



3GPP TSG RAN Meeting #93-e

Electronic Meeting, Sept 13 – Sept 17, 2021

Agenda Item: 9.0.2

Motivation for Network Energy Saving in Rel-18

Background and Justification

NR state of the art



- An increase of network deployment is inevitable due to additional use cases such as eMBB, mMTC uRLLC.
- Dense network is no longer limited to urban areas. Rural areas will be considered dense network due to several IoT devices for agriculture, mining, environments sensors.
- NR BS consumes a large amount of energy even when the load is almost zero, e.g., only SSB/SI transmissions are on-going.
- Definition of idle and PA mode:
 - NW idle stands for almost any non power amplifier related BS activities, e.g., beamforming, interface, digital RX/TX, receive mode L1/L2 processing.
 - NW PA mode stands RF output power of transmit L1/L2 processing, and activation path for digital+analog.

Live node traffic and power consumption



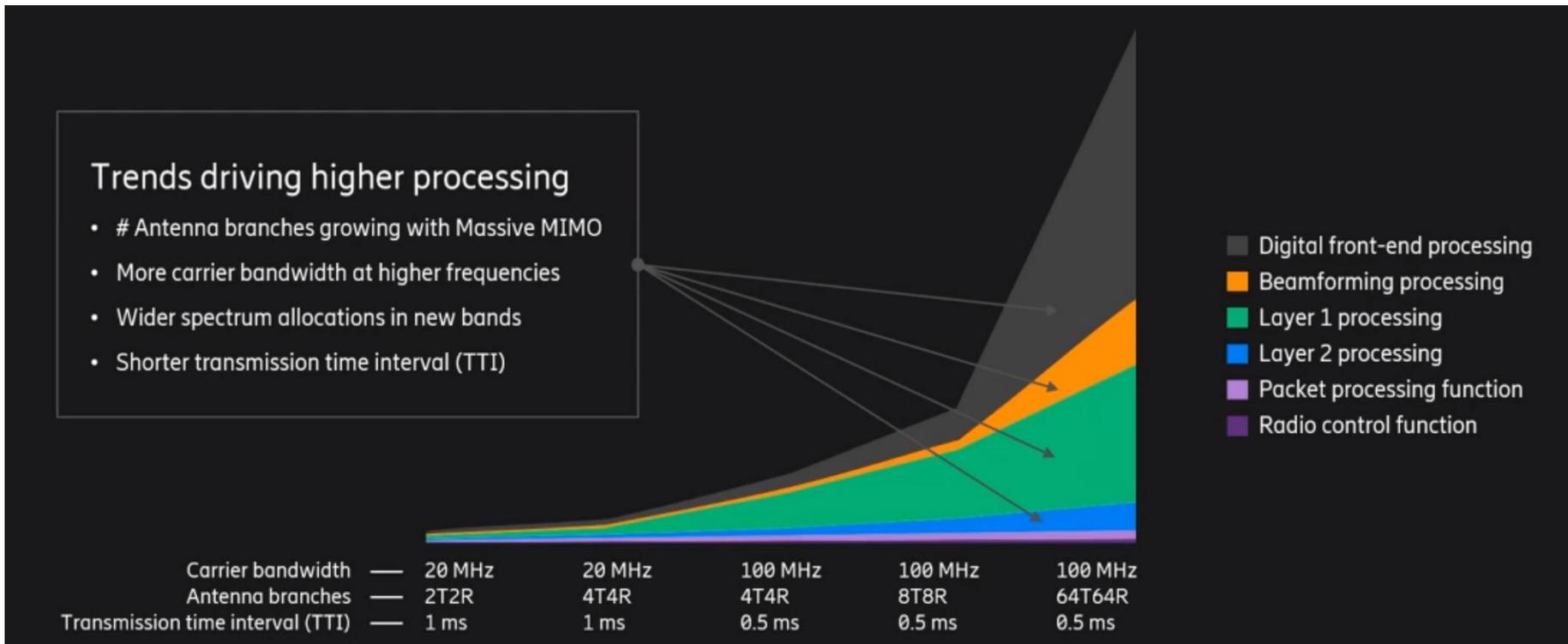
Average DL utilization: 1,51 %
Average power consumption: 268,2W

Background and Justification

NR state of the art



- NR base stations are equipped with larger BWs and panels up to 64T/64R ports.
- The NW energy consumption increases significantly as the number of ports increases.
- As the number of ports increases, the digital front-end and beamforming shape a much larger percentage of NW energy consumption.

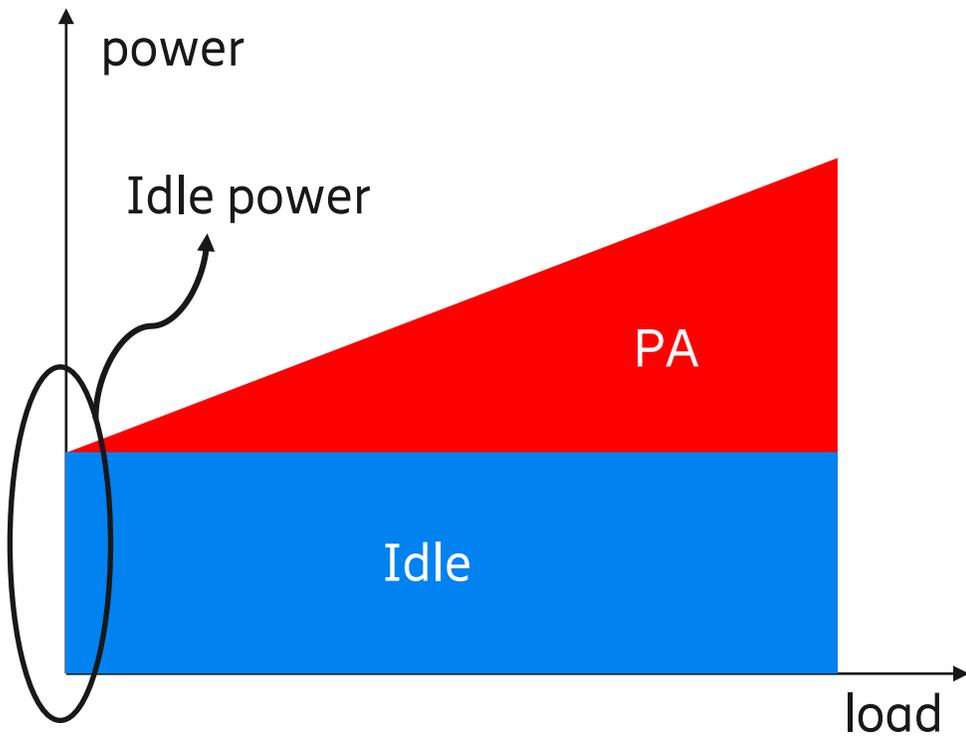


Background and Justification

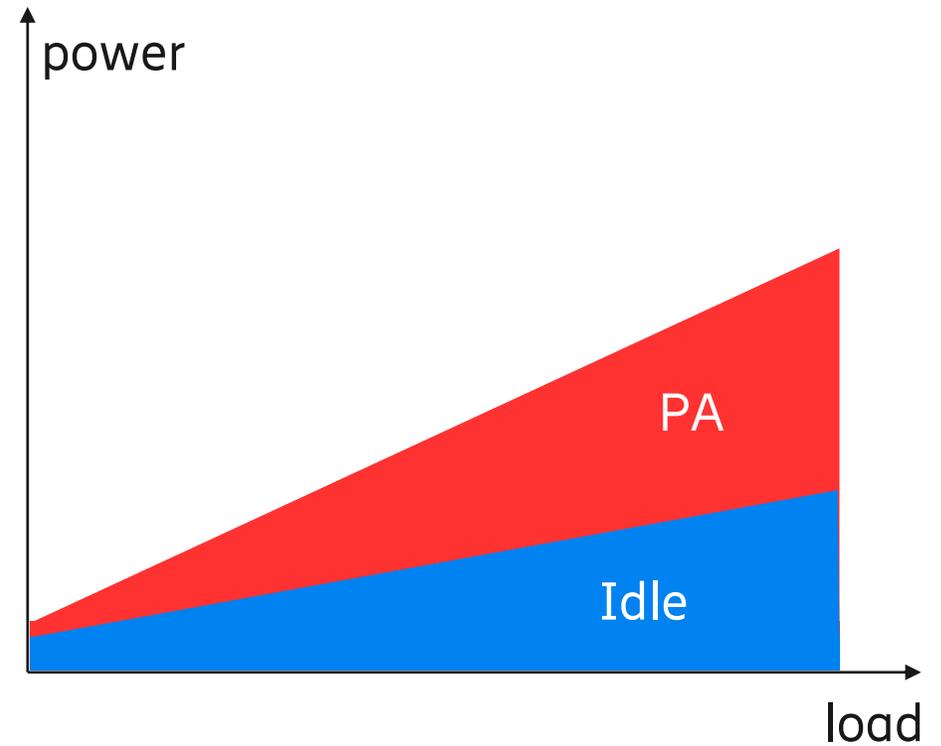
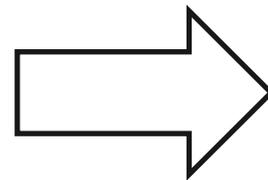
NR state of the art



- The NW power consumption in NR base stations, despite lean signaling, the idle power is high mainly due to higher power consumption in digital chains as well as beamforming and L1 processing.



Today



Target

Background and Justification

NR Network Energy Saving in 3GPP



- In the design of NR, the main motto was that the NW should ideally only transmit when there is data.
- Lean signaling is integral in NR, and should remain as such, e.g., SSB default periodicity of 20ms.
- The NW in idle is not aware of the UE presence in cell, mobility, location coverage, etc.
- The NW in general is not aware of the time-criticality of UE traffic, priority, expected volume, etc.
- Following Rel 15, 3GPP has concentrated on UE power saving in Rel 16 and Rel 17, but not much on NW energy saving.
- The significant NW energy consumption when NW is idle justifies studying and identifying techniques leading to NW energy saving.

Rel-18 Study Item objectives (1/2)



- Study and develop a NW energy consumption evaluation methodology
 - Determine reference configuration(s), e.g., the number of RX/TX chains, BW, coverage, cell size, SA/NSA, FR1/FR2, Urban/Rural, DSS, etc.
 - Identify main functionalities and their associated relative energy consumption when NW is idle and due to PA mode, e.g.
 - Idle: digital parts, beamforming, receive L1/L2 processing, reception, etc.
 - PA: PDCCH, SSB, TRS/CSI-RS, SI, PDSCH transmissions, NW load, etc.
 - Consider relevant references from past or on-going 3GPP groups, e.g., TR38.840.
 - Identify potential sleep states and the associated transition times
 - E.g., Micro, Light, Deep, MIMO sleep modes.
 - Identify KPIs related to NW energy consumption evaluation

Rel-18 Study Item objectives (2/2)



- Study potential NW energy saving techniques.
 - Study and identify NW energy saving techniques in spatial domain
 - e.g. Dynamic TX/RX port adaptation including port ON/OFF, CSI-RS enhancements, broadcast signal enhancements, etc.
 - Study and identify NW energy saving techniques in time domain
 - e.g., Identify techniques which can enable micro/light/deep sleep including micro TX OFF.
 - WUS mechanism to wake up gNB: UE to gNB, gNB to gNB, etc.
 - Study and identify NW energy saving techniques in frequency domain
 - CA/DC adaptation using additional information such as UE assistance information.
 - Study and identify UE assistance information helping NW energy saving
 - e.g., UE traffic type, priority, time criticality, expected volume, coverage, mobility status, location, etc.
 - Study and identify intra NW assistance information helping NW energy saving
 - e.g., UE population, context, coverage, etc.



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