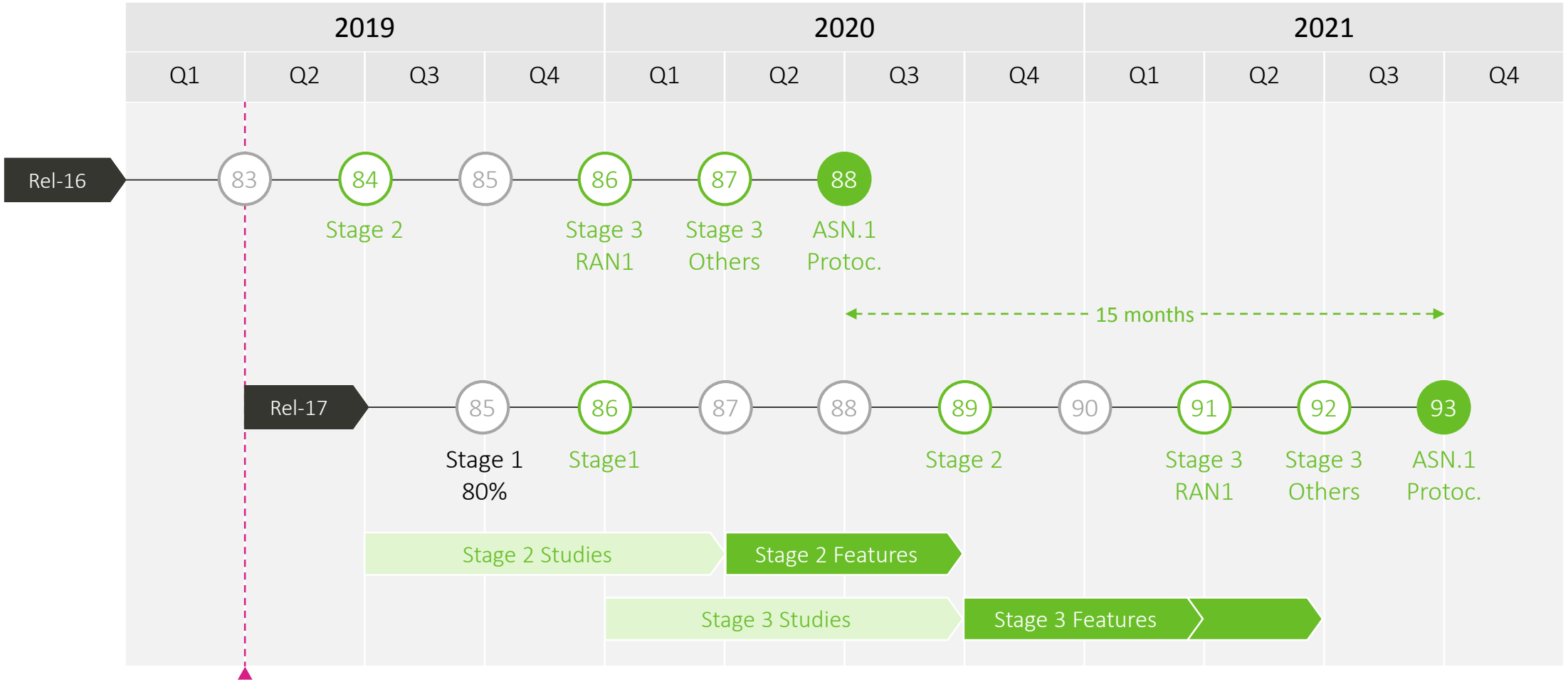
RP-190458

MediaTek view on Release 17
RAN

3GPP TSG RAN#83
Shenzhen, PRC, 18-21 March 2019

Release 17 timeline
15-month release

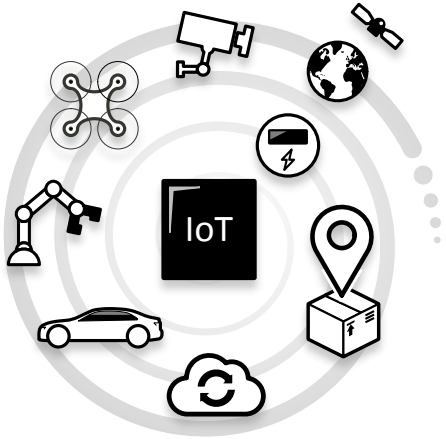


Unleash wireless – everyone, everything, everywhere

New Mobile Experiences

Main drivers
eMBB

Critical enablers
Consistent UX, Energy efficiency



Industries Transformation

Main drivers
mMTC, URLLC, V2X[1]

Critical enablers
Reachability, Energy efficiency

Ubiquitous Connectivity

Main drivers
eMBB, mMTC, URLLC

Critical enablers
Technology, Spectrum

NOTE 1: V2X enablers defined pre-Rel-17

Rel-17 in a nutshell
Main directions

- Energy efficiency
  - Power consumption reduction in mmW and unlic. spectrum
  - Power consumption reduction with/without data Rx/Tx
  - Power consumption reduction of 5G technology components
  - Network measurement/monitoring of UE Energy Efficiency
- Consistent user experience / reachability
  - Higher-layer protocol enhancements
  - Cell-edge coverage enhancements e.g. CoMP
  - UE-assisted interference mitigation
- Ubiquitous connectivity
  - UE-based ‘indoor’ coverage
  - Support for NTN with NR
  - Support for NTN with NB-IoT
- (I)IoT
  - Further URLLC enhancements (cell edge, spectrum & energy efficiency)
  - NR IoT (power and data efficiency)
  - More potent NB-IoT (mobility, latency, data rate)
- New NR bands and associated enablers

UE Power Efficiency

Lead: RAN1

Motivation

- Power efficiency, heat dissipation remain critical points esp. for battery-powered devices and small form factor devices
- mmW, unlicensed spectrum

Objectives

- NR-U: intensive UE monitoring means high power consumption: this needs to be studied
- mmW: Further mmW improvements to address power hungry RF and beamforming operations
- Rel-16 left-overs
  - EN/MR-DC power efficiency: time-domain power saving with E-UTRA
  - Idle mode: Rel-16 focused on connected mode however power efficient idle mode is very important for all devices, and for specific applications
  - BWP Switching time reduction
  - BPW RRC signaling overhead reduction
  - Network measurement for UE energy efficiency

UE-based Indoor Coverage Enhancements

Lead: RAN1

Motivation

- Very limited additional capacity in low bands 0.6-2GHz relative to LTE
- Lower/No indoor penetration in C band and mmW spectrum
- UE-based approaches to enable NR data rates indoors in suburban/rural areas
- Seamless ”out-of-the-box” operation with no/limited user intervention
- Synergy with standalone NR-U
- Home connectivity

Objectives – explore the following alternatives and identify gaps

- UE relay approaches
  - NR Sidelink (PC5) UE-network relay
  - Smart UE-based forwarding (e.g. amplify&forward, additional redundancy)
  - UP-only relay (CP via gNB)
- NR-U access point (deemed possible in Rel-16 already)
- UE as an IAB node (TBC)

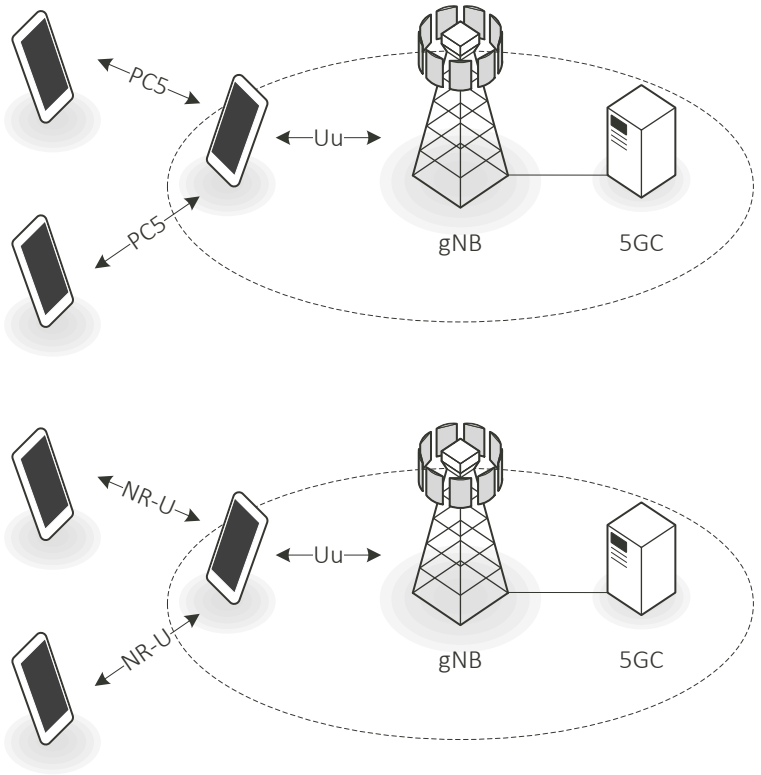


Fig. 1: examples

UE-assisted Interference Mitigation

Lead: RAN1

Motivation

- Finer characterization of the channel response of the desired signal driven by codebook design evolution in NR
  - With the same Tx power, the network can deliver data more efficiently to a UE.
  - However Rx performance is dependent not only on the strength of the desired signal but also on that of the interference
  - Better characterization of the interference at the UE and corresponding feedback to the network can increase performance (e.g. independently of the regular CSI feedback (RI/PMI/CQI)).

Objectives

- Study UE interference characterization and reporting, addressing at least the following issues:
  - ”flashlight” effect due to beam-formed transmission
  - Cross-link interference due to dynamic TDD
  - Overlapping scenarios between SU/MU MIMO and dynamic TDD
  - Reciprocity-based CSI acquisition limitations

NR-based NTN

Lead: RAN1

Motivation

- Non-covered areas e.g. rural broadband, maritime and aircraft communications
- NR suitability for satellite spectrum
- New market opportunities
- LEO deployments can enable NTN service with same cellular device form factor and antenna design
    - Typical LEO Satellite RTT compatible with many Real Time applications
    - Typical LEO Link budget compatible with NR cell-edge data rates

Objectives

- System information, common signalling [RAN2]
- Mobility
    - Idle mode beamspot / cell re-selection [RAN2, RAN4]
    - RRM measurement, triggering of RRM report
    - RLF/HOF, HO Delay / packet interruption
- Scheduling enhancements [RAN1, RAN2]
    - HARQ optimization with max 16 HARQ processes
    - UL timing alignment and Random Access procedures
- Disabling of Closed Loop Power Control, CSI [RAN1, RAN2]

NB-IoT-based NTN

Lead: RAN1

Motivation

- Minimal impact to NB-IoT specs. can unleash significant new market opportunities
- Truly ubiquitous coverage
  - Non-covered areas e.g. rural broadband, maritime routes
- Transportation and logistics
- No specification impact required for HARQ procedure or RACH procedures for LEO NTN deployments.
  - Legacy HARQ scheduling delay K0 can accommodate delay
- No major mobility-related issues identified
  - No CSI and no HO in connected mode
  - UE re-selects new cell when RLF is triggered

Objectives

- Enhancements to system information, common signalling [RAN2]
- Enhancements to mobility [RAN2, RAN4]
  - Idle mode beam-spot / cell re-selection
  - RRM measurements
- Overall RRM/RF performance requirements [RAN4]

Further enhancements to URLLC

Lead: RAN1

Motivation

- Capacity: More attention required on URLLC spectral efficiency and overall system capacity, more specifically on cell-edge UEs.
- NR-U URLLC: URLLC in unlicensed spectrum is challenging, but a subset of URLLC requirements may be satisfied.
- Power Consumption: Improving UE power consumption for battery-powered URLLC devices with a small form factor.
- Balancing UE complexity with URLLC requirements: Traffic pattern for most stringent latency is highly predictable, and does not need the same scheduling flexibility as for eMBB traffic. Unnecessary flexibility causes poorer spectral efficiency and also unnecessary UE complexity.
- URLLC Mobility

Objectives

- Performance and spectral efficiency enhancements for cell-edge UEs (e.g. using CoMP).
- Extending NR-U specification to support at least some URLLC services.
- Control channel enhancements to improve UE power consumption for URLLC UEs.
- Introducing a trade-off between UE critical processing time requirements (N1, N2, etc.) and URLLC traffic predictability.
- De-prioritised R16 topics: Mobility capability for URLLC.

Higher-layer protocol enhancements

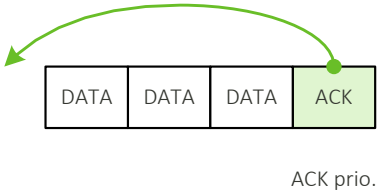
Lead: RAN2

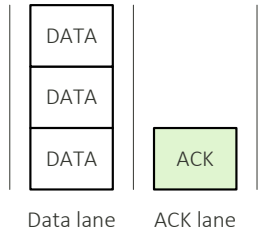
Motivation

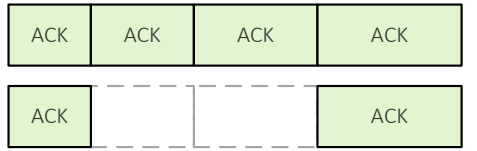
- TCP: pre-eminent transport protocol with known performance bottlenecks
- TCP Acknowledgements
  - Intermingling with TCP Data: head-of-line blocking resulting in lower Tput
  - Cumulative: High ACK volume with redundant ACKs
- TCP high-sensitivity to connection loss
  - Exacerbated with mmW blocking
- Commonalities with other protocols/enhancements (e.g. QUIC, TCP BBR)

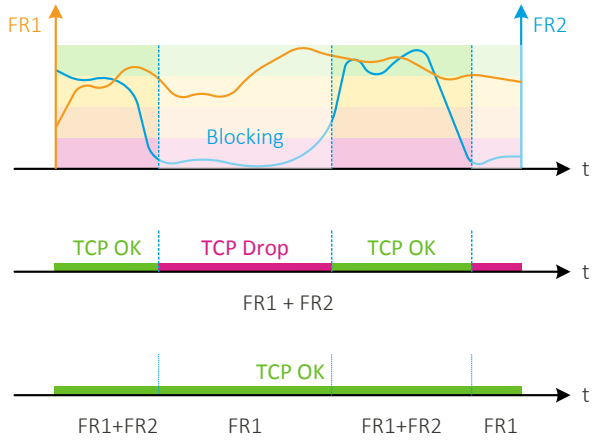
Objectives

- TCP ACK detection, prioritization and selected suppression
- Pro-active link switch to sustain TCP performance









eNB-IoT
Lead: RAN2

Motivation

- NB-IoT use beyond IoT e.g. Kids watches
- Clear demand for a more capable NB-IoT driven by affordability
- Better support for mixed traffic

Objectives

- Data rates enhancements in both UL and DL: higher order modulation [RAN1]
- Latency enhancements: carrier “segregation” per coverage level [RAN2]
- Mobility enhancements: no RLF-based mobility [RAN2]

NR IoT
Lead: RAN2

Motivation

- Demand for IoT beyond LPWA low duty cycle
- Power consumption remains a critical enabler for IoT
- Unique opportunities stem from NR-U
- Need to balance data rates, latency and power consumption

Objectives

- Idle mode / RRC Inactive power saving
  - NR support for eDRX
  - NR support for Wake-up signal for paging
- Background traffic / Signaling enhancements
  - EDT with normal RACH and 2-step RACH
- Scalable UE capability combinations

Misc. NR improvements

- “Normal” technology-driven evolution
  - E.g. Gaps in earlier releases, issues arising in initial deployments
- Further MediaTek views towards RAN#84
  - E.g. UL MIMO codebook design

Thank You!