3GPP TSG RAN#93e
September 13th-17th, 2021

RP-212329
Agenda Item 9.0.2

System Energy Enhancements

MediaTek Inc.

System Energy Enhancements
RAN1-led

3GPP TUs (Total w/ 9 meetings)			
RAN1	RAN2	RAN3	RAN4
13.5	[-]	-	4.5

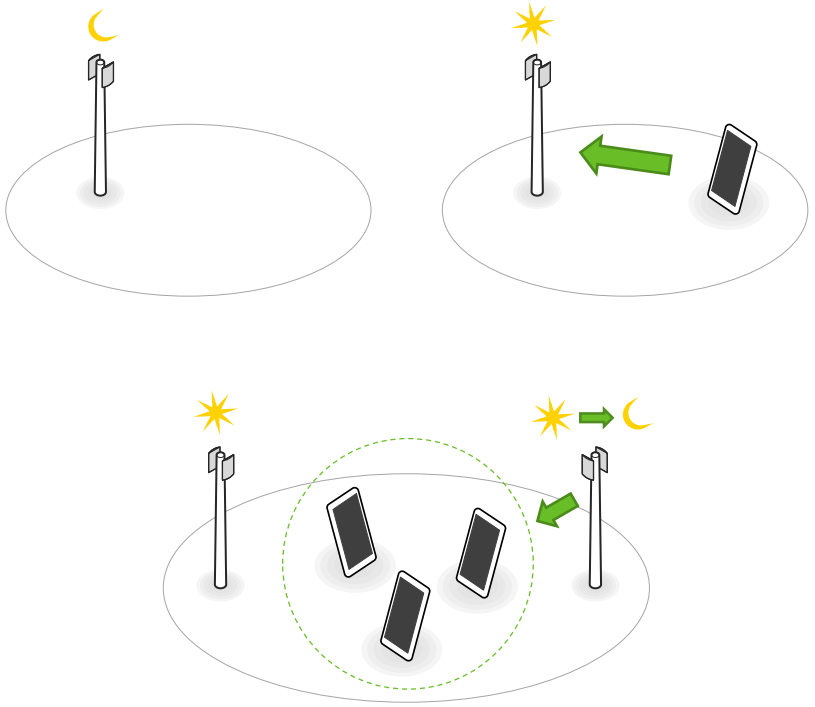
SA/CT Dependency: No

Balance system capacity and energy efficiency
UE/NW cooperation for improved system-wide energy efficiency

Objective I: Enable DCI-based power saving adaptation for multi-TRP and multi-panel [RAN1, RAN4]
TRP-specific DCI-based power saving configurations and UE adaptation behaviors for multi-TRP and multi-panel operations

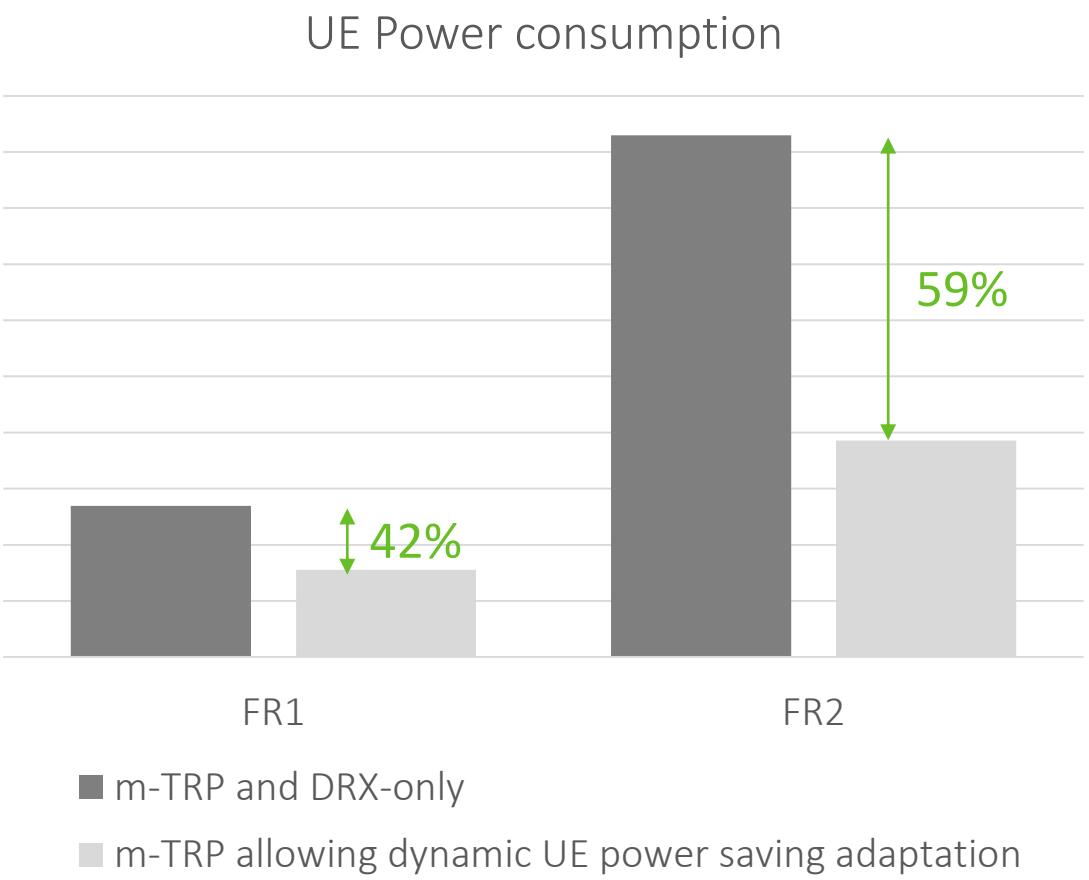
Objective II: Dynamic network power saving via gNB/TRP/beam dormancy [RAN1, (RAN2)]
- gNB wake-up mechanism (triggered by UE) for gNB/TRP/beam dormancy
- Dynamic group indication for gNB/TRP/beam dormancy

Objective III: Evaluation methodology for system energy efficiency [RAN1]
- Develop gNB/TRP/beam power consumption model
- UE power consumption model extension for multi-TRP and multi-panel operations



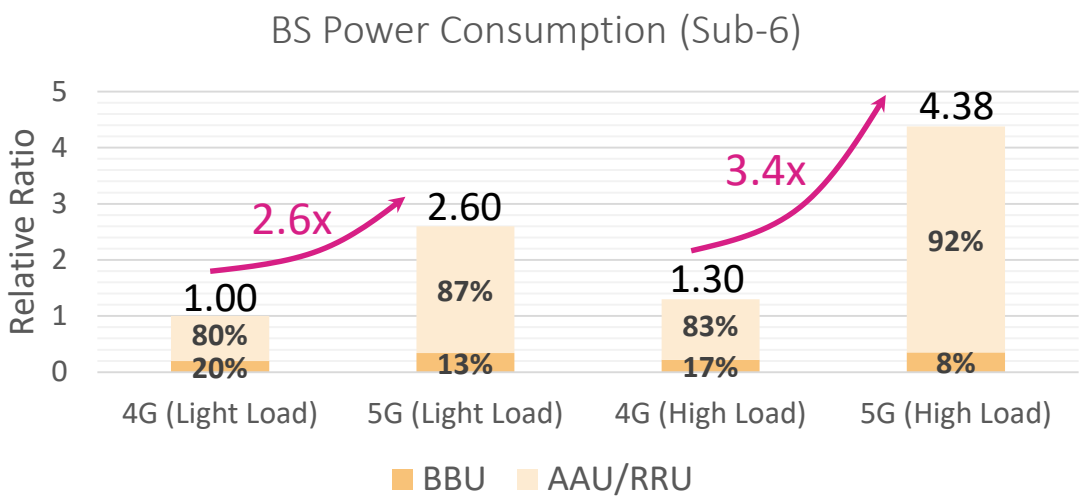
UE Power Saving with Multi-TRP

- Issue: Multi-TRP can apply DRX only
  - Multi-TRP: A common fixed BWP
  - UE power saving: Dynamic BWP switch
  - Conflict example : Multi-TRP vs. SCell dormancy
- Feasible power saving gain
  - 42% and 59% of power saving gains in FR1 and FR2, respectively, can be achieved if dynamic power saving adaptation can be enabled with multi-TRP
- Proposal
  - Enable ***TRP-specific*** DCI-based power saving adaptation for multi-TRP and multi-panel



Network Power Saving

- Observations
  - 5G network power consumption leads to high OPEX, especially due to gNB's AAU
  - Network power consumption can be improved significantly if **gNB/TRP/beam dormancy** can be accommodated for **data inactivity time durations**



Source: BS power consumption measurement in China in 2019

⇨ gNB/TRP/beam dormancy: Target "second-wise" and "(10) ms-wise"

⇨ Dormancy: No UE DL and UL activities: needs UE cooperation

BS power consumption (W)

	Sleep mode			
BS Type	71.4 µs	1 ms	10 ms	1 s
2x2 macro	76.5	8.6	6.0	5.3
4x4 macro	86.3	12.4	7.3	6.2
pico	1.5	0.4	0.3	0.2
femto	0.6	0.2	0.2	0.1

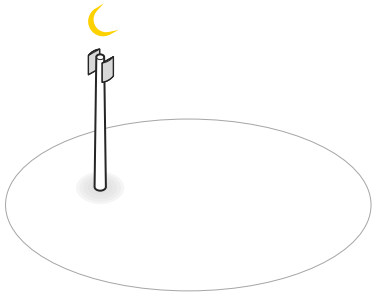
x14 x10 x100 /9 /7 /4 /3

Source: B. Debaillie, C. Desset and F. Louagie, "A Flexible and Future-Proof Power Model for Cellular Base Stations," 2015 IEEE 81st Vehicular Technology Conference (VTC Spring), Glasgow, 2015, pp. 1-7

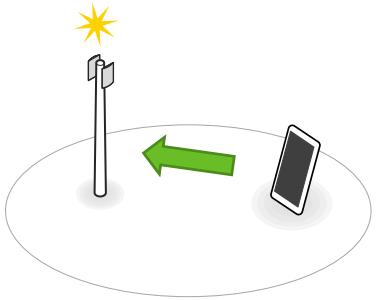
Network Power Saving

Enable gNB/TRP/Beam Long Dormancy and Short Dormancy

Case 1: gNB/TRP/Beam wake-up mechanism to accommodate gNB/TRP/beam long dormancy

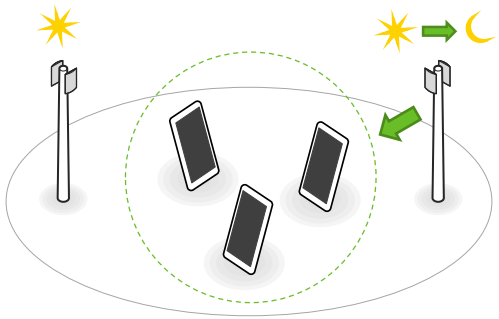


gNB/TRP/Beam OFF if no UE in its responsible area



gNB/TRP/Beam ON upon receiving wakeup notification from UE (conditioned on network rule(s))

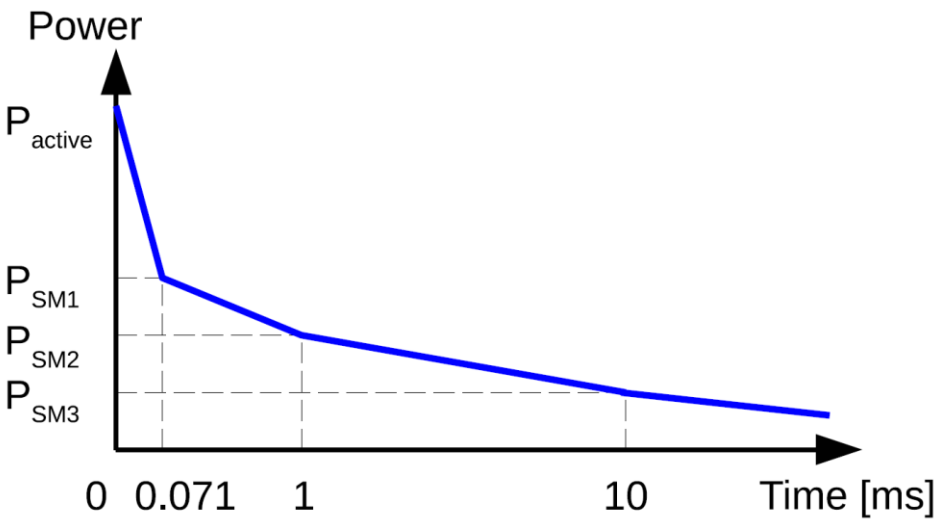
Case 2: Dynamic group indication for gNB/TRP/beam short dormancy

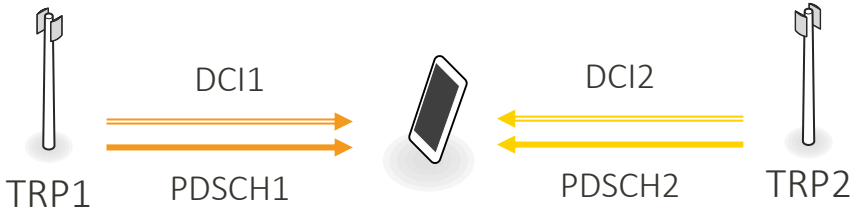


TRP2/Beam OFF after sending sleep indication for UE group

Evaluation methodology

- Develop gNB/TRP/beam power consumption model
  - gNB/TRP/beam Sleep Modes (SMs)
  - Transition time and energy and average power level for each of the sleep modes
  - gNB/TRP/beam operations model
  - Power scaling for RF and baseband adaptations, etc.
- UE power consumption model ext. for mTRP and mPanel operations
  - UE operations for multi-TRP and multi-panel
  - Power scaling for multi-panel and multi-panel operations, etc.
- Fundamental for quantitative evaluations and justification on the potential solutions





Thank You!