

## [94e-12-R18-LowPowWUS] - Version 0.0.6

### RAN

3GPP TSG RAN#94e RP-213492

Electronic Meeting, December 06 - 17, 2021

Agenda Item: 8A.1

Source: vivo (Moderator)

Title: Moderator's summary for discussion [94e-12-R18-LowPowWUS]

Document for: Discussion and Decision

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## 1 Introduction

According to the guidance from RAN chair, this discussion is for the preparation of Rel-18 study item on low power WUS, with the target to provide final SID for approval in RAN#94e.

RAN chair has provided the suggested scope and TU allocation which can be found in the separate document RP-213469, accordingly a draft SID is uploaded in ([https://www.3gpp.org/ftp/tsg\\_ran/TSG\\_RAN/TSGR\\_94e/Inbox/Drafts/%5B94e-12-R18-LowPowWUS%5D](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5B94e-12-R18-LowPowWUS%5D)) with change marks shown compared to the outcome of October email discussion in RP-212733. This draft SID will be the baseline version for discussion during RAN#94e.

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## 2 Week1-Initial round

Following contributions are submitted to RAN#94e to discuss the potential revision for SID of low power WUS. In the following sections, companies are welcome to provide comments to the proposals made in these contributions.

**Table 1:**

RP□212995	On Rel-18 Low Power Wake-Up Signal/Receiver	Apple
RP□213265	Study on Low-power WUS	vivo
RP□213389	Discussion on Rel-18 low-power WUS	ZTE, Sanechips
RP□213356	Targets for Low-power WUS Study	MediaTek Inc.

## 2.1 Use cases

- In RP-212995, it was proposed to remove the exemplary use cases in the objective section 4.1 (P1), and remove the RedCap SI/WI from the list of related work items from Section 2.3 (P2).
- In RP-213265, it was proposed to add wearables to the exemplary use cases in the objective section 4.1 (P3).
- In RP-213356, it was proposed to focus on wearable and industrial wireless sensors in the study (P4).

Considering the contribution inputs as above, please provide your comments on whether and how to revise the SID about the use cases for study.

Please indicate explicitly if you agree or disagree any of the proposals (P1/P2/P3/P4) from the contributions list above.

### Feedback Form 1: Comments on the use cases for study

#### 1 – Futurewei Technologies

(P1) ok. The proposed revision in RP-212995 is acceptable given the text in the justification.

(P3) If P1 is accepted, then P3 is not necessary.

(P4) It is unclear where the revision would be applied.

#### 2 – CATT

The low-power WUS could be used by all UEs once the NR system support the low-power WUS. The use cases should be for all UE with the focus on power sensitive devices.

Our suggestion of modification in use case objective is as follows,

The study should ~~primarily target low-power WUS/WUR for all devices with focus on required by IoT use cases, i.e., power-sensitive devices, small form-factor devices such as industrial sensors or controllers. Other use cases are not precluded.~~

~~As opposed to the work on UE power savings in previous releases, t~~ This study will not require existing signals to be used as WUS. All WUS solutions identified shall be able to operate in a cell supporting legacy UEs. Solutions should give justifiable gains compared to the existing Rel-15/16/17 UE power saving mechanisms. Aspects such as UE power consumption, detection performance, coverage, UE complexity, should be covered by the evaluation.

#### 3 – Spreadtrum Communications

We think LP-WUS can be used for use cases including IoT, wearables, mobile phone. But, we also think it may be widely deployed for IoT devices and wearables in recent years. Further, it is suitable for the low-mobility cases, so IoT (sensors/cameras) can apply it immediately. To avoid the debate of the use cases, we can make it broad currently, e.g. "The study should primarily target low-power WUS/WUR in diverse use cases, e.g. IoT, wearables, mobile phones".

#### 4 – MediaTek Inc.

While we understand the low-power technology can be applied to all type of devices, it will be useful to first target most critical cases to ensure the power saving and latency targets can be made. Given the well-discussed cases in R17 REDCAP, i.e., wearable, IOT and video video surveillance, prioritizing the first

two use cases should be reasonable starting point for the study. When wearable is supported, we also see no issue to apply it to mobile phones or tablets.

#### **5 – SHARP Corporation**

P1: OK to remove the restriction on use cases. And we are in general fine with the detailed changes proposed in RP-212995 for the first paragraph of section 4.1 of the SID. With that, P3 and P4 are not necessary.

P2: Not necessary. We don't see any problem of listing the RedCap SI/WI as related ones, which does not impose any restrictions on the scope of the study.

#### **6 – Panasonic Corporation**

We agree to remove the exemplary use cases in P1. We are neutral to remove the related to work as the RedCap SI/WI in P2. We agree to describe wearables on P3 and P4. We are neutral on industrial wireless sensors in P4.

#### **7 – Ericsson LM**

**Regarding P1**, the use cases should be listed in the Justification section rather than the Objective section.

**Regarding P2**, we prefer to list the RedCap items since the primary target should be IoT use cases such as industrial sensors and wearables which are precisely RedCap use cases (something that may be missed by the reader unless the Rel-17 (and potential Rel-18) RedCap items are listed as related items or at least mentioned in some other way.

**Regarding P3 and P4**, we are fine with adding wearables as one of the use cases beside industrial sensors.

#### **8 – Beijing Xiaomi Mobile Software**

For P1, its intention is to expand the low-power WUS to all type of devices, not just IoT, wearables. In our understanding, we can first focus on low-mobility cases. So the cases in R17 REDCAP, i.e., wearable, IOT and video video surveillance should be the first priority. We do not see the need to remove the RedCap SI/WI as related ones.

P3 and P4, fine with adding wearables beside industrial sensors.

#### **9 – LG Electronics Inc.**

Generally ok with P1 and P2.

If P1 is accepted we don't need P3 and P4.

#### **10 – Samsung Electronics Polska**

Support to add wearable as another example for small form factor devices other than industrial sensors or controllers.

#### **11 – Deutsche Telekom AG**

We don't see a large value in this for Rel-18. In the interest of workload it should be dropped.

#### **12 – Huawei Tech.(UK) Co.. Ltd**

We support P1 (whether as proposed in 2995 or as proposed here), and P2. The use cases should be also the part of the study, and we don't need to restrict the use cases in the objective.

### 13 – ZTE Corporation

P1: OK

P2: OK

P3/P4: if P1 is approved, then P3/P4 is not necessary. If specific use cases need to be kept, we prefer to describe them in justification part instead of objective part.

### 14 – Lenovo (Beijing) Ltd

We are fine with the (P1) in RP-212995 in general to remove the restriction on WUS/WUR for IoT only. However, for the power-sensitive device, we can add “e.g., wearable and video surveillance” to guide the image on the power-sensitive device.

We don't see the problems of listing the RedCap SI/WI as related work items, even we can add the LTE NB-IoT/eMTC Rel.15/16 as the related work items.

### 15 – vivo Communication Technology

We support adding wearable as one of the use cases beside industrial sensors, thus support P3 and P4. We think wearable as part of the redcap devices have commercial interests.

### 16 – Everactive

We agree this study should address and benefit industrial sensors and wearables, but should benefit many, many more use cases. Scalability of the solution is key to addressing these.

Suggested modification for section 4.1:

“The study should primarily target low-power WUS/WUR ~~required by~~ to support a diverse set of IoT use cases, i.e., power-sensitive, small form-factor devices such as industrial sensors or ~~controllers~~ wearables. Other use cases are not precluded.”

Justification/Explanation:

We should consider a diverse set of traffic models, as well as the power floor that must be achieved in order to make a meaningful impact on the lifetime of these devices. RP-213265 (vivo) provides a summary of traffic models.

Industrial sensors will be dominated by uplink traffic, with bursts of data separated by periods of no traffic, with moderate latency requirement and a power floor of 10uW.

Some wearables (e.g. activity monitor) will be similar to these industrial sensors. However, other wearables (e.g. smart watch) will be dominated by downlink traffic, with a lower latency requirement and a power floor of 100uW or more.

### 17 – ROBERT BOSCH GmbH

We propose to consider VRU/V2X to the exemplary use cases. Our proposal to have a unified WUS design that fits Uu and SL.

### 18 – Sony Europe B.V.

**P1 and P2.** We do not agree on removing exemplary use-cases and the RedCap SI/WI from the objectives. Low-power wake-up receiver and wake-up signaling are most beneficial for scenarios with low traffic intensity where the device needs to be available very often or with short latency. RedCap use-cases have the above characteristics in contrast to eMBB type use-cases. Therefore, the RedCap SI/WI is a good starting point.

**P3 and P4.** We are fine to explicitly mention wearables and industrial wireless sensor network as exemplary use-cases since they are a part of the RedCap use-cases and would benefit from low power operation with low latency (not constrained by DRX cycles).

**19 – Intel Corporation (UK) Ltd**

P1 & P2: OK.

P3 & P4: Not necessary/applicable in view of P1.

**20 – Apple Italia S.R.L.**

We support P1, because the example use cases are already provided in justification section.

We also support P2, because we don't think the SI should be automatically linked/limited to RedCap UEs.

If P1 is adopted, P3 is not necessary. Otherwise, we also think wearable should be included as one of the use cases.

For P4, we prefer not to put too much restriction on the use cases at this stage.

**21 – Nokia France**

Probably it is better to mention the potential use cases in the Justification section rather than the Objectives. Therefore P1 is OK. Wearables are already mentioned in the Justification, so we do not see the need for P3 or P4. As for P2, RedCap is indeed related, so we do not see the motivation to delete the reference to it.

**22 – Philips International B.V.**

We agree with Spreadtrum.

Proposal : TBD

## 2.2 Power saving gain

- In RP-212995, it was proposed to have a dedicated bullet on the evaluation of power saving gain, as below
  - "Evaluate the UE power saving gain from low-power wake-up signal/receiver compared to the existing Rel-15/16/17 UE power saving mechanisms [RAN1]" (P5)
- In RP-213356, it was proposed to set a clear power saving target for low power WUS study
  - "Rel-18 study on ultra-low-power WUR & WUS targets 1/10TH or lower power consumption than NR Rel-15/16/17 power saving mechanisms " (P6)

It is moderator's understanding that evaluation of power saving gain is an important task for the study item and will be the most important criteria for potential solution selection, or making any recommendation to future normative work. This seems to be no difference from Rel-16/17 power saving study. Having said that, companies' feedback on the proposals above are welcome.

Please indicate explicitly if you agree or disagree any of the proposals (P5/P6) from the contributions list above.

## Feedback Form 2: Comments on the power saving gain evaluation and target

### 1 – Futurewei Technologies

(P5) Not needed. Companies will evaluate the power savings gain of each design.

(P6) Having a (more aggressive target) for power saving can be good as this is a brand new design. We can capture some wording like this target in the justification.

### 2 – CATT

The low-power WUS is a separated front-end device with ultra-low power consumption. Since the UE power consumption model in TR38.840 is modeled the UE power consumption relative to the deep sleeping mode of regular UE device, a new power model for the low-power WUS needs to be defined relative to the current reference mode in order to compare the power consumption of existing power saving techniques.

We need to include the UE power consumption model of low-power WUS in the objective.

### 3 – Spreadtrum Communications

The power saving gain should be based on R17 power saving techniques, e.g. paging enhancement. In our view, PEI in R17 possibly approached the "bound" of power saving gain because UE has to perform serving-cell measurement per paging cycle (no possibility of long-term sleeping). To break the "bound", the new architecture and procedure (e.g. less serving-cell measurement) should be brought out. Anyway, we can use the R17 as the baseline to compare the power consumption in the study, and the explicit mention about the comparison may not be so necessary. In current version, we have "Solutions should give justifiable gains compared to the existing Rel-15/16/17 UE power saving mechanisms."

### 4 – MediaTek Inc.

We expect the study should explore the feasibility of ultra-low-power front-end receiver and check feasibility in bringing it to NR system. Given WIFI 11ba has a similar exploration with a target of 1/15 or lower power consumption, as quoted in RP-213356, we think NR should also set a reasonable target that is not far from WIFI target, and 1/10 can be the ratio which is better specific than "Justifiable gains". Although the target looks challenging, we see it will bring significant value to this study once the group identifies the feasible solution. Without sufficient differentiation, there will be no motivation for UE chip vendors to support a brand new receiver design with only marginal gain.

### 5 – SHARP Corporation

P5: OK.

P6: Not necessary. The achievable power saving gains would be the outcome of the study. Detailed discussion could be taken upon completion of the study on whether the gains justify moving to the WI phase.

### 6 – Panasonic Corporation

We support both P5 and P6.

### 7 – Ericsson LM

**Regarding P5**, the following is already listed in the objectives: "*Aspects such as UE power consumption, detection performance, coverage, UE complexity, should be covered by the evaluation*" and it is obvious that the WUR feature should be evaluated against a Rel-17 baseline from the following sentence in the

objectives: ”Solutions should give justifiable gains compared to the existing Rel-15/16/17 UE power saving mechanisms.”

That being said, we are fine with adding a bullet to make it even clearer if companies see a need for it.

**Regarding P6**, the magnitude of the gains should not be specified in the SI objectives but should instead be the outcome of the SI. However, in order to ensure that the study focuses on solutions with substantial potential power saving, we might be fine with indicating, e.g., that the study solutions that target at least 80% power saving.

#### **8 – Beijing Xiaomi Mobile Software**

P5 Not needed. It is already covered in the last objective.

P6 to set the target of achievable power saving gains may be difficult in the beginning of the SI.

It would be the outcome of the study.

#### **9 – LG Electronics Inc.**

**P5:** Ok. We tend to agree with Apple that one of the most critical evaluation to determine the feasibility of WUS/WUR

**P6:** In principle, we are ok with considering WUR/WUS design which have lower power consumption than existing power saving mechanism. However we prefer to evaluate first how much power saving gain can be achieved from the new WUR/WUS with consideration of potential system impacts.

Moreover, the definition of “ultra-low-power” is not clear to us. Does it means we need to study both “ultra-low-power WUR&WUS” and “low-power WUR&WUS” in this study item? If so, we are not sure how to differentiate “ultra-low-power” from “low-power” since we do not have clear definition yet. If the intention is to replace the term “low-power” to “ultra-lower-power”, we don’t see strong motivation with this change.

#### **10 – Samsung Electronics Polska**

For P5, we think is it reasonable, which makes the objectives more clear.

For P6, it is good to have some reference/design goal for this LP-WUR/WUS. However, other than added an explicit objective, we think it can be added in justification part instead.

#### **11 – Qualcomm Incorporated**

We agree with P5.

We also agree with P6 in principle, although it may prove difficult to converge on concrete numbers as targets.

#### **12 – Deutsche Telekom AG**

We don’t see a large value in this for Rel-18. In the interest of workload it should be dropped.

#### **13 – Huawei Tech.(UK) Co.. Ltd**

We are OK to have P5 as a separate objective, although it seems already captured in the final bullet of the current objectives. It is not necessary to set the exact value of target gain at this stage before an SI, i.e. not P6.

#### 14 – ZTE Corporation

P5: based on P5, seems that only power saving gain needs to be evaluated. Other aspects, e.g., system impact, latency, etc., also need to be evaluated. Additionally, from our understanding, studying the power saving in the previous version already covers this kind of intention. Therefore, this change is not necessary.

P6: the clear power saving gain is important, especially compared with current power saving schemes. However, it is hard to define a precise target in RAN plenary and we can further discuss and decide it when the SI stage is going to the end.

#### 15 – Lenovo (Beijing) Ltd

Power saving can be one of the important criteria on WUS/WUR considering capacity and latency, etc. All of these factors should be considered together

The achievable power saving gains compared to NR 15/16/17 would be the outcome of the study.

#### 16 – vivo Communication Technology

OK with P5.

For P6 (target), we think the proposed target 1/10 is unclear. For example, which baseline is assumed and what is the the other assumptions, e.g., latency. Since the power consumption can be tradeoff between other aspects. We think P6 can be studied in the SI stage.

#### 17 – Everactive

We have observed different contributors have differing assumptions on the operation of a WUR. Some assume duty cycling is acceptable, while others assume “always-on”. We need to be explicit to avoid confusion.

**Regarding P5 and P6** - we agree on setting a clear power target, but we should provide an absolute value rather than a relative power target, and should couple this with a latency and sensitivity spec.

Our proposed target specifications are: 10uW **average** power (assuming duty cycling), 1s latency, and -100dBm sensitivity.

This still allows for a range of solutions that can meet this target, as well as scalability. For example, assuming a 100uW active power WUR, 10% duty cycling, and 1s latency, this results in average power of 10uW, and an on-time for the WUR of 100ms every 1 second. These numbers are aggressive, but achievable for the right WUS. Assuming 1mW active power WUR, 1% duty cycling, and 1s latency, this also results in 10uW average power with a WUR on-time of 10ms every 1 second. These number are more relaxed on the WUR power, but requires a shorter WUS. Tradeoffs like these will be studied as a part of this SI.

#### 18 – Nordic Semiconductor ASA

P5 : No support, we agree that power saving gain comparison to R17 is already in the SID

P6: No support, we should not select design based on power saving gain only, but also consider e.g. sensitivity. In other words, all trade-offs should be considered when selecting the WUR/WUS design.

#### 19 – Sony Europe B.V.

**On P5.** We think there should be a separate bullet on power saving gain as this is the main motivation for the study of low power WUS/WUR. The evaluation of power saving gain should be for scenarios with low traffic volume and relatively low latency (i.e., not URLLC levels of low latency).

**On P6.** We do not agree on adding such a target gain. (The results provided in RP-213356, as reference, are based on assumption made in IEEE 802.11ba. In our view, we cannot base our target design on an analysis from a different protocol.) We could, however, target receiver designs in range of 10s of uW power consumption for the reception of the WUS.

#### **20 – Verizon UK Ltd**

Support MTK's view that at least we should keep a target in mind and the target should start with being aggressive (for better product/market spacing).

#### **21 – VODAFONE Group Plc**

Support having a target of 1/10th of the power consumption. Agree with Spreadtrum that measurements need to be considered as part of the system design.

#### **22 – Intel Corporation (UK) Ltd**

**P5:** Separate objective not necessary. It can be covered by the following objective with the following edit:

- Study potential system impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity, latency, and **power saving** gains compared to the existing Rel-15/16/17 UE power saving mechanisms [RAN1, RAN2]

**P6:** Not necessary. Without any study, setting such targets would be rather ad hoc, and not very helpful. For instance, the interpretation of "targets" can be a possible source of confusion in WGs. Solutions can be evaluated relative to each other as part of the study. Note that the sentence "*Solutions should give justifiable gains compared to the existing Rel-15/16/17 UE power saving mechanisms.*" in the Objective section already captures the essence of P6.

#### **23 – Apple Italia S.R.L.**

On P5, we would not insist that power saving gain evaluation has to be listed as a separate objective, because it should be common understanding this is the most important metric that needs to be evaluated. But we think it does not fit well in the last objective on system impact: "Study potential system impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity, latency, and gains compared to the existing Rel-15/16/17 UE power saving mechanisms". It is better to remove it from the last objective.

On CATT's proposal to add power model for LP WUR, we think it should be also common understanding that this is part of power evaluation, and we do not have strong view on whether it should be listed or not.

On P6, we do not necessarily need to have a well-defined target, and this can be left to the outcome of the study.

#### **24 – Nokia France**

We do not agree to evaluate the UE power saving gain independently of the other aspects listed in the final bullet of the objective. In particular, it is necessary to understand the scenarios in which any UE power saving gains may be achievable (e.g. under what SINR conditions), and what impacts there may then be in those scenarios on the other aspects of system performance.

One way to accommodate Apple's observation that UE power saving gain is not a "system impact" could be to modify the final bullet as follows:

- Study potential **gains and** system impacts, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity, and latency, and **UE power saving** gains compared to the existing Rel-15/16/17 UE power saving mechanisms, **including evaluating the conditions under which such gains may be achieved** [RAN1, RAN2]

For P6, the target should indeed offer a substantial level of gain, but the benchmark would need to be more clearly defined to make this meaningful.

**25 – Philips International B.V.**

Agree with Ericsson.

Proposal: TBD

## 2.3 Wake-up latency

- In RP-213389, it was proposed to revise one sentence in the justification part to clarify that low power WUS is targeting lower latency than existing eDRX.
  - o "Thus, the intention is to study ultra-low power mechanism with lower latency than eDRX in Rel-18." (P7)
- In RP-213356, it was proposed to set a end-to-end latency target for low power WUS study, as below. The proposal was made by referring to the latency requirement for industrial wireless sensors in TR38.875.
  - o "Rel-18 study on ultra-low-power WUR & WUS targets end-to-end latency less than 100 ms" (P8)

It is moderator’s understanding from previous discussion that the target of low-power WUS is to achieve low power consumption and low latency for UE wake-up, the exact value of achivable wake-up latency will be studied during the SI. Having said that, companies’ feedback on the proposals above are welcome.

Please indicate explicitly if you agree or disagree any of the proposals (P7/P8) from the contributions list above.

### Feedback Form 3: Comments on wake-up latency

**1 – Futurewei Technologies**

P7 and P8: We can decide the values for latency once the study is completed. There may be designs with latencies that are appropriate for specific applications.

**2 – CATT**

We can use the reference configuration for calibration of low-power WUS and the study of the latency.

**3 – Spreadtrum Communications**

The transition time/power is a part of study of power model, similar to R17 study of UE power saving. It is also a part of feasibility of architecture and procedure, or even output of study of architecture and procedure. Till now, it seems we cannot have a compromised transition time (latency) or power. Suggest

making it general.

#### **4 – MediaTek Inc.**

As suggested in our previous response, we should set challenging targets so as to differentiate the study outcome from existing designs. As commented by RP-213389 that eDRX can easily achieve very low power consumption at the expense of very large latency, it is reasonable to set a shorter latency target to accommodate the use cases that cannot be fulfilled by eDRX. If companies generally think IOT is one reasonable use case, the corresponding latency requirement of 100 ms can be utilized. To be more specific, we can add “additional latency introduced due to ultra-low-power WUR & WUS should be within 100 ms”.

#### **5 – SHARP Corporation**

P7 and P8: Not necessary. The achievable latency gains would be the outcome of the study. Detailed discussion could be taken upon completion of the study on whether the gains justify moving to the WI phase.

#### **6 – Panasonic Corporation**

On P7, although we agree it is not aiming corresponding to URLLC, we are not so sure the lower latency than eDRX in Rel-18. To achieve ultra-low-power is more important than short latency. We are ok with the direction of P8.

#### **7 – Ericsson LM**

**Regarding P7**, we agree with the clarification.

**Regarding P8**, we disagree since: (A) the magnitude of the gains (and potential tradeoffs between latency and power consumption) should not be specified in the SI objectives, but should instead be the outcome of the SI, and (B) the startup time of the main receiver will be a lower cap of the WUR downlink latency which may be considerably longer than 100 ms.

#### **8 – Beijing Xiaomi Mobile Software**

P7: WE agree that the low-power WUS is to achieve low power consumption as well as low latency for UE wake-up. Not sure it can achieve lower latency than e-DRX. It depends on the solutions in SI.

P8 will be decided in the SI.

#### **9 – LG Electronics Inc.**

**P7 & P8**: There might be trade-off between power saving gain and system impact including the latency. Also, required latency would be application dependent. In our view, achievable latency is one of the goals to be studied during the SI phase.

#### **10 – Samsung Electronics Polska**

Not necessary. For P7, current wording is clear. For P8, we think can be one of the outcome of the study, as in the last bullet of the objectives.

#### **11 – Qualcomm Incorporated**

We do not agree with P7. There is no need to add “than eDRX in Rel-18”. Adding this would give the impression that SI scope is limited to idle mode use case only. In the previous email discussions, we have seen that there are a number of companies who are interested in connected mode use cases.

Regarding P8, it is unclear why end-to-end latency should be a factor here. For the over-the-air latency, significantly less than 100ms latency would be desirable at least for some of the relevant use cases. We think that the study of different latency requirements for different use cases should be part of the SI scope.

#### **12 – Deutsche Telekom AG**

We don't see a large value in this for Rel-18. In the interest of workload it should be dropped.

#### **13 – DOCOMO Communications Lab.**

For P7 and P8, we agree with moderator that the exact value of achievable wake-up latency will be studied during the SI. Thus, we think no need about these proposals.

#### **14 – Huawei Tech.(UK) Co., Ltd**

We think the detailed latency value can be determined during the study item. The power saving gain and wake up latency depend on the use cases and designs. So, there is no need to restrict the latency requirement too much, and P6/P7 are not needed.

#### **15 – ZTE Corporation**

##### **For P7:**

As mentioned in the SID, 'For example, in fire detection and extinguishment use case, fire shutters shall be closed and fire sprinklers shall be turned on by the actuators within 1 to 2 seconds from the time the fire is detected by sensors, long eDRX cycle cannot meet the delay requirements. eDRX is apparently not suitable for latency-critical use cases. Thus, the intention is to study ultra-low power mechanism with low latency in Rel-18.'

Actually, the meaning of low latency is not clear. Moreover, according to the context, it is observed that one of the motivation for LP WUS is to address the long delay issue by long eDRX cycle. It is nature to say the latency for LP WUS should be shorter than the eDRX.

If other companies are hesitate to add the specific delay value, another possible revision is :

- the intention is to study ultra-low power mechanism ~~with low latency~~ **to address the long delay issue by long eDRX cycle** in Rel-18

**For P8**, LP WUS is a generic tech, if video surveillance is also considered, the latency requirement is not needed to be less than 100ms. Therefore, setting a restricted latency requirement would be over-designed for some use cases and is not needed before the SI stage.

#### **16 – Lenovo (Beijing) Ltd**

The achievable latency considering different solutions and application would be the outcome of the study, and the detail target can be determined in WI stage considering each application.

#### **17 – vivo Communication Technology**

We think P7 is necessary.

For P8 (100ms latency), we think it is not needed. When the main radio is switched off, we think 100ms is not enough for wake-up. And the cited 100ms requirement from Redcap TR we think is for connected mode such that the main radio is not turned off. But for IDLE/INACTIVE, such constraint is not necessary.

### **18 – Everactive**

P7: We agree that a **moderate** latency target should be a part of this SI, and that moderate latency, combined with ultra-low power, is the goal. We do not see a reason to compare it to eDRX or other modes. It's important that we couple an absolute latency target with an average power target and a sensitivity target, and then make latency adjustable so that different latencies can be selected (at different average power levels). We have proposed 10uW average power, 1s latency, and -100dBm sensitivity.

P8: We disagree on a 100ms latency target, assuming a 10uW average power.

Latency should be programmable based on the use case, and average power should scale along with latency. A 100ms end-to-end latency target is lower than required for most IoT use cases, which are machine-to-machine (M2M) type communication where the latency perceived by a human is not a factor. We propose a 1s end-to-end initial latency target for the discussion, assuming a 10uW average power. Lower latency should be possible with higher power (e.g. 100ms at 100uW average power).

### **19 – Nordic Semiconductor ASA**

We do not see restrictions to latency are necessary. In the end latency will be the time needed to wake-up main radio (dependent on DRX configuration) + configured periodicity of WUR/WUS, so mainly in hands of gNB, anyway.

### **20 – ROBERT BOSCH GmbH**

P7: is important for lower latency application. However, we may not specify in the objective "lower than eDRX".

P8: Leave the latency value to the SI.

### **21 – Sony Europe B.V.**

We agree with the moderator comment and view. We should not limit the latency to any particular value. Both DRX and short eDRX can benefit from LP-WuRX.

### **22 – Verizon UK Ltd**

Again, similar view with MTK.

### **23 – VODAFONE Group Plc**

We see the concept of P7 as important, but feel that 100ms (P8) is far too low. Probably we should target improvements compared to DRX of 2.56s.

### **24 – Intel Corporation (UK) Ltd**

**P7:** Not strictly necessary, but can live with it in the context of the background described in the associated paragraph.

**P8:** We do not see a need to set latency target. Agree with Futurewei, that latency targets may vary with different applications, and can be addressed as part of the study, e.g., as part of identification of use cases and evaluation methodology per following objective:

- Identify use cases, evaluation methodology & KPIs [RAN1]

**25 – Apple Italia S.R.L.**

For P7, we do not agree with the change. The first target of LP WUR is to enable much lower power consumption compared to existing solutions. For delay-insensitive applications, there is no need to require that LP WUR provides lower latency compared to eDRX. With this said, we are not suggesting that latency does not need to be considered, because there are also applications that are delay sensitive.

For P8, we do not agree with the change. It is not clear to us why 100 ms should be the target for idle/inactive UEs. Assuming existing solutions with DRX cycle of 1.28 sec, it is impossible to reach such low latency.

**26 – Nokia France**

Targeting lower latency than eDRX ought to be clear, hence P7 is OK. The exact end-to-end latency target may be difficult to state before the study.

**27 – Philips International B.V.**

The justification section is quite clear that WUS SID aims to achieve low power consumption and low latency (lower than eDRX) so we think there is no need to add further details in the objective. We disagree with P7 and P8.

Proposal: TBD

## 2.4 RRC states

- In RP-213389, it was proposed to focus on IDLE/INACTIVE state for low-power WUS. (P9)

It is moderator’s understanding that applicable RRC states was explicitly discussed during previous round of email discussion and no consensus on the restriction for now. Having said that, companies’ feedback on the proposal above (P9) is welcome.

### Feedback Form 4: Comments on the RRC states

**1 – Futurewei Technologies**

We can decide which the states can be used once the study is completed.

**2 – CATT**

The study of low-power WUS should consider both *RRC\_CONNECTED* and *RRC\_IDLE* states since the low-power WUS is a separated front-end device.

**3 – Spreadtrum Communications**

It may be a decision after the transition time/power is decided.

**4 – MediaTek Inc.**

Given limited study time, we would suggest to focus on idle/inactive states since the corresponding UE operations are simpler. The two states are also like the only RRC states where 1/10 power consumption and 100 ms latency targets can really bring meaningful UE experience difference. In connected-mode, the power consumption is dominated by PDCCH monitoring, and the 100 ms latency target is also too

<p>large. There is risk that the inclusion of connected-mode will make the SI not able to conclude any solution fulfilling the diverse requirements.</p>
<p><b>5 – SHARP Corporation</b></p> <p>P9: Not necessary. No need to restrict the RRC states to be studied.</p>
<p><b>6 – Panasonic Corporation</b></p> <p>We support the proposal.</p>
<p><b>7 – Ericsson LM</b></p> <p><b>Regarding P9</b>, we disagree with the proposed limitation of RRC states and agree with the moderator to keep this open during the SI. (It can be noted that WUR gains will be larger for shorter DRX cycles.)</p>
<p><b>8 – Beijing Xiaomi Mobile Software</b></p> <p>Ok to focus on idle/inactive states. The low power Wus would impact the RRM, so we want to restrict to idle/inactive states first to not impact the handover.</p>
<p><b>9 – LG Electronics Inc.</b></p> <p><b>P9:</b> We tend to agree with the P9 that low-power WUS would be beneficial in idle/inactive mode.</p>
<p><b>10 – Samsung Electronics Polska</b></p> <p>Considering the workload, we think it is reasonable to prioritize IDLE/INACTIVE state.</p>
<p><b>11 – Qualcomm Incorporated</b></p> <p>We would prefer not to limit the scope to idle/inactive but rather also include connected DRX, Therefore, we do not agree with P9.</p>
<p><b>12 – Deutsche Telekom AG</b></p> <p>We don't see a large value in this for Rel-18. In the interest of workload it should be dropped.</p>
<p><b>13 – DOCOMO Communications Lab.</b></p> <p>We think no need to restrict the RRC states, it will be studied during the SI.</p>
<p><b>14 – Huawei Tech.(UK) Co.. Ltd</b></p> <p>It is better to let the feasibility of the RRC states be investigated by WGs before deciding at RAN level.</p>
<p><b>15 – ZTE Corporation</b></p> <p>Considering the TU allocation, we do not think we have enough time to discuss the connected mode. Especially, currently, we do not see any benefits to use LP WUS in connected mode.</p>
<p><b>16 – Lenovo (Beijing) Ltd</b></p> <p>In the SI stage, we are open to consider WUS/WUR in both connected and idle modes and compare with the existing work. With the SI output, we can see whether there is benefit of WUS/WUR for two modes.</p>

<p><b>17 – vivo Communication Technology</b></p> <p>We are open to discuss all the states in the SI.</p>
<p><b>18 – InterDigital Communications</b></p> <p>We disagree with the proposed restriction and think that this should be kept open during the SI.</p>
<p><b>19 – Everactive</b></p> <p>We will note that based on publicly available datasheets from module providers for CAT-M1 and CAT-NB1/2 modules, that the power in PSM mode is typically &lt;10uW, which matches well with a 10uW average power target for a WUR. The power of eDRX mode is typically 100x to 1000x higher than the power in PSM mode, and far exceeds the power budget for the target IoT use cases in this study.</p>
<p><b>20 – Nordic Semiconductor ASA</b></p> <p>We should focus on IDLE/Inactive at first. We believe that considering also RRC connected would almost double the work.</p>
<p><b>21 – ROBERT BOSCH GmbH</b></p> <p>Decide the RRC state during the SI.</p>
<p><b>22 – Sony Europe B.V.</b></p> <p>We are fine to start with idle/inactive. Connected mode can be studied if time allows.</p>
<p><b>23 – Verizon UK Ltd</b></p> <p>Agree with Sony above.</p>
<p><b>24 – Intel Corporation (UK) Ltd</b></p> <p>We can accept focusing on Idle/inactive states since the power saving gain potential may be limited for RRC_CONNECTED state if the main receiver needs to be turned on frequently.</p> <p>Perhaps a note suggesting that Idle/inactive states are prioritized could be added – this would not imply RRC_CONNECTED state is precluded but allow for more practical dimensioning of the time-plan for the SI.</p>
<p><b>25 – Apple Italia S.R.L.</b></p> <p>For P9, we think the interaction with different RRC states can be part of the study.</p>
<p><b>26 – Nokia France</b></p> <p>We do not see a need to limit the applicability of WUS to IDLE/INACTIVE states. All RRC states should be included for the study</p>
<p><b>27 – Philips International B.V.</b></p> <p>We agree with Sony.</p>

– About RRC states: IDLE/INACTIVE, CONNECTED

- Keep it open for study: FUTUREWEI, CATT, Spreadtrum, SHARP, Ericsson, Qualcomm, DOCOMO, Huawei, Lenovo, vivo, InterDigital, ROBERT BOSCH, Sony, Verizon, Apple, Nokia, Philips
- Prioritize IDLE/INACTIVE: MediaTek, Panasonic, Xiaomi, LGE, Samsung, ZTE, Nordic, Intel,

## 2.5 Others

- In RP-212995, it was proposed that the study on WUS procedures is not just about the detection of WUS, but the overall function. Following changes are proposed
  - Study and evaluate L1 procedures and higher layer protocol changes needed to support the ~~detection of~~ wake-up signals [RAN2, RAN1] (P10)
- In RP-213389, it was proposed to add the following sentence to the 2nd paragraph of objective section 4.1
  - The impact on network (e.g., network capacity) and legacy UE (e.g., coexistence with legacy UE) should be minimized. (P11)

Moderator thinks the proposal made in RP-212995 above make sense. The intention of proposal made in RP-213389 above is understandable, but it seems the current 5th sub-bullet of objectives has already covered that.

- Study potential system impact, such as network power consumption, **coexistence with non-low-power-WUR UEs, network coverage/capacity**, latency, and gains compared to the existing Rel-15/16/17 UE power saving mechanisms [RAN1, RAN2]

Having said above, companies' feedback on the proposals above are welcome. Please indicate explicitly if you agree or disagree any of the proposals (P10/P11) from the contributions list above.

If you have any other comments to the SID, please also indicate in the feedback form below.

### Feedback Form 5: Other comments

<p><b>1 – Futurewei Technologies</b></p> <p>P10: the proposed change is acceptable</p> <p>P11: not needed as the existing 5th subbullet is sufficient</p>
<p><b>2 – CATT</b></p> <p>We are OK with the proposed change in P10 and P11.</p>
<p><b>3 – Spreadtrum Communications</b></p> <p>For removing "detection of", we are fine for it.</p> <p>For impact to the existing network, we think it has been included.</p>

**4 – MediaTek Inc.**

In addition to coexistence and network capacity, we suggest to include “system overhead” as part of the study. There is fundamental trade-off between receiver sensitivity and receiver power consumption, and RAN groups should figure out a useful solution to enable ultra-low-power WUR & WUS with minimum system overhead. Otherwise, the study outcome may never be specified or deployed in real networks.

**5 – SHARP Corporation**

P10: OK to remove ”detection of”.

P11: agree with moderator that it has been covered by the current objectives.

**6 – Panasonic Corporation**

We agree P10 and P11.

**7 – Ericsson LM**

**Regarding P10**, we agree with the proposed change. (Perhaps it might also be good to mention whether WUR may have other functionalities than detecting WUS.)

**Regarding P11**, we agree with the moderator’s view that it already seems to be covered in the draft SI objective.

**8 – Beijing Xiaomi Mobile Software**

P10: ok.

P11: Agree companies that it has been included in the SID.

**9 – LG Electronics Inc.**

**P10:** We are ok with the proposed update.

**P11:** We have similar view with the moderator. The 5th sub-bullet covers the intention of P11

**10 – Samsung Electronics Polska**

Fine with P10. Agree with moderator that P11 has been covered.

**11 – Qualcomm Incorporated**

We agree with P10.

We also agree with P11 in principle; however, as the moderator has pointed it out, this is already captured.

**12 – DOCOMO Communications Lab.**

P10: agree with this proposal.

P11: agree with moderator that it has been included in the current objectives.

**13 – Huawei Tech.(UK) Co.. Ltd**

We support P10. P11 is already covered.

**14 – ZTE Corporation**

For P10, we are OK with the revision.

For P11, study items in objectives only focus on what should be studied. The concern on NW impact and UE are not addressed. If the NW impact and UE impact are quite large, LP WUS is also not preferred to be introduced in the NW. Therefore, P11 is needed.

**15 – Lenovo (Beijing) Ltd**

We are OK for update from P10 and P11.

**16 – vivo Communication Technology**

We agree to P10.

For P11, we think it has already been covered in the draft SI objective.

**17 – Everactive**

We agree with P10.

We will add that the original intent of studying the advantages of a WUR beyond WUS detection was meant to include things like offloading other networking functions, beyond simply wakeup of a device to receive data.

For example, the WUR could help keep a low-power device synchronized to the network, or help keep its local timing reference synchronized, similar to how broadcast channels are used now (however BCCH currently require the main, higher-power receiver).

For P11 - replace “minimized” with “studied”. Zero impact is impossible assuming these are sharing the same frequency bands.

**18 – Nordic Semiconductor ASA**

P10 OK

P11 Not OK, again impact to legacy will be one of many trade-offs to consider when selecting design.

**19 – ROBERT BOSCH GmbH**

We agree with P10.

P11 is covered.

In the other, we want to stress as well on minimizing the overhead.

**20 – Sony Europe B.V.**

We are fine to remove ”detection of” from P10.

Regarding P11, we agree with the moderator that P11 has already been addressed in the existing objectives.

**21 – VODAFONE Group Plc**

P10 is important -> previous LTE-WUS, LTE-GWUS and NR PEI have all ignored the system impacts of wake up signals. It would be good that RAN did not repeat this for a 4th time!

## 22 – Intel Corporation (UK) Ltd

**P10:** OK

**P11:** Not necessary. Already captured as a metric of interest in following objective.

- Study potential system impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity, latency, and **[power saving]** gains compared to the existing Rel-15/16/17 UE power saving mechanisms [RAN1, RAN2]

## 23 – Apple Italia S.R.L.

We support P10.

For P11, we agree that overhead should be considered, but we also think it is already covered as part of capacity.

## 24 – Nokia France

P10 is OK. For P11, also the impact on network power consumption should be minimized.

## 25 – Philips International B.V.

We agree with the moderator about P10. Studying the implications at higher layer is as important as studying L1.

We agree with the moderator in that P11 is already covered by existing SID.

Proposal: TBD

## 2.6 Summary of the initial round discussion

Thanks for all the inputs in the initial round, Please find a summary as below.

Use cases:

- Many companies mentioned that use cases related to RedCap devices are more relevant for this SI. There were wide support to add wearables to the exemplary use case list. Several companies proposed to move the text on use cases to the justification section.
- There was no consensus to delete the RedCap SI/WI from the list of related work items from Section 2.3
- Proposal: Add ”wearables” to the exemplary use case list and move the following text on use cases to the justification section.
  - The study should primarily target low-power WUS/WUR required by IoT use cases, i.e., power-sensitive, small form-factor devices such as industrial sensors, controllers or **wearables**. Other use cases are not precluded.

Power saving gain

- Most companies were fine to add one dedicated objective on the evaluation of UE power saving gain. To minimize the changes, a revision is proposed to the last bullet of objectives

- Regarding power saving target, many companies think it should be the outcome of the SI and will be used as the criteria to justify the follow-up work item. At current stage it seems difficult to agree on a specific target beyond "Solutions should give justifiable gains compared to the existing Rel-15/16/17 UE power saving mechanisms." As middle ground, some text in the justification section might be considered, but no proposal has been made currently. Further companies' input in the intermediate round are welcome.
- Proposal: Revise the following objective
  - Study potential **gains and** system impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity, latency, and **UE power saving** gains compared to the existing Rel-15/16/17 UE power saving mechanisms [RAN1, RAN2]

#### Wake-up latency

- It was pointed out that mentioning eDRX would imply that the study being restrictive to IDLE/INACTIVE state, however, many companies did not agree with such restriction before the study.
- It seems difficult to define a common latency target without entering into the details of each use case, since the required wake-up latency could be use case specific.
- No proposal can be made.

#### RRC states:

- More companies prefer to not restrict the study to IDLE/INACTIVE state only, this is the same situation as in October email discussion. No proposal can be made.

#### Others:

- Following revision is generally agreeable
  - Study and evaluate L1 procedures and higher layer protocol changes needed to support the ~~detection of~~ wake-up signals [RAN2, RAN1]
- As commented by most companies, similar text exists already for system impact, such as network power consumption and capacity, impact on legacy UEs, etc.

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## 3 Week1-Intermediate round

Based on the initial round of discussion, an updated version of draft SID (v1) has been available in [https://www.3gpp.org/ftp/tsg\\_ran/TSG\\_RAN/TSGR\\_94e/Inbox/Drafts/%5B94e-12-R18-LowPowWUS%5D/ RP-21xxxx%20Draft%20SID%20on%20low-power%20WUS%20WUR%20-%20v1.docx](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5B94e-12-R18-LowPowWUS%5D/ RP-21xxxx%20Draft%20SID%20on%20low-power%20WUS%20WUR%20-%20v1.docx)

Please provide your comments to the latest version in the feedback forms below.

## Feedback Form 6: Comments to the justification section

<p><b>1 – SHARP Corporation</b></p> <p>We are fine with the justification section in v1.</p>
<p><b>2 – Samsung Electronics Polska</b></p> <p>Support the justification part, including newly added the use cases.</p>
<p><b>3 – ZTE Corporation</b></p> <p>ZTE: we are OK with the justification update.</p>
<p><b>4 – Spreadtrum Communications</b></p> <p>Fine for it.</p>
<p><b>5 – Huawei Tech.(UK) Co.. Ltd</b></p> <p>The justification is fine.</p>
<p><b>6 – CAICT</b></p> <p>We are fine.</p>
<p><b>7 – Guangdong OPPO Mobile Telecom.</b></p> <p>We support the use case of wearable.</p>
<p><b>8 – Everactive</b></p> <p>We agree with the proposed changes to the justification.</p>
<p><b>9 – Futurewei Technologies</b></p> <p>OK with the changes to the justification</p>
<p><b>10 – MediaTek Inc.</b></p> <ul style="list-style-type: none"><li>- We are supportive in including "wearable" as one use case.</li><li>- For the paragraph with example of "fire sprinklers", we still have concern on the last sentence, "Thus, the intention is to study ultra-low power mechanism with <b>low latency</b> in Rel-18", since having shorter latency than eDRX doesn't mean low latency for us. Instead, we would suggest the following revision:<ul style="list-style-type: none"><li>o "Thus, the intention is to study ultra-low power mechanism with <b>shorter latency than eDRX</b> in Rel-18"</li></ul></li></ul>
<p><b>11 – Apple Italia S.R.L.</b></p> <p>Even though our preference is not to explicitly limit to particular use cases for the study, we are fine to go with the majority view.</p> <p>We are generally fine with the justification section.</p>

On the sentence "the intention is to study ultra-low power mechanism with **low latency** in Rel-18", we would like to propose to change it to "the intention is to study ultra-low power mechanism **that can support low latency** in Rel-18". The subtle difference is that the original wording seems to imply that the LP WUR always results in low latency, and the suggested wording means that one of the modes for LP WUR can be used to support low latency. If we go with MTK's wording, it becomes "the intention is to study ultra-low power mechanism **that can support shorter latency than eDRX** in Rel-18".

#### **12 – Intel Corporation (UK) Ltd**

We are fine with the latest version for justification section.

#### **13 – CATT**

We are OK to move the target cases for IoT from Objective to Justification. However, our suggestion of modification as follows,

The study should ~~primarily~~ target low-power WUS/WUR ~~required~~ by IoT use cases, i.e., power-sensitive, small form-factor devices such as industrial sensors, controllers or wearables. Other use cases are not precluded.

#### **14 – Ericsson LM**

We are fine with the proposed SID changes.

#### **15 – Qualcomm Incorporated**

As it was discussed before, the use of WUS is not intended to be limited to idle/inactive states. To better align with this, we suggest the following change in the justification:

*“Currently, UEs need to periodically wake up once per DRX cycle, which dominates the power consumption in RRC idle/inactive state periods with no signalling or data traffic.”*

In line with our previous comment, we would prefer to make the following change.

*“The study should primarily target low-power WUS/WUR ~~required by IoT use cases, i.e., for power-sensitive, small form-factor devices such as industrial sensors, controllers or wearables,~~ smart/XR glasses. Other use cases are not precluded.”*

Otherwise, we are fine with the justification.

#### **16 – ROBERT BOSCH GmbH**

We are fine with the SID. We may safely remove IoT use cases.

#### **17 – Sony Europe B.V.**

We are fine with the justification section in the updated version.

#### **18 – Philips International B.V.**

Fine with the latest version

## Feedback Form 7: Comments to the objective section

### 1 – SHARP Corporation

We are fine with the objective section in v1.

### 2 – Samsung Electronics Polska

Suggest to further modify the last bullet, as RAN2 is not supposed to evaluate the gain and system impact given the RAN2 TU allocation, and the fourth bullet already listed the impact to the higher layer protocol changes, so RAN2 can be removed here:

- Study potential **power saving** gains, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity, **and** latency, **and ~~UE power saving gains~~** compared to the existing Rel-15/16/17 UE power saving mechanisms [RAN1, ~~RAN2~~]

### 3 – Samsung Electronics Polska

One more comments:

In our understanding, RAN 4 can be involved on the WUR study and evaluation. However, WUS design belongs to RAN 1 study. We would like to delete RAN 4 for the WUS design bullet, to reduce the unnecessary workload for RAN 4:

- Study and evaluate wake-up signal designs to support wake-up receivers [RAN1, ~~RAN4~~]

### 4 – ZTE Corporation

The motivation for the following change in the objective part should be clarified.

- All WUS solutions identified shall be able to operate in a cell supporting legacy UEs ~~shall be fully backward compatible~~

From our understanding, any WUS solution identified shall have minimized impacts on legacy UE and network. Based on the FL's modification, we understand the WUS solution have the possibility to seriously affect legacy UE since the requirement for the WUS solution is only that the cell can support the legacy UE regardless how serious the impact is. Moreover, the NW impact is not mentioned for the identified WUS solution. We can not accept the WUS solution has the serious impact on the NW. Therefore, the following change is required.

- All WUS solutions identified shall be able to operate in a cell **with minimized impacts on supporting legacy UEs and being back compatible with the NW.**

Additionally, for the last bullet, it looks like latency and UE power saving gains belongs to system impacts. From our understanding, latency, and UE power saving gains can be the potential gains by introducing LP WUS for the UE side, instead of NW side. Therefore, we think the following modification is clearer.

- **Study potential UE power saving gains compared to the existing Rel-15/16/17 UE power saving mechanisms, latency and system impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity. [RAN1, RAN2]**

## 5 – Spreadtrum Communications

Basically supportive.

The power saving gain is described in the first paragraph in the objective part, i.e. "Solutions should give justifiable gains compared to the existing Rel-15/16/17 UE power saving mechanisms. Aspects such as UE power consumption, detection performance, coverage, UE complexity, should be covered by the evaluation". So, it may not necessarily to be repeated in the last objective. The last objective can focus on the system impact.

## 6 – Huawei Tech.(UK) Co.. Ltd

The objectives are OK, although the duplicate mention of power saving gain over Rel-15/16/17 is not necessary.

On the legacy UE/backwards compatible wording, the current version seems suitable, because if the impact of a particular design is too high, the WGs will discard that solution for being not operable in practice (or, if there is a higher impact solution included, a later RAN would consider excluding it from a normative WID). In fact, this whole sentence, in either wording, does not add much to the SID, since it really described business-as-usual for the WG discussions in an SI. Perhaps it can simply be removed.

## 7 – CAICT

We are fine with the latest version.

## 8 – Guangdong OPPO Mobile Telecom.

Generally fine with the intention. However, the gains should compare to R16. The impact should be directly study, not compared.

"Study potential system impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity and latency[RAN1, RAN2]

Study potential **UE power saving** gains compared to the existing Rel-15/16/17 UE power saving mechanisms [RAN1, RAN2]"

## 9 – Everactive

We generally agree with the proposed changes. However, we feel comparing power saving gains to prior releases, e.g. Rel 15/16/17, is not aggressive enough. We prefer the wording that the **power gains make a meaningful impact on the floor power of the UE for the intended use cases**. This will hopefully result in an absolute target spec, rather than something relative to prior releases (that did NOT assume UE's have an ultra-low power WUR). This is an opportunity for us to redefine what "low power" means for a UE.

Regarding network impact, we don't like the term "minimized". We will reiterate that it is impossible for there to be zero impact assuming the WUS is operating in the same cell as other legacy networks. This SI must study the impact on the network for any proposed WUS/WUR solutions. This SI must also study the impact on power savings, which would be used to justify any finite amount of network impact, no matter how small.

We agree with the moderators conclusion on latency and RRC state.

## 10 – Futurewei Technologies

OK with the objectives

### 11 – Apple Italia S.R.L.

We are fine with the objectives.

### 12 – Intel Corporation (UK) Ltd

We are fine with the latest version of the objectives.

### 13 – Nokia France

The last bullet still seems to be causing some confusion. We suggest to rewrite it as follows:

- Studies and evaluations shall include:
  - o impact on network power consumption
  - o coexistence with non-low-power-WUR UEs
  - o impact on network coverage/capacity
  - o latency
  - o UE power saving gains compared to the existing Rel-15/16/17 power saving mechanisms
  - o identifying the conditions under which the gains may be achieved.

Regarding the involvement of RAN4 in the study of wake-up signal designs, we believe it is very important that RAN4 is involved to ensure that aspects within RAN4's expertise are taken into account, such as the impacts of A-MPR.

### 14 – MediaTek Inc.

For the first paragraph of the objective section, we have the following suggestion:

- The updated sentence, "All WUS solutions identified shall be able to operate in a cell supporting legacy UEs" is vague. The objective should target "All WUS solutions identified **should not impact legacy UE operations**"
- The sentence on power saving gain, "Solutions should give justifiable gains compared to the existing Rel-15/16/17 UE power saving mechanisms", is a vague target, and we have concern duplicated functionality to R17 PEI may be allowed with this target. To avoid this, we suggest to set a high bar for the study to come out distinguished solution. Accordingly, the following revision is suggested: "Solutions should give **justifiable substantial (at least [80%]) UE power saving** gains compared to the existing Rel-15/16/17 UE power saving mechanisms"

Note: 80% power saving is suggested in Ericsson's 1st round comment, and we think this can be a starting point.

For the objective part, we have concern on "Identify use cases" since this looks to allow any design by identifying a use case for it. Current wearable and IOT uses cases should be very sufficient with clear understanding of their requirements. In this regard, we would suggest to remove "use case" for the 1st bullet. The last bullet updated looks to define the KPIs for the study, and we would suggest to merge it with 1st bullet of KPIs. Consequently, the following revision to the first bullet is suggested:

- Identify ~~use cases~~, evaluation methodology & KPIs [RAN1]

- **KPIs include at least UE power saving gain and latency increment, compared to the existing Rel-15/16/17 UE power saving mechanisms, impact to legacy UEs, and system impacts, including increased resource overhead and reduced coverage and capacity with low-power wake-up receivers**

**15 – Ericsson LM**

We are fine with the propose SID changes.

**16 – Qualcomm Incorporated**

Agree with the objectives

**17 – ROBERT BOSCH GmbH**

Agree

**18 – Sony Europe B.V.**

At least in the wearables use case, the device can be mobile. The study should also include how mobility and measurements are handled when there is a low power WUS, since the power saving gain may be limited if the low power WUR capable device had to rely on legacy mobility and measurement procedures. While it could be understood that mobility and measurement procedures are handled under the “L1 procedures and higher layer protocols” objective, we think it would be good to be more explicit about this aspect. Hence, we propose to add an objective:

- study and evaluate changes to mobility and measurement procedures to support the wake-up signals [RAN2, RAN1]

**19 – Philips International B.V.**

Fine with the latest version

**Feedback Form 8: Any other comments to the SID, e.g. cover page, timeline, TR, etc.**

**1 – Panasonic Corporation**

We support the proposal and would like to be supporting company.

**2 – vivo Communication Technology**

Moderator Similar as Panasonic comment above, please indicate here if you would like to support the SID, Moderator will collect the information and update the supporting list in the next version. Thank you!

**3 – Samsung Electronics Polska**

Suggest to also include Rel-16 power saving, i.e. 830075 UE Power Saving in NR.

**4 – ZTE Corporation**

Agree Samsung’s suggestion.

<p><b>5 – Spreadtrum Communications</b></p> <p>Please add Spreadtrum into the supporting list. Thanks.</p>
<p><b>6 – CAICT</b></p> <p>We can support the SID and would like add CAICT into the supporting list.</p>
<p><b>7 – Guangdong OPPO Mobile Telecom.</b></p> <p>Ok with Samsung suggestion □ Rel-16 have SI and WI.</p>
<p><b>8 – InterDigital Communications</b></p> <p>We support the SID and can be added to the list. Thanks!</p>
<p><b>9 – Everactive</b></p> <p>We support the SID, please add Everactive to the list.</p>
<p><b>10 – Futurewei Technologies</b></p> <p>Please add FUTUREWEI to the supporting list</p>
<p><b>11 – Apple Italia S.R.L.</b></p> <p>Please add Apple to the supporting list</p>
<p><b>12 – CATT</b></p> <p>We are OK with the Objective. Please include CATT as the supporting company</p>
<p><b>13 – MediaTek Inc.</b></p> <p>Use of "low-power wake-up signal/receiver" may confuse companies since R16 and R17 power saving work both specify low-power wake-up designs. We would suggest to use "ultra-low-power" so as to distinguish the study outcome.</p>
<p><b>14 – ROBERT BOSCH GmbH</b></p> <p>We suggest to add that WUS/WUR design is unified for all 3GPP UEs (including Uu and PC5 interface).</p>
<p><b>15 – Qualcomm Incorporated</b></p> <p>Please add Qualcomm as supporting company.</p> <p>A minor comment but we would prefer not to use the slash character ("/") in the title of the TR because this can cause problems when using the title in the name of files. Therefore, we suggest the following editorial change: <i>"Study on low-power wake up signal <u>+</u> and receiver for NR"</i></p>
<p><b>16 – Sony Europe B.V.</b></p> <p>Please add Sony to the supporting list.</p>

## 17 – Philips International B.V.

Please add Philips to list of supporting companies

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## 4 Week1-Final round

Thanks all for the good suggestions during the intermediate round. Further updated SID is available in [https://www.3gpp.org/ftp/tsg\\_ran/TSG\\_RAN/TSGR\\_94e/Inbox/Drafts/%5B94e-12-R18-LowPowWUS%5D/RP-21xxxx%20Draft%20SID%20on%20low-power%20WUS%20WUR%20-%20v2.docx](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5B94e-12-R18-LowPowWUS%5D/RP-21xxxx%20Draft%20SID%20on%20low-power%20WUS%20WUR%20-%20v2.docx)

Changes can be summarized as

### Justification:

- Following changes are made to address the comments by MediaTek, Apple and ZTE (in the initial round), note that eDRX is taken as an example so that it does not restrict the study to eDRX operation only (as concerned by several companies in the initial round)
  - Thus, the intention is to study ultra-low power mechanism that can support low latency in Rel-18, e.g. lower than eDRX latency.
- Following changes are made according to the suggestion from Qualcomm
  - Currently, UEs need to periodically wake up once per DRX cycle, which dominates the power consumption in periods with no signalling or data traffic
- Changes are made for the last paragraph on use cases, as suggested by Qualcomm, CATT. The emphasis on IoT use cases is kept, since the current formulation is a compromise reached from previous rounds of discussions.

### Objectives:

- Replace "justifiable gains" by "substantial gains" as suggested by MediaTek. The other suggestion to include "80% power saving gain" was not taken as concerned by many companies in the initial round, such quantitative values should be the outcome of the SI, and normally we do not have such statement in a study item (e.g. looking at all the SIDs being prepared for Rel-18). However, "substantial gains" should reflect the spirit already. Hopefully this can also address the comment from Everactive.
- The last objective was rephrased as below with RAN2 removed and resource overhead added, based on the comments from Samsung, OPPO, ZTE, Nokia etc, Nokia's proposal "identifying the conditions under which the gains may be achieved." was not taken as it is business as usual that performance gain is evaluated based on certain condition, e.g. scenarios and associated set of assumptions, which will be discussed during the SI. This bullet can also covers the list of KPIs as proposed by MediaTek.
  - Study potential UE power saving gains and latency, compared to the existing Rel-15/16/17 UE power saving mechanisms. System impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity/resource overhead should be included in the study [RAN1]

- MediaTek commented about "use cases". As discussed before, the use cases for WUS/WUR can be diverse, including different application types and RRC states, the evaluation assumptions and KPIs may also be use case dependent. So it will be useful to discuss the use cases.
- ZTE and MediaTek commented about "shall be able to operate in a cell supporting legacy UEs". In moderator's understanding, it means NW shall be able to operate the legacy UEs and WUS/WUR in the same cell. It is quite obvious that introduction of new features in 3GPP cannot affect legacy UE operations so no need to state that. The system performance impacts to NW or legacy UEs will be studied as stated in the last objective bullet, WG will find a good trade-off between UE gains v.s. system performance impacts, which is business as usual.
- Samsung proposal to remove RAN4 from the objective "Study and evaluate wake-up signal designs..." was not taken given the concern expressed by Nokia.
- Sony commented about the mobility aspects, it is moderator's understanding that mobility aspects can be covered by the following generic objective
  - Study and evaluate L1 procedures and higher layer protocol changes needed to support the wake-up signals [RAN2, RAN1]

**Others:**

- Add Rel-16 UE power saving SI and WI as related projects in section 2.3 (suggested by Samsung, OPPO)
- Replace "/" by "and" for the TR name, as suggested by Qualcomm
- Supporting company list updated
- Respond to ROBERT BOSCH GmbH: From the previous discussion, the SID focuses on the WUS/WUR for NR Uu and TU allocation is very small. Extension this feature to other interfaces, e.g. PC5, LTE can be discussed in future releases when necessary.

The aim of final round discussion is to address remaining concerns to the latest version (v2), please use the following feedback form for the purpose. Repeating the same discussion as in previous round is strongly discouraged.

**Feedback Form 9: Any remaining concerns to the SID (v2)?**

**1 – Spreadtrum Communications**

Thanks for revision. Regarding text in the first paragraph in the objective part "Aspects such as UE power consumption, detection performance, coverage, UE complexity, should be covered by the evaluation", we think "detection" is ambiguous and has been deleted in the other place, and coverage has been included in the Objective 5, i.e. "network coverage/capacity/resource overhead". Therefore, we suggest:

**Aspects such as UE power consumption, ~~detection~~ reception performance, coverage, and UE complexity, should be covered by the evaluation.**

**2 – Beijing Xiaomi Mobile Software**

We are generally fine with the current version. Please adding Xiaomi as the supporting company.

### 3 – Qualcomm Incorporated

No remaining concerns from us.

### 4 – Lenovo (Beijing) Ltd

It is ambiguous for “Thus, the intention is to study ultra-low power mechanism that can support low latency in Rel-18, e.g. lower than eDRX latency”. Does it mean lower than eDRX period? Or lower than delay in case configured with (long) eDRX?

### 5 – Transsion Holdings

We are fine with the latest version.

### 6 – ZTE Corporation

Some minor suggestions

1. If we have the consensus that no intention to change the legacy UE operation, to be more clearer,

- All WUS solutions identified shall be able to operate in a cell supporting legacy UEs **and legacy UEs are not expected to be affected by the WUS solution.**

2. For the last bullet, seems that the latency impact evaluation would be based on the existing Rel-15/16/17 UE power saving mechanisms. Based on the moderator’s update, a further adjustment can be considered:

- Study potential UE power saving gains ~~and latency impact~~, compared to the existing Rel-15/16/17 UE power saving mechanisms, latency impact, and System impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity/resource overhead should be included in the study [RAN1]

### 7 – Samsung Electronics Polska

We can accept current version.

We think ”latency”, ”coverage”, ”detection performance” should be kept.

### 8 – vivo Communication Technology

Moderator

@Lenovo, the latency of eDRX is dominated by long eDRX cycle, that is why eDRX cannot meet the latency requirement for some latency sensitive applications.

@ZTE, Yes the WUS/WUR should be transparent to legacy UEs, however, the performance (e.g. throughput) of legacy UEs may or may not be affected due to WUS/WUR, that is why we need to study the system impact including the co-existence with legacy UEs. Your 2nd revision will be reflected in the next version.

### 9 – Guangdong OPPO Mobile Telecom.

We agree the updating.

### 10 – ROBERT BOSCH GmbH

Ok, we are fine with the comment and we accept the current wording.

### 11 – Huawei Tech.(UK) Co.. Ltd

We think no further changes to the text make any substantive technical difference, and it should be now regarded as stable. The attempts to add a-priori constraints may prove counterproductive before the WGs have looked into the topic, and they should instead be left to work at the level of constraint they agree to be needed.

### 12 – Futurewei Technologies

It updated SID looks good; no need for further edits.

### 13 – Sony Europe B.V.

We are fine with the current version of the SID.

### 14 – Nokia France

Thank you to the Moderator for the good finetuning of the SID.

Regarding our proposal in the intermediate round to include identifying the conditions under which gains may be achieved, we need to highlight the rather important difference between evaluating performance gain in a certain discrete set of conditions, and identifying the range of conditions under which any gains may be achievable. Specifically for this SI, it is necessary to identify the coverage proportion where a WUS may be useful. As a way forward, we could propose the following simple change to the final bullet:

”Study potential UE power saving gains and their corresponding coverage availability, as well as latency impact, compared to...”

We hope this is clearer than our previous proposal.

### 15 – MediaTek Inc.

Current version of SID is evolved toward up-scoping, which makes us worry about the conflict with limited TU budget. For a practical project planning, we would suggest the following updates:

- Use case should be consolidated instead of keeping expanded:
  - o The use cases in Justification are effectively expanded in moderator’s update. Now, XR and smart phones are considered. Given the very diverse requirements for IOT, wearable, XR and smart phones, we cannot understand how this study can still fit in the TU budget considering considering IOT use case in the original draft SID. **Keeping only IOT and wearable use cases in the justification should be a reasonable compromise for an executable SI.**
  - o With expanded use cases, the objective further includes ”identify use cases”, which even worsen the conflict with limited TU budget. Therefore, we suggest to **remove ”use cases” in 1st bullet of Objective**
- Instead of expanding the use cases, the SID should define more stringent power consumption and latency target so as to effectively accommodate more uses cases. In this regard, we suggest the following to the first paragraph of the Objective
  - o ”Solutions should ~~give target~~ **substantial (e.g. at least 80%) power saving gains and limited latency increment (e.g. less than 100 ms)** compared to the existing Rel-15/16/17 UE power saving mechanisms.”

Note: We use ”target” instead of ”give” to avoid hard thresholds on power saving gain and latency increment

- Additionally, in first paragraph of Objective,

- "All WUS solutions identified shall be able to operate in a cell supporting legacy UEs" looks very ambiguous. If we have "coexistence with legacy UEs" as one KPI, we may not need the ambiguous sentence
- The sentence, "Aspects such as UE power consumption, detection performance, coverage, UE complexity, should be covered by the evaluation.", looks to suggest KPIs and also overlapping with last bullet of Objective.

By the above, we would suggest the following overall revision to the Objective part:

"As opposed to the work on UE power savings in previous releases, this study will not require existing signals to be used as WUS. ~~All WUS solutions identified shall be able to operate in a cell supporting legacy UEs.~~ Solutions should **give target** substantial (e.g. at least 80%) power saving gains and **limited latency increment (e.g. less than 100 ms)** compared to the existing Rel-15/16/17 UE power saving mechanisms. ~~Aspects such as UE power consumption, detection performance, coverage, UE complexity, should be covered by the evaluation.~~

The study item includes the following objectives:

- Identify ~~use cases~~, evaluation methodology & KPIs [RAN1]
  - **KPIs includes UE power saving gains and latency impact, compared to the existing Rel-15/16/17 UE power saving mechanisms, low-power WUS detection performance and complexity, and system aspects, such as coexistence with non-low-power-WUR UEs and legacy UEs, network coverage/capacity/resource overhead for low-power-WUR UEs**
- Study and evaluate low-power wake-up receiver architectures [RAN1, RAN4]
- Study and evaluate wake-up signal designs to support wake-up receivers [RAN1, RAN4]
- Study and evaluate L1 procedures and higher layer protocol changes needed to support the wake-up signals [RAN2, RAN1]
- ~~Study potential UE power saving gains and latency impact, compared to the existing Rel-15/16/17 UE power saving mechanisms. System impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity/resource overhead should be included in the study [RAN1]~~"

Note: Since resource overhead can also be represent network energy consumption, we therefore remove network energy consumption from KPIs to avoid overloaded evaluations, particularly considering the limited TU budget.

#### 16 – Apple Italia S.R.L.

We are generally fine with the updated version.

Just one comment: it may be a bit ambiguous whether wearable belongs to IoT use cases or not. Therefore we would like to suggest the following change:

"The study should primarily target low-power WUS/WUR for ~~IoT use cases, i.e.~~, power-sensitive, small form-factor devices such as industrial sensors, controllers or wearables. Other use cases are not precluded, e.g. XR/smart glasses, smart phones."

#### 17 – Intel Corporation (UK) Ltd

We're fine with the latest version from the moderator.

#### 18 – VODAFONE Group Plc

Thanks for the updates.

a) We would prefer stringent targets (e.g. 80% power reduction and no more than 100ms increase in paging latency) to be included.

b) We really ought to indicate that SA is likely to be impacted (it was with WUS, GWUS and PEI, so why not with this work?)

**19 – Ericsson LM**

We agree with the proposed changes to both the justification and the objective, except the removal of RAN2 for the UE power saving bullet. We think including RAN2 in the power saving evaluations will lead to more accurate estimates of the gains compared to legacy, taking the full procedure in to account (and not just the WUR power in one slot). Further, since the bullet also includes capacity and overhead, we think RAN2 still must be listed.

**20 – Philips International B.V.**

No remaining concerns from us

And if you would like to support the SID, please indicate in the following feedback form

**Feedback Form 10: Please indicate if you would like to support the SID**

**1 – Spreadtrum Communications**

Fine

**2 – CAICT**

Support

**3 – SHARP Corporation**

Please add "SHARP" as a supporting company.

**4 – DOCOMO Communications Lab.**

Please add NTT DOCOMO as the supporting company.

**5 – Lenovo (Beijing) Ltd**

Please add Lenovo, Motorola Mobility as supporting company.

**6 – Transsion Holdings**

We Transsion would like to be the supporting company

**7 – CEWiT**

Please add CEWiT as the supporting company.

**8 – ZTE Corporation**

Thanks for the FL's efforts. We are happy to co-source as adding the "ZTE Corporation" and "Sanechips" to the supporting list.

<p><b>9 – Samsung Electronics Polska</b></p> <p>Samsung would like to be the support company.</p>
<p><b>10 – Guangdong OPPO Mobile Telecom.</b></p> <p>OPPO supports.</p>
<p><b>11 – ROBERT BOSCH GmbH</b></p> <p>Please add Robert Bosch GmbH as a supporting company</p>
<p><b>12 – Huawei Tech.(UK) Co.. Ltd</b></p> <p>Both Huawei and HiSilicon co-sign, thanks.</p>
<p><b>13 – Sony Europe B.V.</b></p> <p>SONY is currently listed as a supporting company and we would like to remain in the list of supporting companies.</p>
<p><b>14 – Nokia France</b></p> <p>Please add Nokia and Nokia Shanghai Bell. Thank you.</p>
<p><b>15 – Intel Corporation (UK) Ltd</b></p> <p>Please add Intel as a supporting company. Thanks!</p>
<p><b>16 – VODAFONE Group Plc</b></p> <p>Vodafone can support.</p>
<p><b>17 – Ericsson LM</b></p> <p>Please add Ericsson as a supporting company.</p>
<p><b>18 – Philips International B.V.</b></p> <p>Please add Philips as a supporting company for this WID</p>

Thanks all for the contribution in the SID. Summary of the final round discussion as below

- On justification part, there was no good reason to delete other exemplary use cases as it has been clear from the October discussion that the low-powe WUS/WUR solution should be applicable to both IoT and non-IoT use cases. So no change was made.
- On objective part:
  - Revision based on comments from MediaTek and Vodafone, ”e.g. at least 80% power saving gain” was put in [], Chair’s decision is needed on whether to keep or remove this part. Proposed text ”and limited latency increment (e.g. less than 100 ms)” was clearly not agreeable by several other companies from previous round thus not taken.
    - Solutions should **target** substantial gains [(e.g. at least 80% power saving gain)] compared to the existing Rel-15/16/17 UE power saving mechanisms.

- Delete "use cases" in the 1st objective as suggested by MediaTek. Moderator actually think it is fine to keep it but given no other company shared their view on deletion or keep, so it was deleted.
- The last objective was revised according to the suggestion by ZTE and Nokia. RAN2 was added back as suggested by Ericsson, indeed some evaluation has to involve RAN2, e.g. latency.
  - Study potential UE power saving gains compared to the existing Rel-15/16/17 UE power saving mechanisms **and their coverage availability, as well as latency impact**. System impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity/resource overhead should be included in the study [RAN1, RAN2]
- Other proposed changes to remove some redundant or merge the last objective into the first objective were not taken as there is no essential difference with or without such changes, and 30+ companies has support the current formulation.
- "shall be able to operate in a cell supporting legacy UEs" seems clear for most of companies, so was kept.
- Regarding SA impact as commented by Vodafone, given it is a full release study, the interaction with SA is very unclear at this point. So selected "don't know" for now. We can revisit this issue later when the study becomes clearer.
- Revision based on
  - Other editorial changes
  - Supporting company list updated

Final SID will be uploaded in RP-213563, with one yellow highlighted part to be decided by Chair.

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## 5 Week2-Initial round

Based on the discussion last friday, a new update SID (-v5) is available in [https://www.3gpp.org/ftp/tsg\\_ran/TSG\\_RAN/TSGR\\_94e/Inbox/Drafts/%5B94e-12-R18-LowPowWUS%5D/RP-21XXXX%20New%20SID%20on%20low-power%20WUS%20WUR%20for%20NR-%20v5.docx](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_94e/Inbox/Drafts/%5B94e-12-R18-LowPowWUS%5D/RP-21XXXX%20New%20SID%20on%20low-power%20WUS%20WUR%20for%20NR-%20v5.docx)

with change marks compared with last version (RP-213563) shown.

- The sentence about use cases was modified to be more accurate as proposed by Apple
- Based on the discussion, inclusion of "[e.g. at least 80% power saving gain]" was not agreeable at this point. Instead, the following changes can be made to clarify what would be the expectation of the "gains"
  - "Solutions should target substantial gains compared to the existing Rel-15/16/17 UE power saving mechanisms, where the gains may include UE power saving and/or lower latency."
- Based on the comments from MediaTek, the following changes were made to to give some clear focus for the use case and KPI
  - "Identify use cases to focus, evaluation methodology & KPIs [RAN1]
    - Prioritize IoT and wearable use cases.
    - The KPIs include at least UE power consumption, coverage and wake-up latency."

- Remove RAN2 from the last objective as suggested by Samsung and MediaTek, with the understanding that RAN2 evaluation (e.g. on latency impact) can be triggered by RAN1 if necessary, this was reflected by added a Note:
  - o "Note: The need for RAN2 evaluation will be triggered by RAN1 when necessary."
- More supporting companies listed and some other changes required by RAN secretary.

Please provide your comments on the latest version (-v5), if any. As indicated by RAN chair, this SID will be treated during morning GTW session, **so early feedback before the GTW session (UTC 12:30 Monday) will be helpful.**

### Feedback Form 11: Any comments to the latest version (-v5)?

#### 1 – MediaTek Inc.

Thanks for moderator's revision. For providing a clear objective for a 3rd release of power saving study/work subject to 1 TU time budget, we see there is need for further adjustment. Below please find our suggestions:

- Target:

- o As a 3rd release of power saving study/work, we should be clear about the remaining issue(s). From the Justification section, we see fulfilling the battery issue for IOT and wearable use cases with NR cellular connection is one remaining issue. The fire sprinkler example also reflects the need of better trade-off in power saving and latency.
- o While the above issues are of consensus, current wording in the objective is still not clear whether we should resolve the issues or not. **The added sentence, "where the gains may include UE power saving gain and/or lower latency", looks a wish instead of a target.** To task the study to resolve the issues described in the Justification section, we suggest to change it as **"where the gains target to resolve the battery issue and provide better trade-off in power saving and latency"**
- o Resolving the battery issue will require specific evaluation methodology, KPIs and requirements, which can in turn ensure useful solution(s) identified from this study.

- Prioritization:

- o **The battery issue and the latency issue of eDRX are both related to idle/inactive mode.** For connected-mode, the major target is reduction of PDCCH monitoring instead of achieving a lower standby power consumption. **Since NR has provided enhancements for connected-mode in R16 and R17, it is reasonable to prioritize idle/inactive mode for this study.**
- o The other consideration is the time budget which looks not sufficient to study two different mechanisms for idle/inactive-mode and connected-mode (which are subject to different performance targets!)
- o By the above, we suggest the following update to 1st objective bullet. Note the change "identify **use cases to focus**" is because it is duplicated with "Prioritize IOT and wearable use cases".
- o "Identify ~~use cases to focus~~, evaluation methodology & KPIs [RAN1]
  - Prioritize IoT and wearable use cases **and idle/inactive mode operations**
  - ..."

#### 2 – Nordic Semiconductor ASA

There are more KPIs to consider such as coexistence, overhead, this are already mentioned in bellow bullet

- Study potential UE power saving gains compared to the existing Rel-15/16/17 UE power saving mechanisms and their coverage availability, as well as latency impact. System impact, such as network power consumption, coexistence with non-low-power-WUR UEs, network coverage/capacity/resource overhead should be included in the study [RAN1]

therefore, better to remove bellow sub-bullet, as it is contradicting to above

- Identify use cases to focus, evaluation methodology & KPIs [RAN1]
  - o Prioritize IoT and wearable use cases.
  - o ~~The KPIs include at least UE power consumption, coverage and wake-up latency.~~

### 3 – Spreadtrum Communications

We are basically fine with it, since the wording is general now.

### 4 – ZTE Corporation

We are generally OK with the update. For the following statement, the lower latency by WUS seems should be compared with the Rel-15/16/17 UE power saving mechanisms, which is a little bit weird.

- “Solutions should target substantial gains compared to the existing Rel-15/16/17 UE power saving mechanisms, where the gains may include UE power saving and/or lower latency”

Therefore, a modification to make it clearer is needed as follows

- “Solutions should target substantial gains, where the gains may include UE power saving **compared to the existing Rel-15/16/17 UE power saving mechanisms**, and/or lower latency”

### 5 – Beijing Xiaomi Mobile Software

1) Agree with the previous comment that the KPIs are already covered in the last bullet.

2) A small question:

Do we need to move the last second bullet to the last one? In my understanding, higher layer starts the work after the gains have been identified.

### 6 – Huawei Tech.(UK) Co.. Ltd

1. It is a bit confusing for the WGs to have the KPIs listed differently in two different places. Does it mean when identifying use cases that only the subset of KPIs listed in that objective are of primary interest? What happens to the longer list in the final bullet? The final bullet has been iterated (more than!) enough by now, and should be where KPIs are captured. WGs will have no difficulty interpreting that correctly together with the other bullets.

2. The prioritization of certain use cases before knowing what are the other (non-precluded!) use cases seems strange. This SI lasts for the whole release, thus proper initial discussions can be had in RAN1 to set the use cases, without RAN rushing to judgement before the technical basis has been opened up by experts. If RAN does not like the workload of what RAN1 decides, then it can intervene upon receiving an SR showing the agreements.

## 7 – Sony Europe B.V.

In the updated SID, we think the moderator has done a good job in addressing concerns that were raised in the email discussion on Friday. The SID that we nearly agreed on Friday was the subject of discussion since June (in one form on another) and we only needed to make the tweaks that were controversial on Friday. These tweaks have been made in v5 and so we are happy with it.

While the proposed text changes from Mediatek might be OK, we think that the v5 version from the moderator is at least just as good.

While KPIs are discussed in two bullets in the SID, we think this is OK. The first bullet is about **identifying** and the other bullet is about **studying**.

For the sake of progress, we are OK with v5, as provided by the moderator.

## 8 – VODAFONE Group Plc

We agree with MediaTek on modifying the wording from **”where the gains may include UE power saving gain and/or lower latency”** to **”where the gains target to resolve the battery issue and provide better trade-off in power saving and latency”**. We also agree with MediaTek on the prioritisation of Idle/Inactive (ahead of connected mode).

## 9 – Ericsson LM

We think changes are fine overall, with some exceptions:

- We don't think a KPI on “wake-up latency” should be added: DL latency will be determined by the (e)DRX cycle and is obvious from the configuration, i.e. no need to evaluate. E.g. with the use of a 10 min eDRX cycle, it does not matter if a few ms are shaved off in the WUS design (e.g. by having a shorter WUS, or time gap between WUS and PDCCH). Further, the time delay for starting up the main receiver will be much longer than a few ms. So no need to have latency as a KPI. (The definition of “wake-up latency” is also unclear, does this refer to something else than DL latency, and if so, why is that relevant?).
- Editorial: “UE power consumption” is an incorrect term and should be changed to “UE energy consumption” or “UE power saving”.
- Editorial: “Identify use cases to focus **on**, ...”