

Agree

22 – China Telecom Corporation Ltd.

We support the rev1 of objective 1.

23 – Guangdong OPPO Mobile Telecom.

Fine with the first objective

24 – LG Uplus Fine with the proposal
25 – Deutsche Telekom AG Fine with us.
26 – Panasonic Corporation We are ok with the proposal.
27 – Fujitsu Limited We are fine with the revision.
28 – HUAWEI TECHNOLOGIES Co. Ltd. Agree with rev1 of Draft objective 1.
29 – Fraunhofer IIS We support the revised objective 1.
30 – KDDI Corporation Agree

Round2Q2: do you agree with rev1 of study objective 2 for the definition of an evaluation methodology and KPIs?

Draft objective 2 (rev1): Definition of an evaluation methodology and KPIs [RAN1]

- ~~The evaluation methodology should not focus on a single KPI.~~ The evaluation methodology should **target for** ~~allow~~ evaluating ~~how to enable~~ system-level network **energy consumption and** energy savings **gains**, ~~while balancing and~~ **as well as assessing** impact to network and user performance (e.g. spectral efficiency, capacity, UPT, latency), **energy efficiency**, and **consider** UE power consumption/complexity **when appropriate. The evaluation methodology should not focus on a single KPI, and should reuse existing KPIs or develop new KPIs when appropriate.**

Feedback Form 9: Comments on Round2Q2

1 – SHARP Corporation We support the rev1 of study objective 2.
2 – Beijing Xiaomi Mobile Software Agree with rev1 of study objective 2.
3 – VODAFONE Group Plc Agree with rev1 of study objective 2.

4 – Nokia France

Mostly OK, but in the last sentence the default should be to reuse existing KPIs, while of course new KPIs can be developed if existing KPIs are shown to be insufficient. We suggest the following modification: "**…and should reuse existing KPIs as far as possible, while new KPIs can be developed if existing KPIs are found to be insufficient.**"

5 – MediaTek Inc.

We think **the following sentence somehow conflict the consensus from RAN#93-e where balancing the impact to UE power consumption/complexity should be part of KPI**:
"**assessing** impact to network and user performance (e.g. spectral efficiency, capacity, UPT, latency), **energy efficiency**, and **consider** UE power consumption/complexity **when appropriate** "

For UE power consumption, there is clear evaluation definition in TR38.840. If the reason to make the above change is unclear definition of UE complexity, the following revision would be useful to keep original wording as much as possible:

"~~**assessing**~~ **balancing** the impact to network and user performance (e.g. spectral efficiency, capacity, UPT, latency), energy efficiency, ~~and **consider**~~ UE power consumption~~/complexity **when appropriate**~~, **and required UE operations**"

6 – Apple Italia S.R.L.

We would like to suggest changing "**consider** UE power consumption/complexity **when appropriate**" to just "UE power consumption/complexity". We do not see why this should be put in a different wording compared to other factors. It is about "assessing the impact" on these aspects, and we do not see any issue with it.

7 – CATT

We support the updated objective 2.

8 – Futurewei Technologies

Support the updated objective 2

9 – Motorola Mobility UK Ltd.

In our view, assessing any impact on UE power consumption/complexity is necessary. Thus, we propose the following revision.

"The evaluation methodology should target for evaluating system-level network energy consumption and energy savings gains, as well as assessing impact to network and user performance (e.g. spectral efficiency, capacity, UPT, latency), energy efficiency, and **UE power consumption/complexity**. The evaluation methodology should not focus on a single KPI, and should reuse existing KPIs or develop new KPIs when appropriate.

10 – InterDigital Belgium. LLC

Support rev1 of study objective 2

11 – Samsung Electronics Co.

We share the views from others on UE power consumption.

12 – Intel

Ok with changes

13 – vivo Communication Technology

We share similar concerns as MTK and Apple mentioned. MTK's revision is fine for us.

14 – AT&T

We support draft objective 2 (rev1) as presented by the moderator

15 – ZTE Corporation

We support the objective 2 revised by moderator.

16 – Qualcomm Incorporated

We agree with the rev1 of study objective 2.

17 – China Mobile Com. Corporation

We are general fine with *Draft objective 2 (rev1)*. And considering the newly added "**energy efficiency**", may be it is more related to the first half sentence, that is network **energy consumption and** energy savings **gains** can be reflected by energy efficiency. While the second half sentence is to consider other aspects that need to be balanced.

18 – NEC Telecom MODUS Ltd.

We are fine with rev1 of Draft objective 2.

19 – Ericsson LM

The updated proposal is fine with us.

20 – CEWiT

We are fine with the revised draft objective 2

21 – Telia Company AB

Agree with rev1 of study objective 2 with Nokia proposed modifications.

"**…and should reuse existing KPIs as far as possible, while new KPIs can be developed if existing KPIs are found to be insufficient.**"

22 – China Telecom Corporation Ltd.

We support the rev1 of objective 2.

23 – Guangdong OPPO Mobile Telecom.

We think the UE complexity and power consumption should be take into the same way. Thus it should be remove with ”consider”.

”~~**consider**~~ UE power consumption/complexity ~~**when appropriate**~~ ”.

Although complexity does not have model to evaluate it can be commonly discussed in UE sided. We prefer to keep it.

24 – LG Uplus

We are fine with the proposal.

25 – Deutsche Telekom AG

Generally fine with the proposed objective except that we support Nokia’s proposed change with respect to the KPI related sentence.

26 – Panasonic Corporation

We are ok with the proposal.

27 – HUAWEI TECHNOLOGIES Co. Ltd.

Agree with rev1 of Draft objective 2.

In our view, it is natural that the existing KPI when appropriate can be used and new KPI is motivated otherwise. The point is we are not sure whether/which existing KPI is suitable or not prior to the first study of energy saving on network side. Therefore, we prefer to keep the current wording related to KPI. We think the “when appropriate” can address the concern from Nokia. We could also be ok with the following:

The evaluation methodology should not focus on a single KPI, and should reuse existing KPIs ***when applicable,*** *or develop new KPIs* ***as needed*** ~~*when appropriate*~~*.*

Regarding the comments on UE power consumption/complexity, we are ok to use “~~*consider*~~ *UE power consumption/complexity* ~~*when appropriate*~~” as Apple and Motorola suggested. However, we think it should also be clear that the main target of this item is on network side energy saving, rather than saving of UE power (which is the focus of other items, for several releases). Thus, we should firstly strive to identify all techniques that enable network energy saving as well as the impact on all dimensions including UE side. The techniques that move to WI will for sure need further discussion in consideration of the balance of all these aspects.

28 – Fujitsu Limited

We support the rev1 of study objective 2**.**

29 – Rakuten Mobile

Agree

30 – Fraunhofer IIS We support rev1 of objective 2.
31 – KDDI Corporation Support revised objective 2.

Round2Q3: do you agree with rev1 of study objective 3 on techniques for network energy saving? Would you agree to consider the deleted sub-bullets as starting point for some text in the justification part of the SID, aiming to provide an example list of technical solutions to be investigated by the study?

Draft objective 3 (rev1): Study techniques to improve network energy savings ***[RAN1, RAN2, RAN3, RAN4]***

- ~~How to achieve more efficient dynamic and/or semi-static and finer granularity adaptation of transmissions and/or receptions in one or more of time, frequency, spatial, and power domains, with potential support/feedback from UE, and potential UE assistance information [RAN1, RAN2]~~
- ~~*Intra-network information exchange/coordination [RAN3]*~~

Note: legacy UEs should be able to continue accessing a network implementing Rel-18 network energy savings techniques, with the possible exception of techniques developed specifically for greenfield deployments.

Feedback Form 10: Comments on Round2Q3

1 – SHARP Corporation We support the rev1 of study objective 3.
2 – Beijing Xiaomi Mobile Software Agree with rev1 of study objective 3. But we think it is better to have the deleted subbullets, to give some guideline on how to save energy.
3 – VODAFONE Group Plc Deleted sub-bullets seem fine to use as examples in justification section of SID.
4 – Nokia France We agree with rev1; this is an improvement over the original objective.
5 – Apple Italia S.R.L. We feel completely removing the sub-bullets may be counter-productive, because now the SID does not provide any directions for the study. It is our understanding based on the previous comments that companies are generally fine with the scope proposed by the sub-bullets. Therefore we think it is still good to include something along the line to provide more clarity in terms of what we intend to study.

6 – MediaTek Inc.

Keeping original subbullets is useful to categorize the enhancements in time, frequency, spatial and power domains as well as intra-network information exchanging. Leaving only the main sentence somehow makes the scope too open-ended. We suggest to reuse the original version and include other dimension(s) if proposed.

7 – CATT

We support the update objective 3 without specific direction of study during the study item.

8 – Futurewei Technologies

We prefer the previous version of objective 3. The sub-bullet is not restrictive and can provide guidance for study.

9 – Motorola Mobility UK Ltd.

Improving UE PA efficiency is not directly relevant to network energy savings SI. While RAN4 can provide feedback on PA efficiency assumption at gNB for evaluating network energy consumption in Objective 2, we don't think that RAN4 involvement to study network energy saving techniques is necessary. Further, we can leave adaptation aspects and guidelines without mentioning detailed techniques in the SID for facilitating study convergence, as follows:

"*Study techniques to improve network energy savings,* ***in terms of how to achieve more efficient dynamic and/or semi-static and finer granularity adaptation of transmissions and/or receptions in one or more of time, frequency, spatial, and power domains***."

10 – InterDigital Belgium. LLC

We think it would be fine to have the sub-bullets in the objectives, but also ok to have them only in the justification section of the SID.

11 – Intel

Ok with changes

12 – vivo Communication Technology

Keeping the sub-bullet is preferred.

13 – AT&T

Agree, removing the sub-bullet is preferred

14 – Samsung Electronics Co.

In order to reflect the above Conclusion to question 4, we suggest the following revision:

"Study techniques to improve network energy savings **in terms of both BS transmission and reception"**

15 – ZTE Corporation

We think it is better to keep the original sub-bullets, which are not restrictive. Instead, these sub-bullets provide useful insight into the potential study areas. Moreover, we also think the techniques aimed to improve energy efficiency at NW reception side can be considered.

16 – Qualcomm Incorporated

We do not agree with the revision and suggest bringing back the sub-bullets. The sub-bullets, that are arguably broad, were already agreed (in RAN#93e) and still provide a more focused scope compared to the main bullet alone. As pointed out by the other companies, further identification of the potential techniques, within the scope of the sub-bullets, can be left to the study phase.

We are also fine to further clarify the aspects brought up by the companies, as follows.

Regarding "intra-network information exchange/coordination", we agree with Samsung's suggested update to "information exchange/coordination over network interfaces".

Regarding the difference between "support/feedback from UE" and "UE assistance information", we think the latter is a subset of the former. Therefore, we may change "support/feedback from UE, and potential UE assistance information" to just "potential support/feedback from UE".

We also agree with Apple's comment that the "potential support/feedback from UE", and "information exchange/coordination over network interfaces" should be captured at the same level.

17 – NEC Telecom MODUS Ltd.

We support rev1 of Draft objective 3. The detailed techniques for network energy saving need further consideration and evaluations.

18 – China Mobile Com. Corporation

We also prefer to keep the sub-bullets since the mentioned sub-bullets refect what we have widely discussed and provide high level guidelance for the study phase.

19 – Ericsson LM

Since the number of meetings are limited, a bit more focus would be helpful to develop the discussions particularly per WG. So are in favor of keeping the sub bullets. We also suggest updating the wording to "*study and identify techniques*" so that expected outcome is clear.

20 – CEWiT

Fine with the updated proposal. The deleted sub-bullets can be mentioned as starting point for discussion.

21 – China Telecom Corporation Ltd.

We are OK with the rev1 of objective 3. And we prefer if the sub-bullet can be revised general like□

- The techniques could include but not limited to potential enhancement in time/frequency/spatial/power domain, UE assistance information, intra-network information exchange/coordination.

22 – Telia Company AB

We are ok with this change in rev1. Guidance for potential and not restricting techniques would be needed in the justification part.

23 – Guangdong OPPO Mobile Telecom.

We support the rev1 of study objective 3.

24 – Deutsche Telekom AG

We would prefer to keep the sub-bullets in the objective description.

25 – LG Uplus

We are fine with the proposal but like other companies said, it is better to have the sub-bullets to feel some examples

26 – Panasonic Corporation

We are ok with the proposal.

27 – HUAWEI TECHNOLOGIES Co. Ltd.

We prefer the previous version and can be ok with the rev1 of draft objective 3.

28 – Fraunhofer IIS

We support the revision of objective 3 as it is broad and capture all directions and possible scenarios.

29 – KDDI Corporation

We are fine in general, but share the sympathy some companies saying having some direction helps later discussion.

Round2Q4: proposal on potential prioritization of scenarios and network power consumption states: the study should prioritize idle/empty and low/medium load scenarios (the exact definition of such loads is left to the study) for the following scenarios (mapping between scenarios and network loads is left to the study):

- Urban micro in FR1, including TDD massive MIMO (note: this scenario can also model small cells)
- FR2 beam-based scenarios (note: this scenario can also model small cells)
- Urban/Rural macro in FR1 with FDD with/without DSS (no impact to LTE expected in case of DSS)

Feedback Form 11: Comments on Round2Q4

1 – TELECOM ITALIA S.p.A.

WE have a strong concern with the proposal. We do not agree with the statement:

EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency is a combination of Urban micro in FR1 (including TDD massive MIMO) and Urban/Rural macro in FR1 with FDD

We believe EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency with ”low/medium” load is the key scenario to investigate. And in real deployments, we expect the

coverage in n78 to be similar to one of the FDD layers.

2 – VODAFONE Group Plc

Agree with Telecom Italia that DC macro with FDD anchor + TDD Massive MIMO on higher FR1 (3.5 GHz) is a key scenario.

3 – Nokia France

We are fine with the Moderator's proposal.

In considering the distinction behind Telecom Italia's concern, we understand that they would like to consider also a 500m ISD for the TDD layer, as with the FDD layer; otherwise, the scenario seems in line with the moderator's statement. We hope that the energy efficiency techniques considered in the study will be more generic than being tied to a particular ISD, so perhaps this is an indication that the bullets are overly specific.

4 – MediaTek Inc.

We see current moderator proposal is to first focus on network energy saving design at per-serving cell basis. DC/CA scenario can also apply the identified solutions for each serving cell of the cell groups. Yet, to address TELECOM ITALIA's concern, we may add a note: **The energy saving design(s) to be studied/identified is applicable per serving cell. Additional design(s) specific to EN-DC/NR-DC, if identified, is not precluded.**

5 – CATT

We would prefer to list the scenarios as examples. The exact evaluation scenarios could be discussed in the Network energy saving evaluation methodology in the beginning of study item along with other parameters.

6 – Motorola Mobility UK Ltd.

Fine with the proposal in principle. The prioritized scenarios can be included in Objective 2 (Definition of an evaluation methodology and KPIs).

7 – Futurewei Technologies

We are generally fine with the proposal with a few clarification points. First, the modeling of the scenario with certain level of **average** load should reflect the case where the load varies across neighbor cells which is not only more realistic but also provides more insight for solution. Second, scenarios with multiple frequency layers should also not be precluded for study.

8 – InterDigital Belgium. LLC

Fine with moderator proposal.

9 – Intel

While we think it would be preferrable to focus on FR1, we are ok with the proposal.

10 – vivo Communication Technology

Fine

11 – AT&T

Agree with previous operator comments, it's not clear why the fourth bullet was removed

12 – Samsung Electronics Co.

Fine with the proposal.

13 – ZTE Corporation

We are okay with the proposal.

14 – Qualcomm Incorporated

We don't think it is necessary to limit the study of FR1 Urban/Rural macro to FDD at this stage. Hence, we propose to keep the original wording by having the following update:

- Urban/Rural macro in FR1 ~~with FDD~~ with/without DSS (no impact to LTE expected in case of DSS)

15 – NEC Telecom MODUS Ltd.

We support to prioritise the listed 3 scenarios in the study of Network Energy Savings. Agree with the moderator to merge the small cell deployment into more general scenarios.

16 – Ericsson LM

We are fine with the updated list of scenarios.

17 – China Mobile Com. Corporation

We are fine with the proposed scenarios. A note can be added that both single carrier and multiple carriers deployment can be considered during the study

18 – CEWiT

We are fine with the scenarios and power consumption states mentioned

19 – China Telecom Corporation Ltd.

We are general fine with the rev1 of objective 4. And we are also fine that other scenarios such as EN-DC/NR-DC be included.

20 – Guangdong OPPO Mobile Telecom.

We are Ok with the revision. It should also be OK without listing the scenarios. This can be don in evaluation phase. Seems the revised list would simply and accelerate the work.

21 – Telia Company AB

We agree with TIM, Vodafone and AT&T. DC macro with FDD anchor + TDD Massive MIMO on higher FR1 (3.5 GHz) would be needed as one scenarios.

Side comment:

It would be also nice to understand what load levels (eg. PRB usage % or other) different companies are referring when stating idle, low, medium high (max?) loads. Any suitable load KPI for that?

Also there might be need to have possibility to build dynamic power consumption model with different weighting of the load levels for each scenario.

22 – Deutsche Telekom AG

We strongly support other operators' view to have "EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency" as a dedicated scenario.

23 – LG Uplus

We also prefer to have "*EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency"* as it is the most common deployment scenario from my understanding.

24 – Panasonic Corporation

We are ok with the proposal.

25 – HUAWEI TECHNOLOGIES Co. Ltd.

We are OK to clarify the load assumptions per the comment from some companies. For example, we can modify the objective as below:

the study should prioritize idle/empty and low/medium load scenarios (the exact definition of such loads is left to the study) for the following scenarios (mapping between scenarios and network loads is left to the study) **for a serving cell**:

- Urban micro in FR1, including TDD massive MIMO (note: this scenario can also model small cells)
- FR2 beam-based scenarios (note: this scenario can also model small cells)
- Urban/Rural macro in FR1 with FDD with/without DSS (no impact to LTE expected in case of DSS)

and also multi-carrier scenarios with different loads among carriers by the combination of the above and EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1.

26 – Fujitsu Limited

We are OK with the proposal.

27 – Fraunhofer IIS

We support the proposed prioritization. We believe that small cell deployment and Urban/Rural for different traffic load scenarios have a high potential in energy saving; thus, small cell deployment could be prioritized or at least highlighted. Therefore, we would propose to explicitly mention small cells as indicated below:

"….

- Urban micro in FR1, including TDD massive MIMO **and small cells**
- FR2 beam-based scenarios, **including small cells**
- Urban/Rural macro in FR1 with FDD with/without DSS (no impact to LTE expected in case of DSS)"

28 – KDDI Corporation

Fine with the proposal.

4.2 Intermediate Summary

There was almost unanimous support for rev1 of objective 1, and a suggestion to remove the part on "utilizing information from known models, external references and other relevant information" since it actually brings no information but may create unnecessary debates in RAN1. The moderator agrees with the suggestion.

Rev2 of objective 1: Definition of a network energy consumption model [RAN1]

- *Adapt the framework of the power consumption modelling and evaluation methodology of TR38.840 to the network side, ~~utilizing information from known models, external references and other relevant information,~~ including relative energy consumption for DL and UL (considering factors like PA efficiency, number of TxRU, network load, etc), sleep states and the associated transition times, and one or more reference parameters/configurations.*

Regarding rev1 of objective 2, comments were received on the formulation relative to KPIs with suggestions to reuse existing KPI as much as possible or as appropriate. Comments were also received on UE power consumption and complexity, suggesting that it should be more than just a consideration. There was also one comment on adding "and required UE operation", and one comment about the addition of "energy efficiency". Other companies are encouraged to respond to those comments in the final phase. The moderator suggests the following revision to address the first two comments provided by several company:

Rev2 of objective 2: Definition of an evaluation methodology and KPIs [RAN1]

- *The evaluation methodology should target for evaluating system-level network energy consumption and energy savings gains, as well as assessing impact to network and user performance (e.g. spectral efficiency, capacity, UPT, latency), energy efficiency, and ~~consider~~ UE power consumption/complexity. The evaluation methodology should not focus on a single KPI, and should reuse existing KPIs **when applicable** or develop new KPIs ~~when appropriate~~ **as needed**.*

Regarding rev1 of objective 3, it was suggested that RAN4 does not need to be involved in the study of objective 3. Half of the responses were generally fine with the deletion of the potential techniques, while the other half preferred to keep the list of potential techniques with the classification in time, frequency, spatial, and power domains, while some companies also acknowledged that the list actually puts no restriction to the scope of the techniques that can be considered in the study. It was suggested to at least keep clarity that the study should be in terms of both BW transmission and reception. Given the split views and seeing some support for the suggestion to use this text somewhere in the justification section of the SID, the moderator's proposal is to go ahead to rev1 of objective 3 while keeping text about BS transmission and reception, and to provide some text in the justification section about the potential areas of study. This will be found in the draft SID provided in the inbox draft folder:

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5BRAN94e-R18Prep-09%5D

Rev2 of objective 3:

- Study **and identify** techniques to improve network energy savings **in terms of both BS transmission and reception** [RAN1, RAN2, RAN3, ~~RAN4~~]

Note 1: legacy UEs should be able to continue accessing a network implementing Rel-18 network energy savings techniques, with the possible exception of techniques developed specifically for greenfield deployments.

Regarding the potential prioritization or consolidation of the scenarios, and the considerations on targeted network loads, there were strong concerns from network operators about considering that "EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1" could be a combination of the other three scenarios. It was asked whether the moderator's proposal was meant to focus on the scenario with a single serving cell. The moderator would like to clarify that this was not the intention. The suggestion from the moderator is therefore to keep the fourth scenario in the list, to clarify that the list of scenarios is a list of examples, and that both single-carrier and multi-carrier deployments are included. A couple of more individual comments are also reflected in the updated text relative to scenarios and network loads.

The study should prioritize idle/empty and low/medium load scenarios (the exact definition of such loads is left to the study) for the following ***example*** *scenarios (mapping between scenarios and network loads is left to the study)* ***including single-carrier and multi-carrier deployments, also allowing different loads among carriers and neighbor cells****:*

- Urban micro in FR1, including TDD massive MIMO (note: this scenario can also model small cells)
- FR2 beam-based scenarios (note: this scenario can also model small cells)
- Urban/Rural macro in FR1 ~~with FDD~~ with/without DSS (no impact to LTE expected in case of DSS)
- EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency

In addition, there was a comment suggesting that while we list scenarios of interest, the techniques to be studied and identified should provide network energy savings gains in all scenarios. A note to that purpose is provided for discussion in the final round.

Note 2: the identified techniques should offer network energy savings irrespective of the scenario, while the amount of gains may depend on the specific deployment scenario and network load.

All updated objectives, notes, and a draft justification section, are provided in the draft SID placed in the inbox draft folder:
https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5BRAN94e-R18Prep-09%5D

5 Final Phase

5.1 Final Proposals

All updated objectives, notes, and justification section, are provided in the draft SID placed in the inbox draft folder:

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5BRAN94e-R18Prep-09%5D

Comments are invited on the justification section in the draft SID

Feedback Form 12: Comments on the justification section in the draft SID

1 – CATT We would suggest to clarify the last sentence with addition underline. ”The study should investigate how to achieve more efficient operation dynamically and/or semi-statically and finer granularity adaptation of transmissions and/or receptions in one or more of network energy saving techniques in time, frequency, spatial, and power domains, with potential support/feedback from UE, potential UE assistance information, and information exchange/coordination over network interfaces.
2 – Apple Italia S.R.L. We are fine with the justification section.
3 – Futurewei Technologies We are ok with the justification part
4 – InterDigital Belgium. LLC Fine with the justification section.
5 – Beijing Xiaomi Mobile Software We are ok with the justification part
6 – Spreadtrum Communications Basically fine for the justification part.
7 – AT&T Very nicely written
8 – CEWiT We are fine with the justification section

9 – KDDI Corporation

we are fine with the justification part

10 – Ericsson LM

The Justification section looks fine. We suggest changing the part "study network energy savings techniques" to "identify and study network energy savings techniques".

11 – Deutsche Telekom AG

The justification is fine with us.

12 – China Telecom Corporation Ltd.

We are fine with the justification section.

13 – TELECOM ITALIA S.p.A.

fine :-)

14 – LG Uplus

We are fine with the proposal with nice reference from GSMA

15 – NEC Telecom MODUS Ltd.

We are fine with the justification section. However, to make the description more general, we suggest using fewer abbreviations in the SID, for example□

'Most of the energy consumption comes from the radio access network and in particular from the ***Active Antenna Unit (AAU)***, with data centres and fibre transport accounting for a smaller share.'

16 – Guangdong OPPO Mobile Telecom.

Basically fine for the justification part.

17 – Telia Company AB

We agree with the excellent justification.

18 – MediaTek Inc.

Thanks for moderator's draft. The justification part looks good for us.

19 – Motorola Mobility UK Ltd.

Fine with the justification section.

20 – ZTE Corporation

We are okay with the justification in general. For the the following parts, we think it is relevant to implementation. We think it can be removed.

The power consumption of a radio access can be split into two parts: the dynamic part which is only consumed when data transmission/reception is ongoing, and the static part which is consumed all the time to maintain the necessary operation of the radio access devices, even when the data transmission/reception is not on-going.

21 – Fraunhofer IIS

The justification section looks fine to us.

22 – Nokia France

Well written, thanks.

23 – HUAWEI TECHNOLOGIES Co. Ltd.

We are fine with the justification.

24 – Verizon UK Ltd

Looks fine.

Comments are invited on the objectives section in the draft SID, where objectives 1, 2, 3 were updated as in the intermediate summary, including the updates of the notes and scenarios.

Feedback Form 13: Comments on the draft objectives section in the draft SID

1 – CATT

For network energy consumption modeling, we need to add a sub-bullet ”Define the energy consumption models for backhaul access” in order to evaluate the gNB power consumption of backhaul access between gNB-gNB and gNB-CN

2 – Futurewei Technologies

We are ok with the objectives part

3 – Apple Italia S.R.L.

For the scenarios, we understand the intention is that these scenarios are provided as examples, and the exact scenarios to be evaluated may still need to be further discussed, especially considering that we cannot evaluate too many scenarios to reduce the workload. Therefore, we would like to suggest the following changes:

The study should prioritize idle/empty and low/medium load scenarios (the exact definition of such loads is left to the study). ~~for t~~**T**he following example scenarios (mapping between scenarios and network loads is left to the study) including single-carrier and multi-carrier deployments **are used as the starting point for discussion on prioritized scenarios for the study.** ~~, also allowing dD~~ifferent loads among carriers and neighbor cells **are allowed.**~~:~~

- Urban micro in FR1, including TDD massive MIMO (note: this scenario can also model small cells)
- FR2 beam-based scenarios (note: this scenario can also model small cells)

- Urban/Rural macro in FR1 with/without DSS (no impact to LTE expected in case of DSS)
- EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency

4 – InterDigital Belgium. LLC

We are fine with the objectives section.

5 – Beijing Xiaomi Mobile Software

We would like to add a note in the Objective

Note 3□negative impacts on UE experience should be avoided or at leat reduced while practicing energy saving techniques for the network side.

6 – Spreadtrum Communications

Basically fine for the objectives part. But, we also support MTK's revision to change **"assessing impact" to "balancing impact"**. We think the UE power consumption should be balanced for all potential network energy savings techniques.

7 – AT&T

We support the draft objectives. Thank you for drafting them.

8 – CEWiT

We are fine with the draft objectives

9 – Qualcomm Incorporated

We still believe the third objective is too broad for a SID, and we do not agree to this in its current form. The original sub-bullets should be brought back (from the justification section to the objective) to provide a more focused scope. We further propose the following modification to the objective main statement:

"Study and identify techniques on the gNB and UE side to improve network energy savings in terms of both BS transmission and reception [RAN1, RAN2, RAN3]"

The motivation for this modification is our view that significant power saving can be achieved by moving the power amplifiers to a more power efficient operating point. That might be done by lowering power amplifiers input back-off and utilizing techniques on both UE and gNB side to mitigate the resulting signal distortions.

We have requested in the previous round to add back the sub-bullets which mentioned UE assistance techniques. Since those are not added, we think the above modification should clarify that the proposed SI should evaluate such techniques.

We propose to delete the following part

~~The study should prioritize idle/empty and low/medium load scenarios (the exact definition of such loads is left to the study)~~

The study should focus on maximal power saving and it is not clear that this goal is achieved by focusing only on idle or lightly loaded scenarios.

We also have concerns with the second note. While we agree with the high-level intention, we think it may be immature, before the study, to impose such a restriction that the techniques "should offer network energy savings irrespective of the scenario". As part of the study, we may identify some techniques that may be specifically applicable to the idle scenarios, or some that may only be applicable to FR2, or the last scenario listed in the objective. Hence, we propose to remove note 2.

10 – KDDI Corporation

we are fine with the objective section.

11 – Ericsson LM

The objectives are in general fine.

Still, for Objective 3, we still prefer to bring back the sub bullets. It is good that they are reflected in the justification section. The objectives gives the structure of SI, and while it is good to be open to all potential ideas, including where different RAN groups should contribute is essential for the progress of the work. For example, it is not clear from the current objective where RAN3 should contribute.

Regarding the scenario "EN-DC/NR-DC macro with FDD anchor band and TDD/Massive MIMO on higher FR1 frequency", "FDD anchor band" should be replaced with "FDD PCell" to avoid confusion. "TDD/-Massive MIMO on higher FR1 frequency" should be updated to also include FR2 (i.e. "TDD/Massive MIMO on higher FR1/FR2 frequency") so as to not exclude FR1-FR2 DC from evaluation scenarios. Given that this is the final round, it is OK if FR1 is kept in square brackets for now. Nevertheless, it is expected that by the time Rel 18 starts to be implemented, most networks are stand-alone. For now we can keep the scenario, but in later stages it should be given a lower priority compared to the other ones.

12 – Samsung Electronics Co.

- As for the scenarios, we are fine with Apple's above suggestion to manage the workload.
- Regarding the third objective, RAN4 needs to be added back, at least for studying power domain aspects.

13 – Deutsche Telekom AG

We are generally fine with the objectives, but as also proposed by other companies we would prefer for Objective 3 to include the deleted sub-bullets.

14 – China Telecom Corporation Ltd.

We prefer the objective 3 with the deleted sub-bullets, but since they are included in the justification, we are fine with the current objectives.

15 – Huawei Tech.(UK) Co.. Ltd

Moderator: more input would be helpful on CATT's proposal to add a sub-bullet "Define the energy consumption models for backhaul access" in order to evaluate the gNB power consumption of backhaul access between gNB-gNB and gNB-CN. One question from the moderator to CATT is how RAN could proceed with such objective since RAN does not normally assume any specific technology for the transport on the backhaul?

16 – TELECOM ITALIA S.p.A.

Generally fine with the proposal.

- We do not agree with Ericsson's comment "Nevertheless, it is expected that by the time Rel 18 starts to be implemented, most networks are stand-alone". Therefore, this scenario should be kept in scope with high priority.

- We do not agree with Qualcomm's proposal to remove the sentence "The study should prioritize idle/empty and low/medium load scenarios (the exact definition of such loads is left to the study)", even if we do not disagree with their proposal to also study loaded scenarios. From our perspective, however, it is better to prioritize this scenario and then study other scenarios if time allows

17 – LG Uplus

Support. Like many mentioned, good to see the deleted sub-bullets in the justification. Good idea to provide the feeling and some example of direction to members/readers still without sub-bullets in objectives

18 – Fujitsu Limited

We are fine with the draft objectives.

19 – NEC Telecom MODUS Ltd.

Fine with the objectives.

20 – Guangdong OPPO Mobile Telecom.

We support the draft objectives. The example deployments scenarios can be further down-selected in the study. Thus, the bullet are fine.

21 – Telia Company AB

We are generally fine with the objectives. Objective 3 is ok for us with or without bullets for RAN1, RAN2 and RAN3 focus area guidance.

22 – Motorola Mobility UK Ltd.

Fine with the objective section.

23 – MediaTek Inc.

Thanks for moderator's update. We still see changing **"assessing impact"** back to **"balancing impact"** as RAN93-e email discussion outcome is necessary, which ensures careful study and specification to achieve overall system energy saving. We would like to point out user satisfaction is to secure operator income, which is as important as saving network energy cost for operators.

24 – ZTE Corporation

We are okay with the draft SID in general.

For the third bullet in the draft SID, it will be more beneficial for the group to carry out the research if the potential study areas described in the justification can be added as sub-bullets in the objective.

As to the scenarios, we agree that there will be more chance for NW energy saving and less impact on UEs' experience in medium/low load scenarios.

25 – Fraunhofer IIS

We are fine with the objective section.

26 – Nokia France

The objectives are mostly fine now.

For objective 2, we are not entirely happy with the adopted modification of our comment. The point is that developing new KPIs is not an alternative to reusing existing KPIs; existing KPIs that are sufficient should not be unnecessarily re-developed. Hence we propose: "and should reuse existing KPIs whenever applicable; where existing KPIs are found to be insufficient, ~~or develop~~ new KPIs may be developed as needed." This still seems consistent with Huawei's observation.

We are OK with the Moderator's way forward on objective 3. We do see that RAN4 may need to be involved, though.

The Moderator's handling of the list of scenarios is OK.

27 – HUAWEI TECHNOLOGIES Co. Ltd.

The objective section is generally okay to us. Some editorial suggestion on Note 2 as below:

Note 2: the identified techniques should ~~offer network energy savings~~ be applicable irrespective of the scenario, while the amount of network saving gains may depend on the specific deployment scenario and network load.

The restriction in the current note 2 is a little bit too strong since it may be difficult to ensure one technique to achieve network energy saving gain for all scenarios. By the way, we are fine to delete the note 2 also if people prefer it better.

As to the comment to delete "The study should prioritize idle/empty and low/medium load scenarios (the exact definition of such loads is left to the study)" from Qualcomm, we would prefer to keep it since it should clear that more network energy saving gains can be achieved for idle/empty and low/medium load scenarios. For other scenario e.g. high/full load, it is expected that gNB has to operate with full power to ensure getting done all the transmission, in which case seems SE is the main target. In addition, we don't think the sentence here preclude high load case, i.e. high load case can be studied also.

Comments are invited on the other parts of the draft SID

Feedback Form 14: Other comments on the draft SID

1 – Intel

RAN#98 is December 2022 and RAN#99 is March 2023, so TR submission for info and for approval meeting date may need to be updated to reflect the SI duration of 9 month with possibility of extension to

12 months.

Therefore, assuming RAN1 starts in Q2 2022, TR output should state should be TSG#97 for info, and TSG#98 for approval.

Regarding responsible WGs and TU planning, the moderator suggests 1 TU per RAN1 meeting for 4 meetings (2022/Q2/Q3/Q4), and 0.5 TU per RAN2 and RAN3 meeting for 3 meetings (2022/Q3/Q4). If there is a need for RAN4 involvement e.g. in the modeling phase, coordination by LS with RAN4 should occur as needed. Likewise, coordination with SA5 may occur as needed.

Feedback Form 15: Comments on the possible TU allocation for the 9-months study

1 – CATT

We are supportive of the proposed timeline and TU allocation.

2 – Futurewei Technologies

We are ok with the suggested TU and plan for 9-months study

3 – InterDigital Belgium. LLC

We support this planning.

4 – Beijing Xiaomi Mobile Software

OK with the planning

5 – Intel

1 TU for 9 month with the objectives defined does not seem to be a realistic TU allocation.

We think performing a very broad scoped study such as network energy saving (based on objectives) with 1 TU only for 9 months is challenging and may not be able to accomplish the objective set. At the very least in Q3 and Q4'2022 there should be 2 TU so that completing SI within 9 months seems plausible.

6 – Qualcomm Incorporated

We agree with the proposed TU allocation.

7 – KDDI Corporation

We agree with the planning

8 – Ericsson LM

The TU assignment looks fine considering that the major load is expected to be in RAN1. Considering RAN2 parts is expected to need more work load than RAN3, it may be better to move 0.5 TU from RAN3 to RAN2, and let RAN2 to have 1 TU in the last meeting.

9 – Samsung Electronics Co. As commented above, RAN4 involvement is needed for objective 3, responsible WG, and TU planning.
10 – China Telecom Corporation Ltd. We are fine with the time plan.
11 – CEWiT We are fine with the time plan
12 – NEC Telecom MODUS Ltd. We agree with the planning.
13 – Guangdong OPPO Mobile Telecom. We agree with the planning
14 – MediaTek Inc. Thanks for moderator proposal. The plan looks good for us.
15 – ZTE Corporation We think the proposed time plan is okay.
16 – Motorola Mobility UK Ltd. In the beginning of SI, more time may be needed to agree on scenarios, evaluation metrics, and evaluation assumptions. During the 9-months study, 2 TUs, 2 TU, 1.5 TU, 1.5 TU, and 1.5 TU can be allocated for each of 5 RAN1 meetings, respectively.
17 – Fraunhofer IIS We agree with the proposed planning.
18 – HUAWEI TECHNOLOGIES Co. Ltd. We are okay for this proposed timeline and TU allocation.
19 – Nokia France This seems reasonable, but we agree with Samsung that TUs should also be allocated in RAN4.

5.2 Final Summary

Summary of comments on the draft justification section in the draft SID

The vast majority of comments agreed with the proposed justification section without any change, and a few comments suggested minor revisions, which are all reflected in v2.

Summary of comments on the draft objectives section in the draft SID

CATT proposed add a sub-bullet ”Define the energy consumption models for backhaul access” in order to evaluate the gNB power consumption of backhaul access between gNB-gNB and gNB-CN. Given the lack of input on this proposal, it is not reflected in the updated draft SID. More discussion at RAN#94e will be needed on this proposal.

Xiaomi proposed adding a note 3 saying that “negative impacts on UE experience should be avoided or at least reduced while practicing energy saving techniques for the network side”. It is the moderator’s understanding that the text of objective 2 already covers this aspects by assessing/balancing impact to user experience including UPT, latency as well as UE power consumption/complexity.

Spreadtrum echoed MediaTek’s proposal to replace “assessing impact” with “balancing impact”, noting that “balancing” was used in the summary of the June email discussions. Here the moderator clarifies his understanding that assessing impact to network and user experience is implicitly intended to achieve some balance between network energy savings and impact to the network and user experience. However, the moderator thinks both formulations would be fine, so the WID is revised by keeping both formulations as assessing/balancing.

Qualcomm did not support the simple formulation of objective 3, as it was felt to be too broad. Qualcomm proposed the following formulation, which is adopted in v2, and can be further discussed at RAN#94e:

- Study and identify techniques on the gNB and UE side to improve network energy savings in terms of both BS transmission and reception [RAN1, RAN2, RAN3]

Qualcomm proposed deleting the sentence on prioritizing idle/empty and low/medium load scenarios. The moderator would like to note that such prioritization was supported by a large majority of companies in the previous round, and that other responses provided in the final round did not agree with Qualcomm’s proposal.

Qualcomm proposed deleting the note that was added after the intermediate round saying that “the identified techniques should offer network energy savings irrespective of the scenario”. Huawei supported deleting the note. Since this note was added based on comments from just a couple of companies, the moderator feels that there is not enough support for this note so it was removed.

A few companies expressed a preference to bring back the last paragraph of the justification section as a sub-bullet of objective 3, while some of these companies were also fine with the objective 3 in v1. A comment is added to the justification section to keep in mind this point for discussion at RAN#94e, noting that a majority of companies actually preferred not to keep this text under objective 3 in the intermediate round.

Nokia provided some revisions to objective 2, clarifying the objective on reusing existing KPIs and defining new KPIs. The revisions are reflected in v2.

Samsung and Nokia asked to add RAN4 as responsible WG for objective 3. The moderator’s understanding is that RAN4 may need to be involved for providing input to RAN1 for the first objective on network energy consumption model, but that the evaluations of the techniques may only need to be performed by RAN1 for objective 3 based on the model. At this point RAN4 is added in brackets to objective 3, and it can still be clarified at RAN#94e considering that there has not been a lot of discussion on RAN4 involvement.

Summary of comments on the possible TU allocation for the 9-months study: the moderator suggested 1 TU per RAN1 meeting for 4 meetings (2022/Q2/Q3/Q4), 0.5 TU per RAN2 and RAN3 meeting for 3 meetings (2022/Q3/Q4), and 0.5 RF TU per RAN4 meeting for 2 meetings (2022/Q3/Q4).

Based on the comments from Intel, Ericsson, Samsung and Nokia, the following revision is provided. and more discussion will be needed at RAN#94e.

- RAN1: 1 TU per meeting in 2022/Q2/Q3 and 2+2 TU in Q4
- RAN2: 0.5 TU per meeting in 2022/Q3 and 0.5+1 TU in Q4
- RAN3: 0.5 TU per meeting in 2022/Q3 and 0.5+0.5 TU in Q4
- [0.5 RF TU per RAN4 meeting for 2 meetings (2022/Q3/Q4)]

The final version of the draft SID is provided in RP-212709.

6 References

1. RWS-210659, Summary of RAN Rel-18 Workshop, June 2021
2. RP-211663, Moderator's summary for discussion [RAN93e-R18Prep-13] Network energy savings, RAN#93-e
3. RP-212608, RAN Chair's Summary for RAN Release 18, RAN#93-e