# UE Power Saving Enhancements
## Secure 5G/NR success

3GPP TSG RAN#84
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A.I. 8

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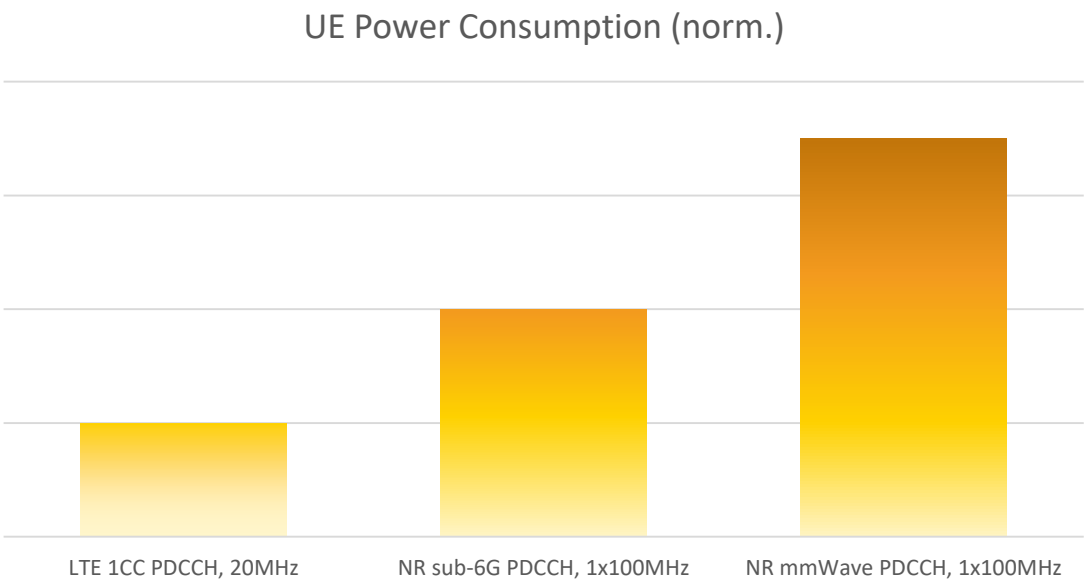
# Motivation
## User Experience

User experience = key to 5G/NR success

- Mass transition to 5G will be slower if UE battery life expectations are not met
- Users expect better 5G device battery lifetime with 4G-like applications
- NR UE power saving features are essential enablers for the 5G ecosystem

| User Experience | Design Aspect |
|---|---|
| Data Rate | Capacity |
| Battery Life | UE Power Saving |

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# Rel-16 to Rel-17

- Rel-16 Study
  - Power model and system simulation assumptions
  - Power-saving enablers, focusing on connected-mode and FR1
  - Effective for 1st wave of NR deployment where NSA and FR1 are common
- Rel-16 Feature
  - PDCCH-based power-saving signal/channel
  - Cross-slot scheduling based power-saving
  - TBD: DRX enhancement (WUS, short cycle), BWP-based MIMO layer adaptation, RRM relaxation, UE assistance information etc.
- Rel-17
  - Idle/Inactive mode power saving: NR standalone, NR IOT opportunity
  - FR2, NR-U power saving: More capacity without compromised user experience

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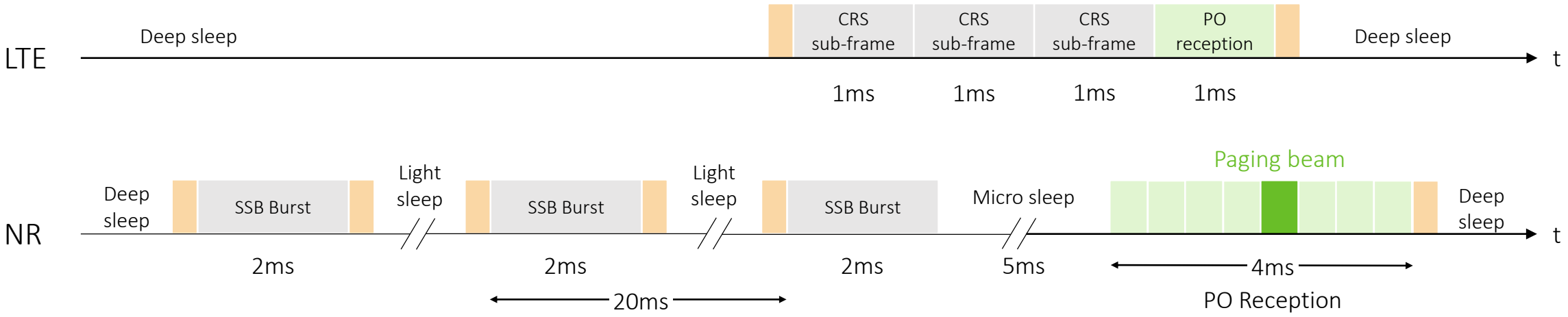
# Idle/Inactive mode for NR Standalone

- Over 70% power consumption increase compared to LTE: need for reduction




- Potential improvements include
  - Wake-up design for (beam-formed) paging
  - eDRX support
  - Broadcast cell-specific sync. resource information (e.g. TRS) for idle mode UEs

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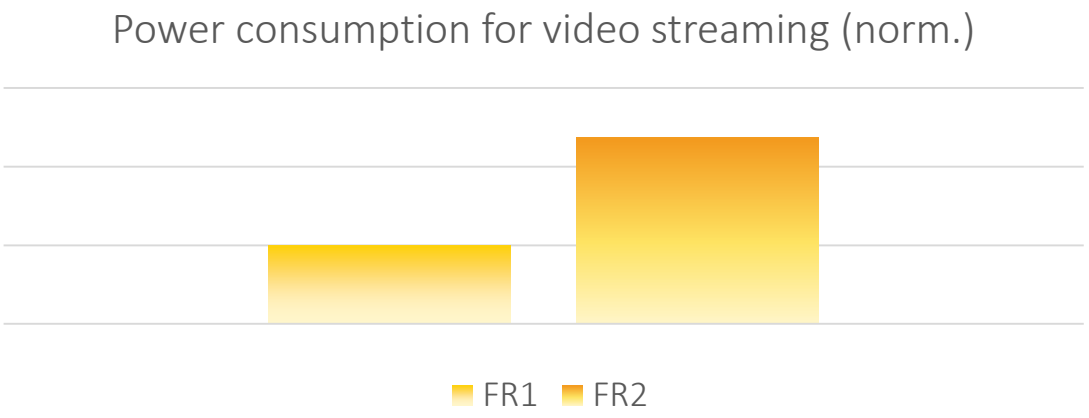
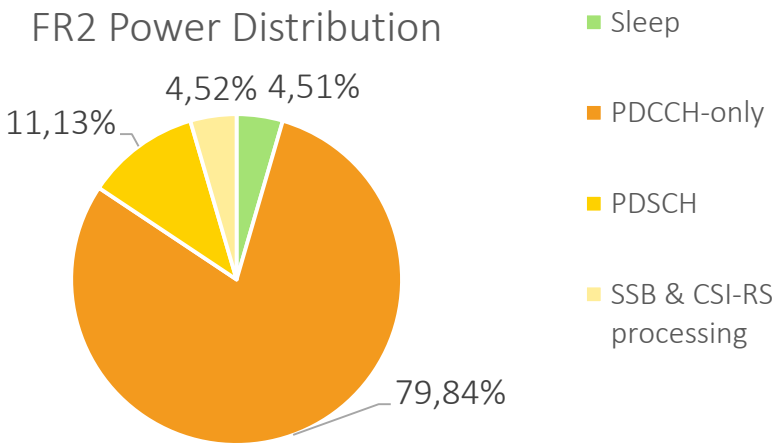
# FR2 Connected mode

- FR2 PC more challenging than FR1
- Example: sys. sim. with 1080p video streaming:
  - Packet size: 0.5 Mbytes, mean arrival time: 200 ms
  - DRX period: 160 ms, OnDuration size: 8 ms
  - FR1: 1 CC x 100 MHz; up to 4-layer MIMO
  - FR2: 2 CC x 100 MHz; up to 2-layer MIMO
  - FR2 UE power consumption is more than 2x of FR1
  - PDCCH-only and SSB/CSI-RS proc. for BM are the two largest power consuming operations not related to PDSCH
- Possible improvement directions:
  - More aggressive PDCCH monitoring reduction during data inactivity durations
  - Power saving for beam-management

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# NR-U Power Saving

- Higher UE Rx activity than with licensed spectrum
  - More PDCCH and PDSCH occasions for the same scheduling flexibility subject to LBT successful rate

- Possible improvements

Rel-16: Continuous (mini-slot) monitoring for COT

Rel-17 I: Reduced occasions when no data intended for the UE

Rel-17 II: New energy-efficient preamble design

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# Thank You!

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