3GPP RAN#101

RP-231609

Bangalore , 11–15 September, 2023

Views on LP WUS for R19

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Brief introductions for R18 SI

- The study on LP WUS and its receiver is summarized in TR 38.869
  - LP WUS can be applied for eMBB/IoT and wearable cases, mainly for stationary and low/medium speed scenarios.
  - Evaluations on power consumption/coverage have been done. LP WUS shows large power saving gain and its coverage performance is similar as PUSCH msg3 but worse than PDCCH.
  - Waveform comparisons across OOK/FSK/OFDMA signals are completed.
  - Receiver architectures for envelop detection/FSK or OFDMA based receiver are studied.
  - Procedures for RRM measurement, synchronization, LP-WUS monitoring for RRC idle/inactive and RRC connected UE, (de)activation procedures of LP-WUS are studied.

Suggested scope for R19 WI- RAN1

Waveform

- OOK-1/OOK4 are recommended based on simulations in SI .
  - OOK-1 is more robust to timing error, and of lower complexity compared to OOK-4, but with lower bit rate.
  - If relatively small bitrate carried in LP WUS/LP-SS, OOK-1 is preferred.

Coverage

- OOK-based LP WUS coverage is similar as PUSCH msg 3, and worse than PDCCH
- Whole cell coverage is beneficial and should be pursued.
- Coverage enhancement should be supported
  - Robust coding, e.g., Manchester coding.
  - Time domain repetition
  - Power boosting

Suggested scope for R19 WI- RAN1

Synchronization

- Periodical synchronization signal, LP-SS, is recommended.
  - LP WUR can stay sync with gNB and monitor LP WUS by duty cycle manner.
  - Serving cell RRM measurement based on LP –SS by LP WUR should be supported.
  - LP-SS is cell specific, e.g. cell ID is carried, if supporting neighboring cell RRM measurement.
  - The periodicity of LP –SS should be designed for both synchronization and RRM measurement.

RRM measurement

- Serving cell RRM measurement based on periodical LP –SS by LP WUR should be supported.
- Neighboring cell RRM measurement should also be supported if LP WUS coverage is whole cell.
- Serving/neighbor cell RRM measurement by main radio can be relaxed, including partially/fully offloaded to LP WUR.

Coexistence with other NR channels/signals

- LP-SS/WUS can be multiplexed with other NR channels/signals of main radio in the same OFDM symbols.

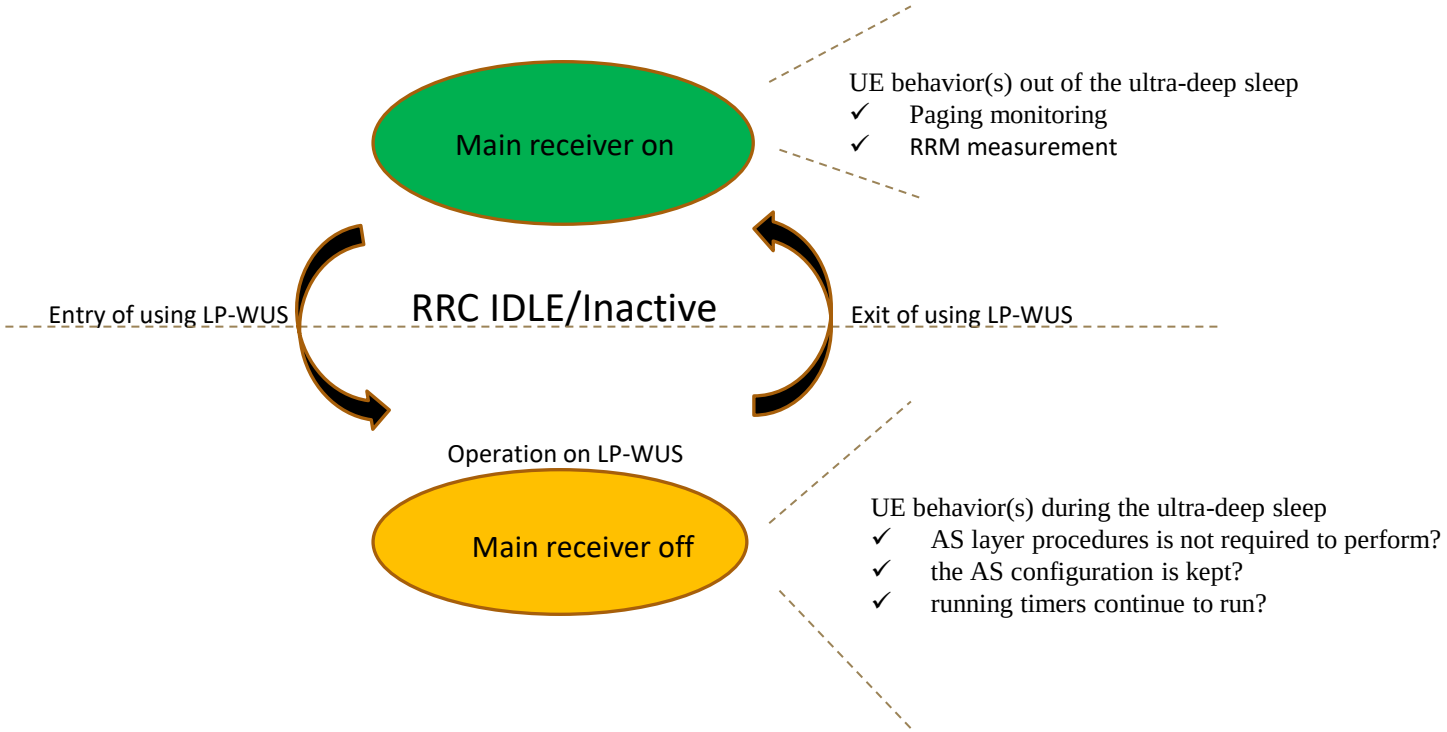
Suggested scope for R19 WI- RAN1

Information carried

- For LP-WUS for RRC idle/inactive UE
  - Different LP WUS monitoring occasions correspond to different UE groups, similar as PO.
  - At least wake up indication for Paging DCI monitoring is indicated.
  - At least UE sub-group ID is indicated, similar as PEI.
    - Different or the same UE subgrouping method can be applied for LP WUS and PEI
- For LP-WUS for RRC connected UE
  - UE specific configured monitoring occasions.
  - A single LP WUS occasion can correspond to one or multiple UEs, with separate indication for each UE/UE subgroup
    - UE subgroup is subject to gNB configuration
  - At least wake up indication for PDCCH monitoring is indicated.

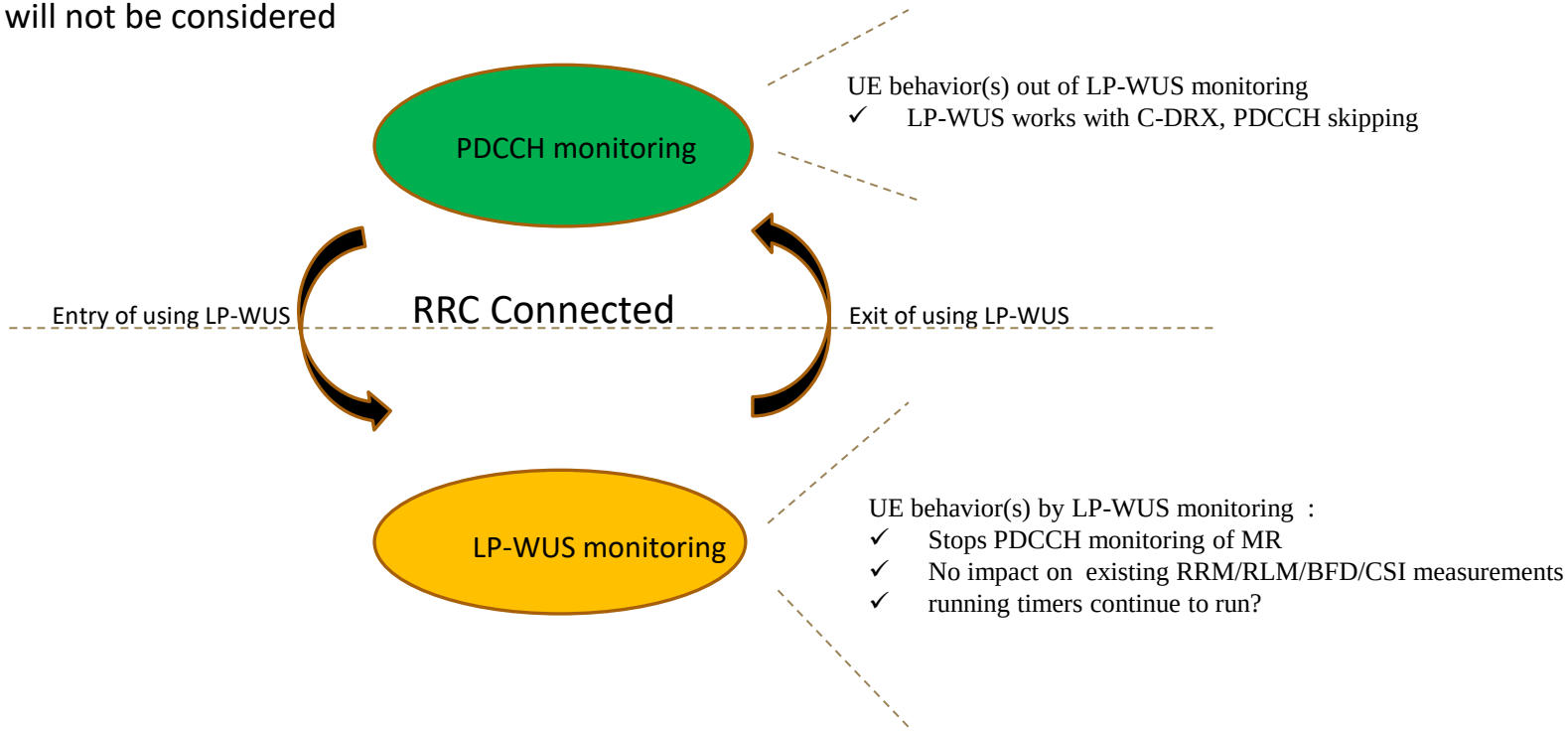
Suggested scope for R19 WI- RAN2

- For LP-WUS for RRC idle/inactive UE
  - Procedures for UE entering/exiting of LP-WUS monitoring should be specified.
  - Procedures for UE MR paging monitoring triggered by LP-WUS should be specified



Suggested scope for R19 WI- RAN2

- For LP-WUS for RRC connected UE:
  - Procedures for UE entering/exiting of the LP-WUS monitoring should be specified.
  - Procedures for LP-WUS monitoring by LP-WUR and PDCCH monitoring triggered by LP-WUS, e.g., how LP-WUS works with C-DRX/PDCCH skipping/SSSG switching, should be specified.
  - No impact on existing RLM/BFD/CSI measurements for MR. RRM based on LP-WUR can be supported.
  - Dual DRX will not be considered



Summary

- Proposal 1: RAN is suggested to consider the following objectives for Rel-19 LP-WUS WI:

Specify LP-SS and LP-WUS(RAN1):

- Specify an OOK (OOK-1 and/or OOK-4) based LP-WUS/LP-SS, including the information carried, occupied resources and multiplexing with legacy channels, that can be detected by LP-WUR.
- Specify coverage enhancement schemes for LP-WUS/LP-SS.

For LP-WUS for RRC idle/inactive UE (RAN2, RAN1):

- Specify necessary procedures to allow UE enter/exit of the LP-WUS monitoring (RAN2, RAN1)
- Specify necessary procedures to allow UE MR (Main receiver) paging monitoring triggered by LP-WUS (RAN1, RAN2)

For LP-WUS for RRC connected UE(RAN1, RAN2):

- Specify necessary procedures to allow UE enter/exit of the LP-WUS monitoring (RAN2, RAN1)
- Specify necessary procedures to allow LP-WUS monitoring by LP-WUR and PDCCH monitoring triggered by LP-WUS, e.g., how LP-WUS works with C-DRX, PDCCH skipping(RAN1, RAN2)

  Note: (1) No impact on existing RLM/BFD/CSI measurements for MR; (2) Dual DRX is not considered.

For RRM measurement(RAN4, RAN2, RAN1):

- Specify further RRM relaxation of UE MR for both serving and neighbor cell measurements, including partially/fully offloading serving cell/neighbor measurements to LP-WUR, for RRC idle/inactive/connected UE (RAN4, RAN2, RAN1)

Specify UE RF and RRM core requirements (RAN4)

- Specify UE Rx RF requirement for the new features introduced in this WI
- Specify RRM core requirements for the new features introduced in this WI

Thanks