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3GPP TSG RAN Rel-19 workshop RWS-230078
Taipei, June 15 - June 16, 2023

Agenda Item: 5

Source: Spreadtrum Communications

Title: LP-WUS in Rel-19

Document for: Discussion and decision

R19 LP-WUS WI: Background

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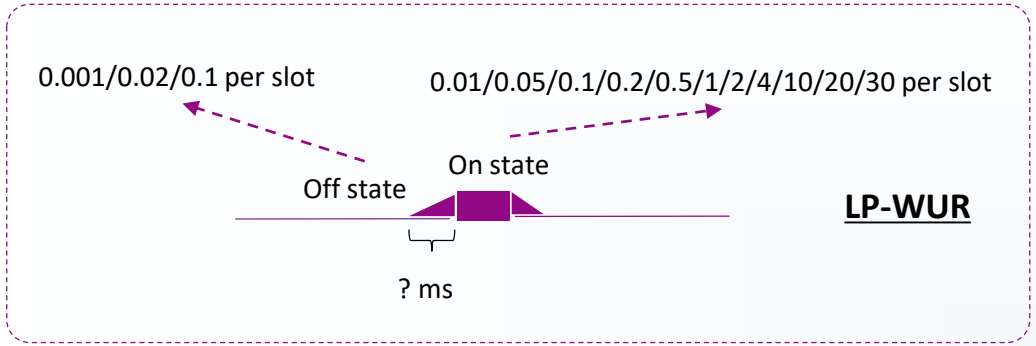
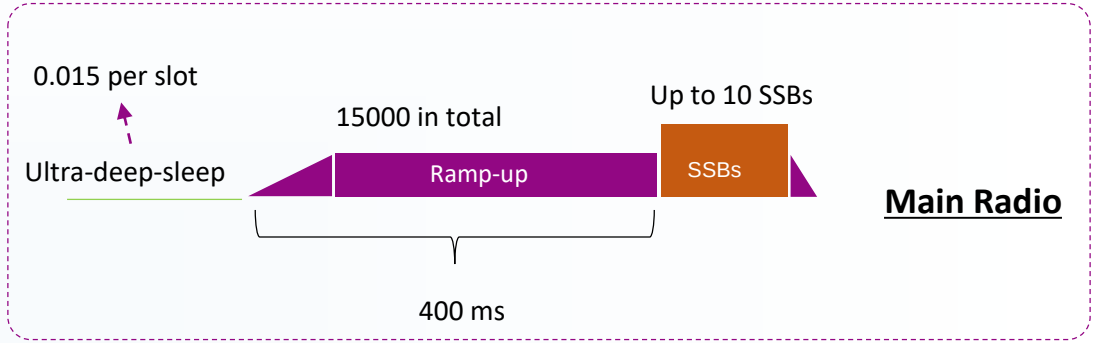
R18 LP-WUS SI

- To be completed in Sep. 2023 => outcome TR 38.869

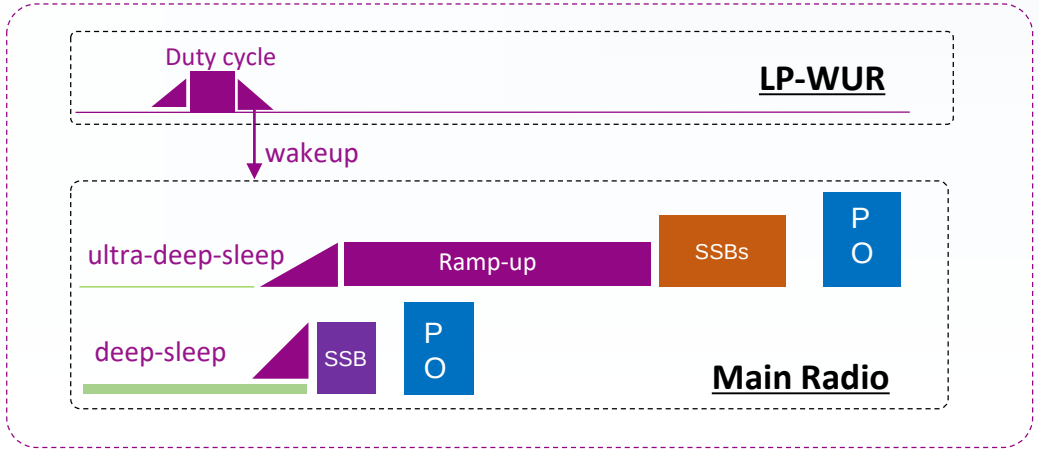
Power model for LR



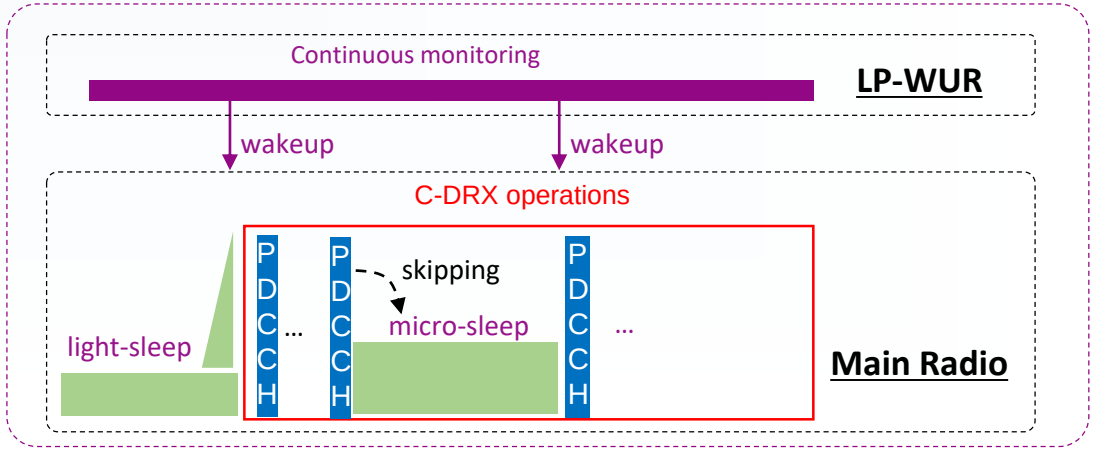
Power model for ultra-deep-sleep for MR



Example of power consumption for RRC IDLE/INACTIVE state



Example of power consumption for RRC CONNECTED state



R19 LP-WUS WI: KPIs (1/2)

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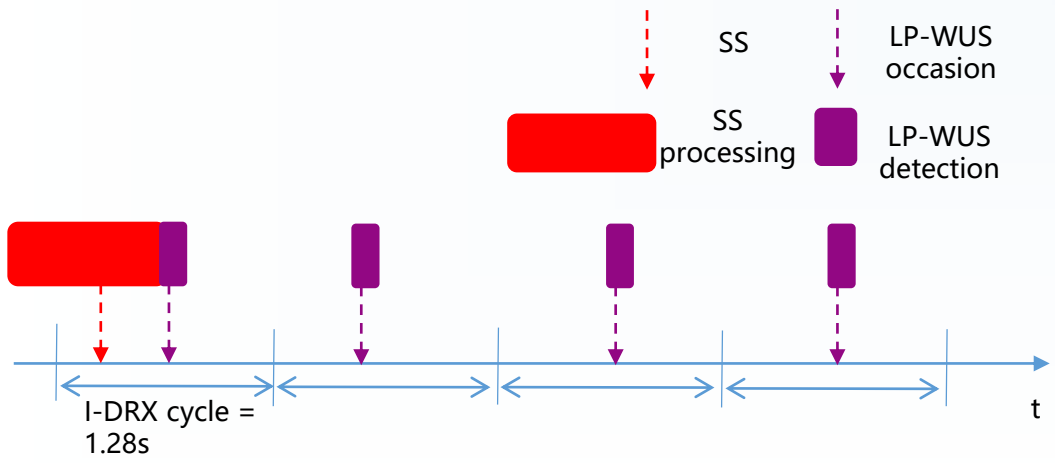
◻ KPIs for UE in RRC IDLE/INACTIVE state

Power saving gain

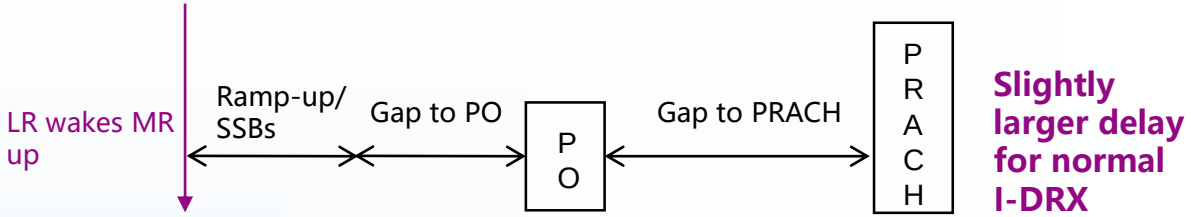
- Power saving gain is > 20% compared to R17 PEI solution in our evaluation for both ultra-deep-sleep and deep-sleep
- In essence, power saving gain comes from
  - RRM measurement relaxation of MR
  - Out-of-sync tolerance of LR
- Insensitive to power consumption for LR on state, since power consumption is averaged across duty cycle
- Longer duty cycle, larger power saving gain



Note: Here, duty cycle of LP-WUS is assumed same as that of I-DRX

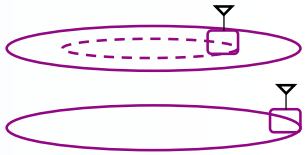
Latency

- Latency is slightly larger than that of legacy paging for normal I-DRX, since PO should be monitored in general cases



Coverage target

- Discontinuous coverage: PUSCH for Msg.3
- Continuous coverage: Paging PDCCH



System overhead

- System overhead depends on coverage target and LP-WUR complexity
- LP-WUS can replace DCI format 2_7 (PEI)

Observation 1: Duty cycled monitoring is suitable in RRC IDLE/INACTIVE state

Observation 2: Power saving gain is achievable in RRC IDLE/INACTIVE state

R19 LP-WUS WI: KPIs (2/2)

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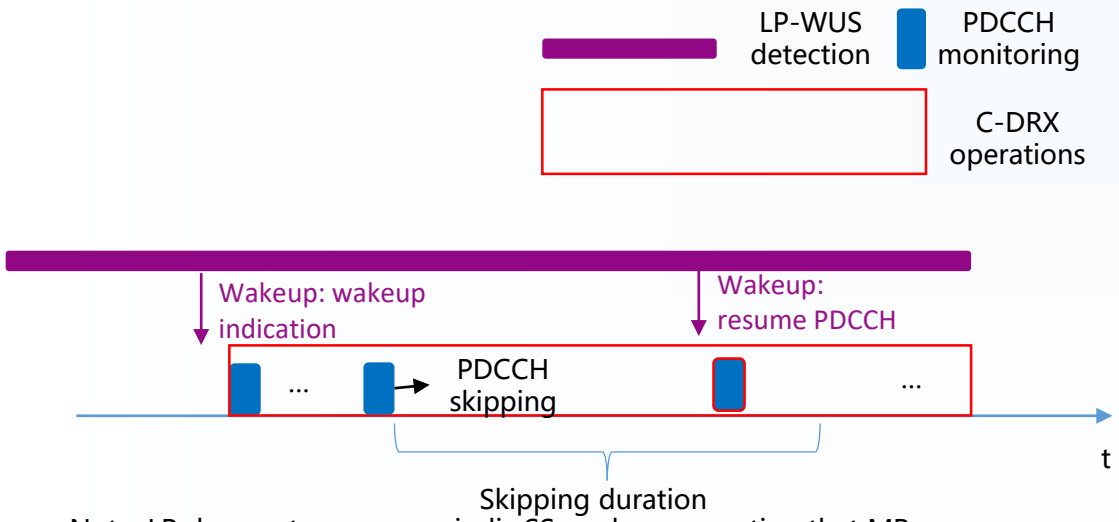
◻ KPIs for UE in RRC CONNECTED state

Power saving gain

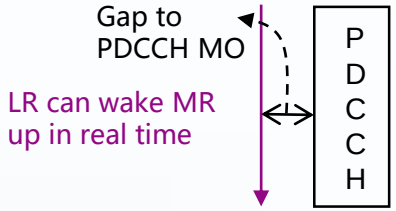
- Power saving gain may come from
  - PDCCH monitoring reduction at MR through real-time wakeup due to continuous monitoring
- May be sensitive to power consumption for LR on state due to continuous monitoring
  - Usually



Note: LR does not process periodic SS, under assumption that MR provides sync to LR

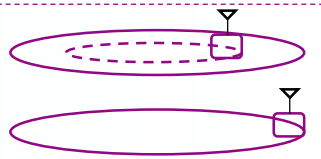
Latency

- Latency is smaller than that of R16/17 PDCCH adaptation and WUS for C-DRX due to ccontinuous monitoring



Coverage target

- Discontinuous coverage: PUSCH for Msg.3
- Continuous coverage: Paging PDCCH



System overhead

- System overhead depends on target coverage and LP-WUR complexity
  - High-precise sync can be provided by MR
- LP-WUS can replace DCI format 2_6 (DCP)

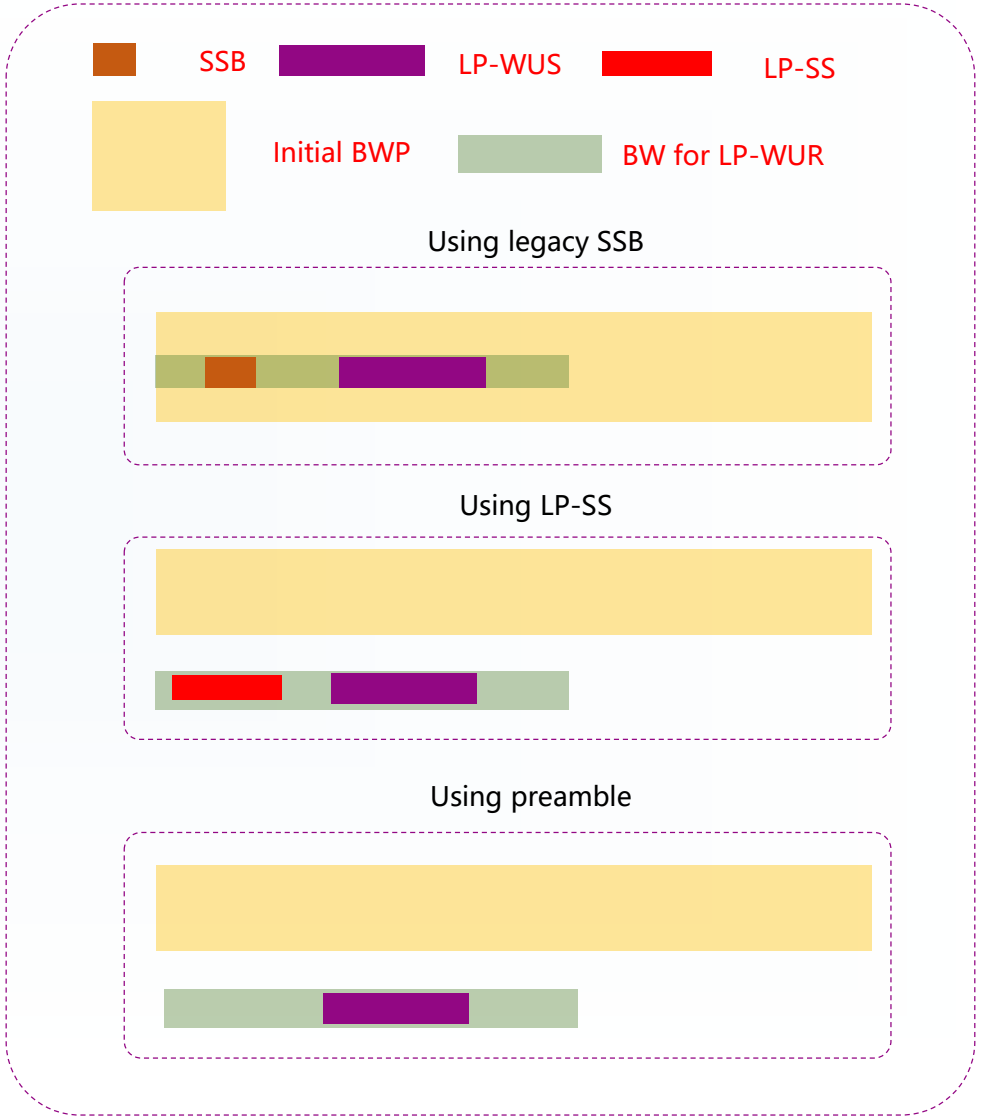
Observation 3: Continuous monitoring is suitable in RRC CONNECTED state

Observation 4: Power saving gain and/or latency reduction is achievable in RRC CONNECTED state

R19 LP-WUS WI: Objectives

- **LP-WUS physical design**
  - Waveform
    - Supporting OOK-1 (same SCS)? It seems enough for scaling of coverage, system overhead and payload size
    - Additionally supporting OOK-4 (up to M=4)?
    - Additionally supporting OOK-2/FSK (up to 4 segments per OFDM symbol)?
  - Channel coding
    - Manchester code
  - Preamble
    - Necessary for continuous monitoring
  - Payload content
    - UE group information for idle/inactive state; UE ID or C-RNTI for connected state
- **Synchronization/RRM measurement**
  - Idle/inactive state: Using periodic LP-SS or preamble for low-complexity receiver; Using legacy SSB for high-complexity receiver
  - Connected state: MR can provide sync/measurement information to LR
- **LP-WUS physical procedures**
- **High layer procedures for LP-WUS**

Synchronization/RRM measurement in RRC IDLE/INACTIVE state



Observation 5: Scalable or configurable design is better for compromise

Thanks

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