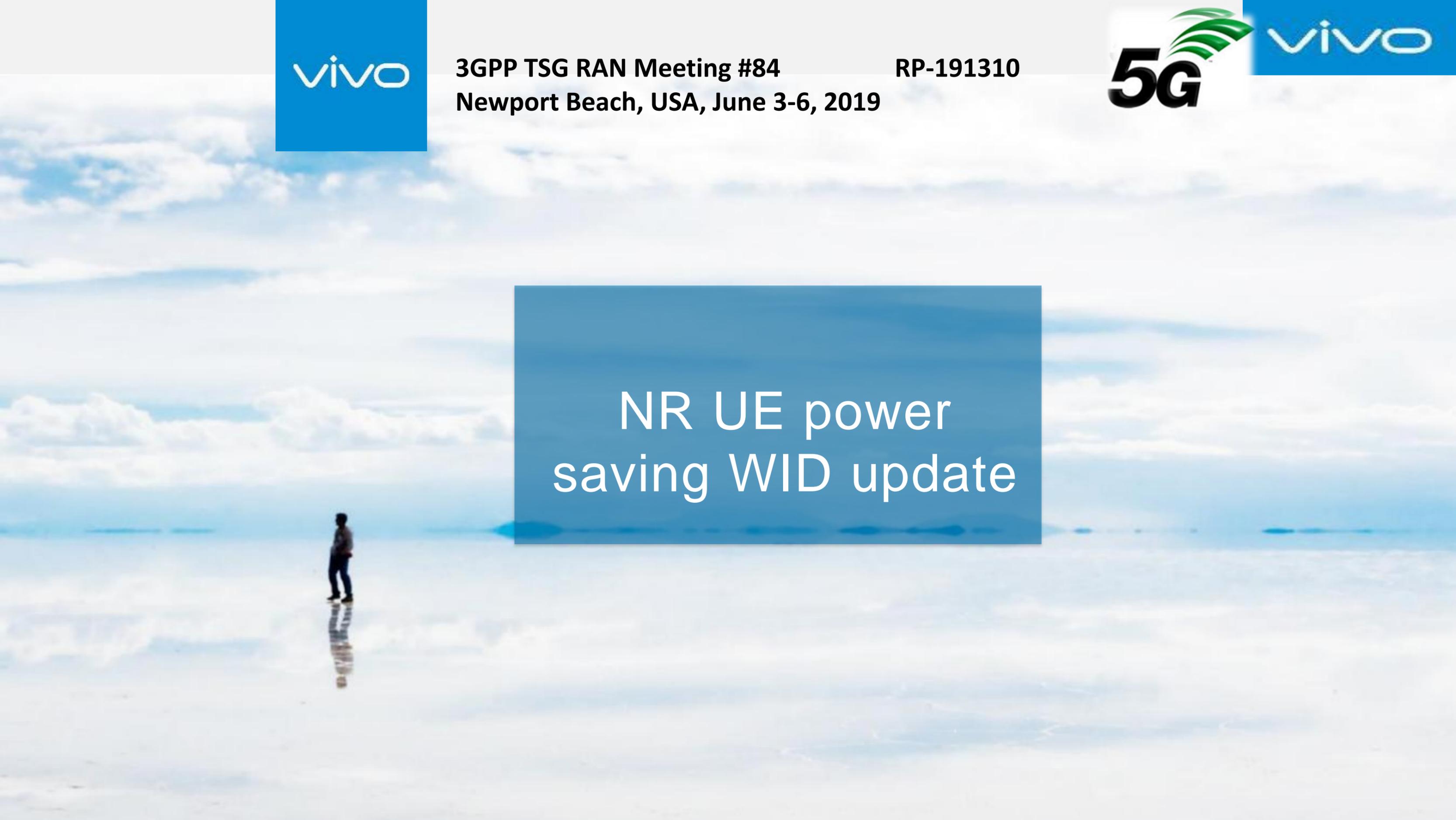


The vivo logo is displayed in white lowercase letters on a blue square background.

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The background of the slide is a photograph of a person standing on a beach, looking out at the ocean under a cloudy sky. The person's reflection is visible in the wet sand.

NR UE power saving WID update

- A new Rel-16 work item on NR UE power saving WID is agreed in RAN #83 meeting.
- The WID need to be updated in RAN #84 meeting after the RAN2 work of SI is completed.
- In this contribution, the update of WID is proposed based NR power saving TR and RAN2 recommendations.

- In TR 38.840, based on the evaluation, the schemes of power saving signal/channel triggering wake-up for CDRX show power saving gain of up to 50% comparing to the baseline with the agreed C-DRX reference configuration.
- In RAN2, the PDCCH-based power saving signal/channel scheme for wake-up purpose is considered jointly with c-DRX, i.e. it is only configured when DRX is configured.
 - If it is not configured, the legacy DRX operation should be applied.
 - If it is configured, the PDCCH-based power saving signal/channel should be monitored at occasions located at a known offset before the start of the *drx-onDurationTimer*.
- Furthermore, RAN2 have also discussed the power saving for DC/CA case. It is agreed that UE's power consumption can be saved in CA configuration by reducing PDCCH monitoring on activated SCells.
- Thus, we propose Specify PDCCH-based power saving signal/channel to indicate the UE to monitor the PDCCH in the subsequence onDuration of DRX, including single carrier and CA case.

- In TR 38.840, the power saving schemes with UE adaptation to the number of MIMO layers or number of Tx/Rx antenna (panels) provides up to 30% power saving gain for the dynamic antenna adaptation.
- In RAN2, it was agreed that
 - In addition to per cell MIMO layer configuration, another MIMO layer can be configured to the initial/default BWP.
 - The UE applies another configuration of MIMO layer when the active BWP is switched to the initial /default BWP
 - It should be further studied in the WI phase if this can be extended to a per-BWP MIMO layer configuration.
- Thus, we propose *specify dynamic adapted MIMO layer configuration at least based on BWP framework.*

- In TR 38.840, relaxing measurement period is well studied in the SI and provided with the following justifications:
 - Significant power saving gains, e.g., up to 26.6% by relaxing measurement period 4 times.
 - Up to 7.1% power saving gain can be observed if reducing the number of measured cells for IDLE state. Up to 21.3% power saving gain can be observed if reducing the number of measured cells for CONNECTED state.
 - Marginal mobility impact for low mobility and cell central UEs.
- In RAN2, it was agreed RRM measurement for neighbour cells for both intra and inter-freq. can be relaxed for UE in RRC_CONNECTED/RRC_IDLE/INACTIVE.
 - From RAN2 perspective, it is beneficial to perform RRM measurement relaxation by allowing measurements with longer intervals, and/or by reducing the number of cells/carriers/SSB to be measured.
- Thus, we propose
 - Specify network controlled neighboring cell RRM measurement relaxation by extending measure interval.
 - Specify network controlled neighboring cell RRM measurement relaxation by reducing the number of cells/carriers to be measured.

- In TR 38.840, it is captured that PDCCH monitoring periodicity configurations can be dynamically adapted with or without C-DRX.
 - For PDCCH skipping, the power saving gain is in the range of 9%~83%.
 - For PDCCH periodicity adaptation, the power saving gain over the agreed baseline is in the range of 5% ~ 63.8%.
- In RAN2, it was agreed that DCI-based PDCCH monitoring skipping is aimed to operate on a short time scale (i.e. shorter time scale than the L2 DRX). Under this condition, it has not been identified that DCI-based PDCCH monitoring skipping duplicates the DRX functionality.
 - The MAC timers are not affected by the DCI-based PDCCH monitoring skipping command, except for timers related to UL triggered activities (e.g. RA, SR and BFR),
- Thus, we propose *Specify DCI-based PDCCH monitoring skipping and periodicity adaptation.*

- In TR 38.840, the UE assistance information for the power saving schemes for further studies are as follows,
 - UE preferred processing timeline parameters, e.g., K0, K1, K2 values, UE preferred BWP information/configuration, UE preferred antenna configuration, including MIMO layers, antenna panel awareness information, UE assistance/feedback on the DRX configurations/parameters, UE preferred BWP provided to assist network in BWP switching, UE request on SCell/SCG activation/de-activation/configuration, UE preferred PDCCH monitoring parameters/search space configuration/maximum number of blind decoding
- In RAN2, it was agreed that it is also identified as helpful to further evaluate the following UE's assistance information: mobility history information (e.g. similarly as in LTE via mobilityState, and MobilityHistoryReport, power preference indication, UE's preferred information related to C-DRX, BWP and SCell configurations.
- Thus, we propose Specify and design the signaling for UE assistance information, e.g. power preference indication extension including preferred C-DRX configuration, BWP and SCell configurations, preferred state transition.

From vivo perspective, we have the priority list in descending order as follows:

1. PDCCH-based power saving signal/channel triggering UE adaptation and wake up
2. Dynamic MIMO layer adaptation
3. Network controlled neighboring cell RRM measurement relaxation
4. DCI-based PDCCH monitoring skipping and periodicity adaptation
5. UE assistance information

Handling of other features:

- Fast act./deact. Scell can be discussed in *LTE_NR_DC_CA_enh.* WI.
- Following features can be postponed to Rel-17
 - Power saving for paging procedure
 - Serving cell RRM relaxation
 - Additional resources

The objective is to specify the UE power saving techniques with UE adaption in achieving UE power saving. The power saving technique should address latency and performance in NR as well as network impact. The objective of the UE power saving includes the following.

- 1) Specify power saving techniques with UE adaptation with focus in RRC_CONNECTED mode [RAN1, [RAN2](#), RAN4]
 - a) Specify the power saving techniques with power saving signal/channel
 - i) Specify the PDCCH-based power saving signal/channel triggering UE adaptation in RRC_CONNECTED
 - [ii\) Specify PDCCH-based power saving signal/channel used to indicate the UE to monitor the PDCCH in the subsequence onDuration of DRX, including single carrier and CA.](#)
 - ~~ii) Note: this objective shall not duplicate DRX operation and impact to DRX is studied at RAN2~~
 - ~~iii) Note: Any change of PDCCH channel coding and payload interleaver is not in the scope~~
 - b) Specify the procedure of cross-slot scheduling power saving techniques
 - i) Note: The procedure is in addition to Rel-15 cross-slot scheduling procedure
- [2\) Adapted MIMO layer configuration \[RAN1, RAN2, RAN4\]](#)
 - ~~e)a) Evaluate the required switching and interruption times for UE dynamic adaptation to the maximum number of MIMO layers [RAN4]~~
 - [b\) Specify dynamic adapted MIMO layer configuration at least based on BWP framework \[RAN1, RAN2\]](#)
Note: Switching on/off the RF is part of the evaluation
- [3\) RRM measurement relaxation \[RAN2/RAN4/RAN1\]](#)
 - [a\) Specify network controlled neighboring cell RRM measurement relaxation by extending measure interval.](#)
 - [b\) Specify network controlled neighboring cell RRM measurement relaxation by reducing the number of cells/carriers to be measured.](#)
- [4\) Specify DCI-based PDCCH monitoring skipping and periodicity adaptation. \[RAN1/RAN2\]](#)
- [5\) Specify and design the signaling for UE assistance information, e.g. power preference indication extension including, preferred C-DRX configuration, BWP and SCell configurations, preferred state transition. \[RAN2/RAN1\]](#)



vivo

Thanks