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Agenda item: 9.3.5

Document for: Discussion

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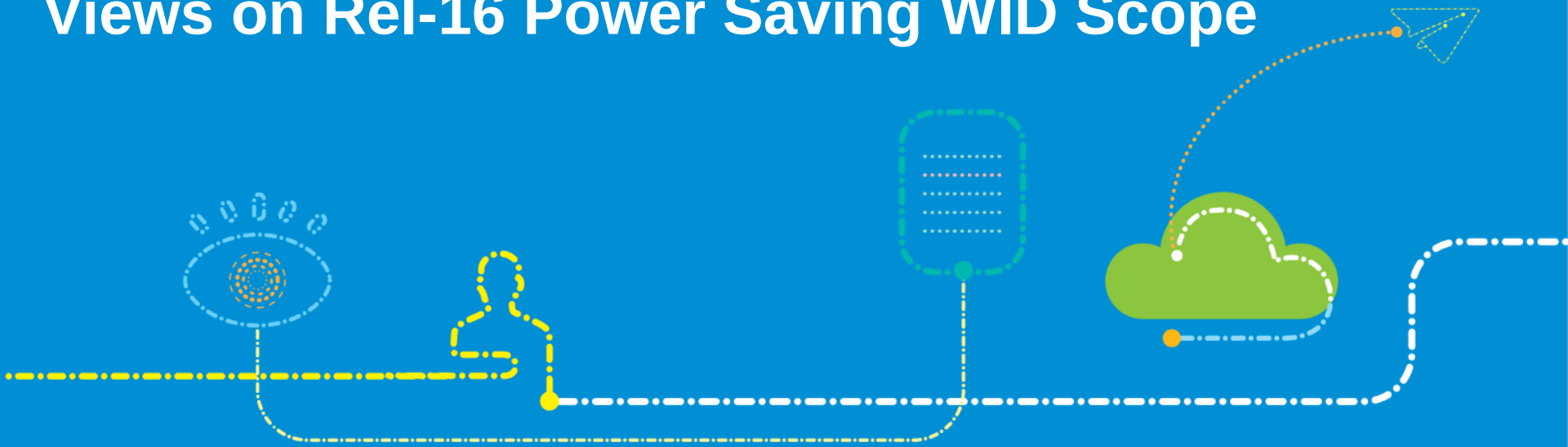
# Views on Rel-16 Power Saving WID Scope



# SI Scope and TU allocation

The power saving techniques studied in RAN1 SI phase includes adaptation in

- time/frequency/spatial domain
- DRX configuration
- PDCCH monitoring behavior
- RRM measurement

The adaptation may be

- triggered by power saving signal/channel
- assisted by UE assistance information

The RAN1 TU allocation of UE power saving in WI

| 2019H1 | | | 2019H2 | | |
|---|---|---|---|---|---|
| 96 | 96bis | 97 | 98 | 98bis | 99 |
| \ | 2 | 2 | 1 | 1 | 1 |

**Observation: Items studied in SI cannot fit into the total 7 RAN1 TUs in WI phase.**

**Proprosal 1: Identify the priorities of power saving techniques to be specified in WI.**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# Issue #1: Time domain

The power saving techniques in time domain discussed in SI phase include

- Cross-slot scheduling
- Same-slot scheduling
- Multi-slot scheduling

Regarding same-slot scheduling, it is observed that

- The power consumption is reduced when data traffic is low, which can also be achieved by cross-slot scheduling
- It may increase power consumption when data traffic is high
- The power saving gain of same-slot scheduling is much related to the UE capability, such as PDCCH/PDSCH processing time, and the timeline of UL transmission.

The power saving gain of multi-slot scheduling is 2% at most which is much smaller compared with cross-slot scheduling.

**Proposal 2: Focus the normative work of time-domain techniques only on cross-slot scheduling in WI phase.**


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# Issue #2: Frequency domain

The power saving techniques in frequency domain discussed in SI phase include

- BWP switching enhancement
- SCell operation

Meanwhile, SCell operation including fast activation has been discussed in CA-DC.

Enhancement on SCell operations in CA-DC WI makes power saving enhancement for SCell a moving target.

**Proposal 3: Specify SCell operation in CA-DC WI to avoid redundant discussion, or postpone it to future release.**


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# Issue #3: Antenna domain

Two adaptation schemes have been proposed: dynamic adaptation and semi-static adaptation

- Both schemes can achieve power saving gain
- Dynamic adaptation has very small impact on network performance, e.g, latency, UPT, …

The introduction of antenna configuration adaptation would not significantly increase the standardization workload with a propoer design.

**Proposal 4: Specify adaptation in antenna domain for UE power saving in Rel-16.**

**- Down-select between dynamic adaptation and semi-static adaptation in WI phase**


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# Issue #4: PDCCH monitoring

The adaptation in PDCCH monitoring behavior discussed in SI phase includes

- skipping PDCCH monitoring
- dynamic PDCCH monitoring periodicity
- PDCCH blind decoding redution

To achieve power saving gain, the reduction in PDCCH blind decoding times would increase the blocking rate, which has high impact on network performance.

**Proposal 5: Do not include reduction of PDCCH blind decoding times in the WI scope.**


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# Issue #5: Power saving signal/channel

Power saving gain is observed when power saving signal/channel triggers UE adapt in, e.g., DRX configuration, PDCCH monitoring behavior and BWP switching.

The functionality of power saving signal/channel include

- Wake-up signalling (WUS)
- Go-to-sleep signalling (GTS)

Regarding the neccessity of introduction of Layer-1 GTS

- In Rel-15, MAC CE could terminate the inactivity timer which bears a similar functionality
- Compared with a frequenct L1 signalling, L2 signalling has a smaller overhead and HARQ feedback
- The power saving gain is an accumulation of time, the delay of L2 signalling is not significant

**Proposal 6: Specify the wake-up signalling in WI phase. De-prioritize enhancement of Rel-15 go-to-sleep signalling.**


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# Issue #6: RRM measurement

Reducing power consumption caused by RRM measurement in both RRC connected mode and idle mode are discussed in SI phase

- In RRC connected mode, power saving gain of RRM measurement can be observed for PDCCH-only case without data traffic, which is not realistic in practical network
  - The impact of RRM relaxation to network performance is not clear, which needs to be studied by RAN4 or RAN2
- In RRC idle/Inactive mode, the overall power consumption is small. The actual benefit from optimization on power consumption of RRC idle/Inactive mode is doubtful.
  - The relevant network impact hasn't been studied
- Most of the schemes proposed in RAN1 should be evaluated by RAN2 or RAN4 first.

**Proposal 7: RRM enhancement for power saving is not included in the RAN1-centric scope of Rel-16. Task RAN2 and RAN4 to further study the RRM measurement power reduction and the corresponding performance impact.**


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# Conclusion

We have the following proposals for NR UE power saving

- Identify the priorities of power saving techniques to be specified in WI.
- Focus the normative work of time-domain techniques only on cross-slot scheduling in WI phase.
- Specify SCell operation in CA-DC WI to avoid redundant discussion, or postpone it to future release.
- Specify adaptation in antenna domain for UE power saving in Rel-16.
  - Down-select between dynamic adaptation and semi-static adaptation in WI phase
- Do not include reduction of PDCCH blind decoding times in the WI scope
- Specify the wake-up signalling in WI phase. De-prioritize enhancement of Rel-15 go-to-sleep signalling.
- RRM enhancement for power saving is not included in the RAN1-centric scope of Rel-16. Task RAN2 and RAN4 to further study the RRM measurement power reduction and the corresponding performance impact.


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# References

[1] TR38.840, Study on UE Power Saving


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# Thank you

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