Qualcomm

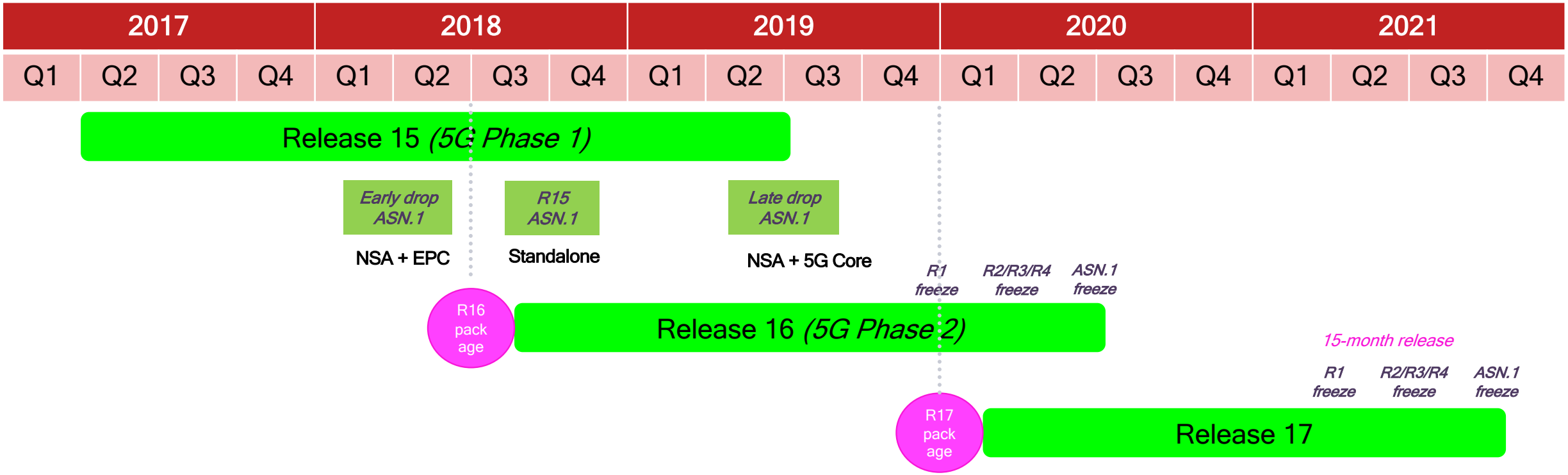
RP-190834

3GPP RAN #84
Newport Beach, 3-6 June 2019

Views on 3GPP RAN Rel-17

Qualcomm

3GPP work-planning & schedule



Principles for 5G evolution

From Rel-16 to Rel-17: working towards the fulfillment of the 5G vision

- The Rel-16 package did
  - Expand cellular to new verticals
    - Automotive, industry/factory automation, broadcasters, cable operators, satellite comms, etc
  - Include a number of items meant for eMBB enhancements
    - UE power savings, eMIMO, RIM/CLI, IAB, etc.
  - Explore expansion to new spectrum (>52.6GHz, 7-24GHz, unlicensed)
  - Continue LPWA / 5G Massive MTC evolution with NBIOT/eMTC

- Release 17 should leverage the flexibility of 5G to
  - Sustain a healthy evolution path for Mobile Broadband
  - Expand into new spectrum
  - Expand into new use cases
  - Balance the needs of the increasing number of actors participating in 3GPP and/or committed to the 3GPP ecosystem

Principles for 5G evolution

Shorter releases + balance evolution, ability of market to absorb & longer-term!

- Release 17 agreed to be 15-month long => good

- Balance evolution, ability of market to absorb & longer-term
  - Many of the Rel-16 items generally expected to have continuations into Rel-17
  - <u>**However**</u>, for some items we should ask ourselves the following:
    - *Is a continuation project in Rel-17 worth it?*
    - *If the targeted gain of a "continuation project" is minimal/incremental, does it justify the time to be spent in 3GPP?*
    - *Does a "continuation project" create the risk of slowing adoption of Rel-16 as customers might then prefer to "wait"?*
  - Bottom line: avoid auto-pilot continuation projects on all fronts
  - For some items we should consider "taking a break" to ensure that the market can "absorb" the R16 content
    - Avoid that standards get too far ahead of product roadmaps
    - If every single Rel-16 project had a "continuation", it would be impossible to open new areas!

Use cases expansion

On the increase of “full stack” projects

- Since Rel-13, 3GPP has seen an increase of “full stack” projects to address new verticals
  - “Full stack projects” is a term with which we define projects with components in most RAN, SA & CT WGs taking place at the same time in the same release
- The trend has increased, and RAN Rel-16 includes several projects that have a corresponding (and related) activity in TSG SA
- This is expected to continue, or even increase. It is thus important to maintain a strong cooperation between RAN & SA/CT to align timelines & consider “2nd order effects”
  - e.g., SA2 working on a feature that has RAN2/RAN3 impact without having a corresponding RAN2/RAN3 project, or viceversa
- We should all keep the whole 3GPP end-to-end picture into consideration as we plan for Rel-17
  - Also see slide 22 of this presentation

On the use of unlicensed spectrum

- Rel-16 will contain the baseline for NR based unlicensed operation, including standalone
- From Rel-17 onwards, the unlicensed component should be considered in any project as applicable
  - In the same way as we are ok to have FR2 considered as part of several different work/study items
- In other words, it should be possible to have a unlicensed component as part of a URLLC enhancements project and as part of a eMBB enhancements project
  - As opposed to a single “catch-all” NR-U evolution project on its own
- This does not detract from the core 3GPP principle that licensed spectrum is the preferred mode of operation, as per RP-140057 (endorsed in RAN #63)

On the split of WG time allocation between LTE & NR

Time for a rethink / re-merge

- The current Time Unit split between LTE & NR made sense when we wanted to compartmentalize the more “research oriented” NR track & the LTE evolution tracks

- However, the overall ecosystem picture has changed since then
  - Global traction of 5G NR deployments
  - Certain 5G vision components firmly fulfilled by a LTE-based design (36.xxx series)
    - E.g. 5G Massive IOT, 5G Broadcast

- We should re-merge the NR track & the LTE track from the perspective of TU planning
  - To the extent that we avoid approving projects based on the sheer number of supporting companies & we are rigorous in evaluating the merit of each, every new project can & should stand on its own feet, whether it is based on NR concepts or LTE concepts
  - Single total “TU budget” for RAN WGs irrespective of the basis RAT for new projects from 2019 onwards
    - We could keep some small separate TU budget for the respective “maintenance” parts if deemed necessary

Qualcomm's view of RAN Release 17

We estimate we can accommodate ~11 RAN1-led projects & few more RAN2-led projects

RAN1-led	
eMBB enh. incl. MIMO	1024QAM, 8RX UE, hierarchical mobility, MIMO enhancements. Including unlicensed. See RP-190835
NR for 52.6 -71 GHz	Work item directly for a a smaller range covering the 60GHz band, based on FR2 design. See RP-190837
IIOT enh. incl. NR-U	URLLC-U, IIOT/URLLC in FR2
NR-Lite	Lower tier, smaller bandwidth NR for IOT (non LPWA) eg certain sensors, cameras, wearables. See RP-190844
Massive MTC enh. (NBIOT/eMTC)	Data rate increase, Power enh., Relays, Async UL, Multicast. See RP-190850
NR V2X enhancements	Ultra reliability over PC5; V2X in pedestrian/micromobility; RSU enhancements. See RP-190839
IAB enhancements	gNB spatial mux'ing (SDM), other RAT backhauling, topology improvements
NR Positioning Enh	Improve accuracy, use RTT for network sync, multi-carrier positioning. See RP-190861
XR in 5G NR	Study - Gap analysis on AR, VR, XR over NR. See RP-190836
NR UE-UE Sidelink	Study - High-performance UE-UE offload link (NCIS)
NTN (Satellites)	Study - NR adaptation to satellite link

RAN2-led	
Multi-SIM / DSDS	Study - SA2 Study approved
NR "Mixed Mode" Multicast	Study - For V2X, IOT, PuBS. SA2 study approved. See RP-190853
Small data for NR	Small data and fast transition for RRC Inactive and Idle modes. See RP-190838
IIOT extensions	Ethernet multicast & other leftovers as/if needed

RAN3-led	
EnTV + 5GC	Work in RAN3 corresponding to ongoing item in SA2. See RP-190853

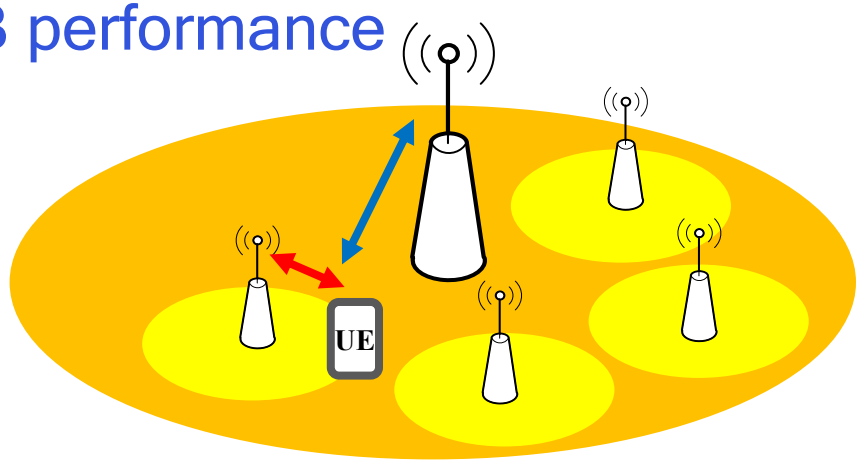
Organization of "NR sessions" &"LTE sessions" to be re-considered

RAN1-led

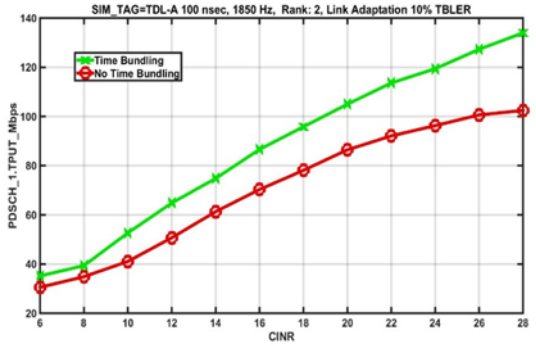
Qualcomm’s view of RAN Release 17

NR Mobile Broadband Enhancements

Work Item covering multiple areas, focused on eMBB performance



- Mobility Enhancements
  - Hierarchical mobility
  - UL-based measurement and triggering
  - Multi-beam mobility enhancements
- Coverage and Capacity
  - Reference signals
  - CSF w/ reciprocity (incl. FDD), enhancements for medium-to-high Doppler
  - Enhanced beam management
  - Multi-TRP for uplink and unlicensed spectrum
- Spectral Efficiency
  - Peak rate enhancements
  - UE Rx from 4 to 8
  - Simultaneous Tx of uplink physical channels
- Power Saving Enhancements
- Lesson Learned from Rel-15 deployments



500 Km/h, 4 GHz, TDL-A 100 nsec, rank 2

More details in RP-190835

52.6 - 71 GHz

Proposal for “>52.5GHz”: address the subset 52.6 - 71 GHz first

- Range of the RAN Plenary study (52.6 to 114) was arbitrary => **consider splitting it**
  - 60GHz bands stands-out: global, available today, regulations in place
  - No 3GPP solution which can tap on market opportunities

- Address the subset 52.5-71 GHz first with a simple approach that extends FR2 characteristics
  - Open Rel-17 **work item** on 60GHz
  - **Define FR2x**: 52.6GHz-71GHz => includes 60GHz (57GHz-66GHz) and extended 60GHz band (66GHz-71GHz)
    - FR2x inherits all properties of NR2 (64 SSB beams, waveform, etc.)
    - SCS is increased (TBD) - to cover 2GHz channel BW with smaller FFT size
    - Licensed & unlicensed

- Range 71GHz-114.25GHz can be considered separately: no urgency

Address this in Rel-17 with a “simple approach” Work Item that extends FR2 principles

More details in RP-190835

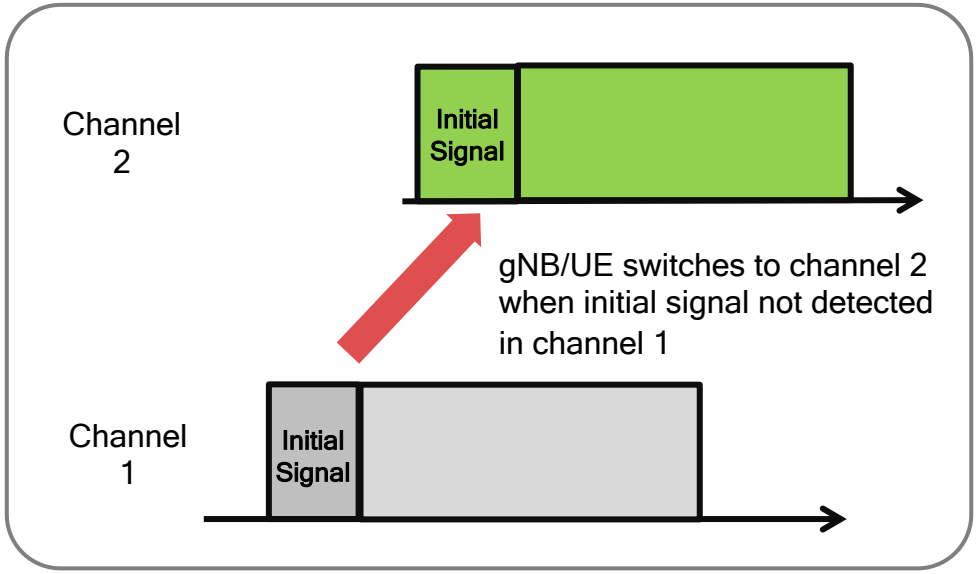
Industrial IOT / URLLC enhancements

Work Item

- IIOT enhancements in Unlicensed Spectrum
  - IIOT with spectrum sharing and unlicensed operation
    - Adjacent deployments sharing licensed spectrum
    - Multiple operator sharing spectrum via FBE enhancements
  - Multi-TRP/CoMP in unlicensed
  - Interference handling in NR-U

- IIOT enhancements in licensed operation
  - Group control on SPS/CG retransmission
  - Power control enhancements for retransmission
  - Combined DL and UL grant or SPS and CG configuration
  - Reliability improvement for small payload ACK/NACK

- IIOT enhancements in FR2
  - Feedback enhancements for IIOT
  - Beam switching enhancements for IIOT
  - Enhanced processing timeline for FR2
    - No capability 2 support in FR2



Channel/BWP switching based on initial signal detection

NR-Lite (NR-IOT)

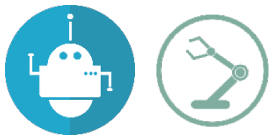
Expand the ecosystem

- What are Low Tier 5G UEs
  - Industrial sensors / video monitoring
  - Relaxed IOT devices
  - Wearables
  - May or may not be power constrained

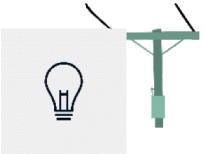
Healthcare

Smart cities

Transport and logistics

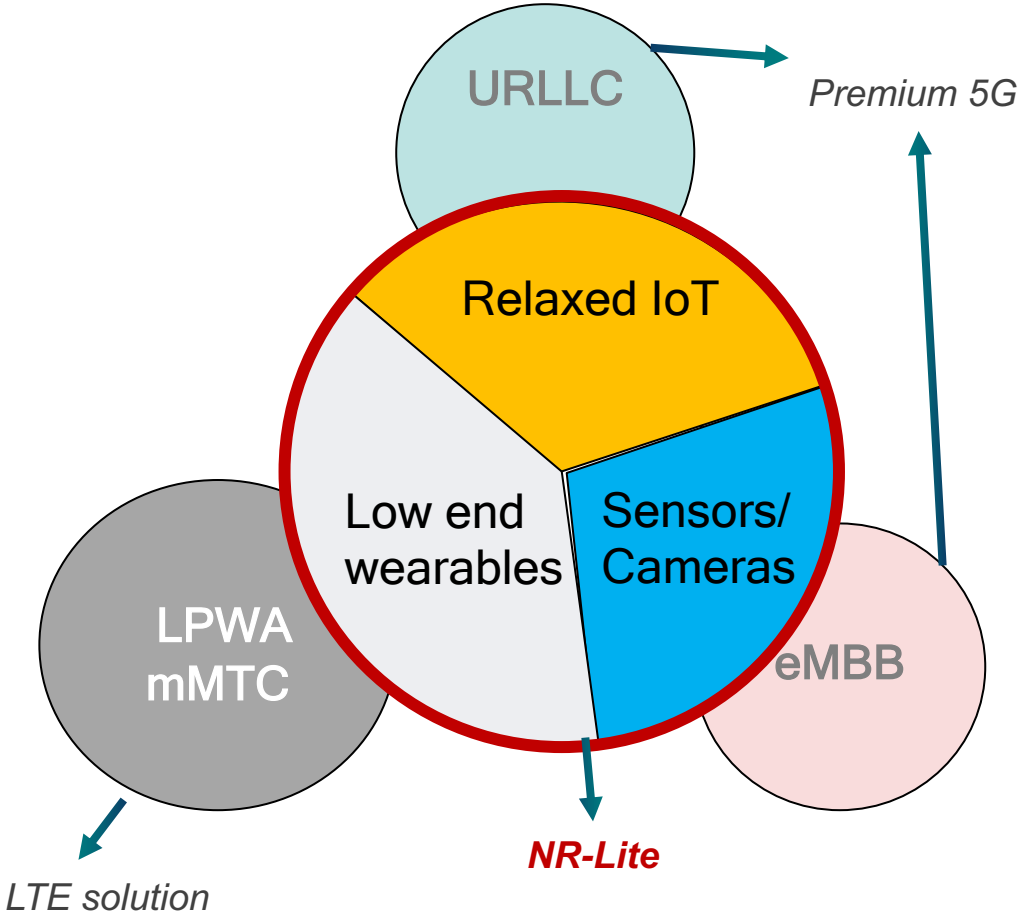


Process automation



Elec. distribution

Building automation

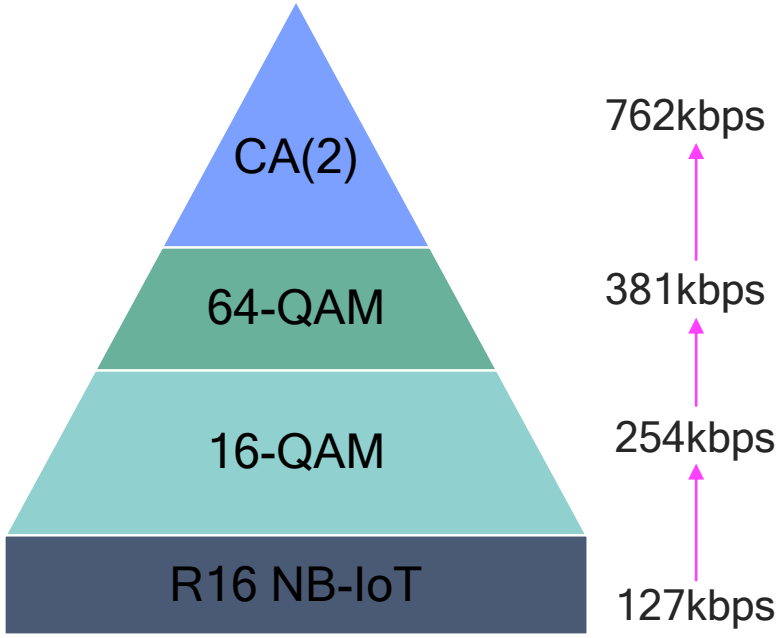


Characteristics	requirement
Latency	10-30ms
Reliability	1e-3/1e-4/1e-5
Data rate	10Mbps and below
Coverage	MCL=143dB

LPWA / Massive MTC enhancements

Work Item – continuation of NBIOT / eMTC

- Increase of data rates:
  - Introduce higher order modulation (up to 64QAM) & larger bandwidth/carrier aggregation to DL NB-IoT
  - Enable scheduling of PDSCH in all the subframes (increase throughput by 20%) for eMTC
- Power enhancements:
  - Relaxed monitoring of paging / wake up signal
- Relays
  - Several SA1 studies include UE relays in their requirements
  - Consider both UE and network-based relay
- Async uplink
  - Allow for msg1 transmission without timing advance
- Multicast/broadcast for eMTC/NB-IoT connected to 5GC



More details in RP-190850

NR V2X enhancements

“URLLC on PC5”, pedestrian/micromobility safety & RSU enhancements

- Ultra reliability enhancements over PC5
  - Rel-16 will introduce HARQ to get more reliability
  - However several applications such as coordinated driving target 99.99% or 99.999%
  - Further enhancements needed to achieve ultra-reliability: URLLC on PC5

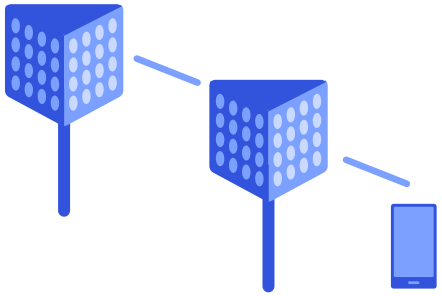
- Pedestrian to Vehicle & Micromobility
  - Pedestrian / micromobility safety (“Vulnerable Road Users”)
  - To be addressed by V2X PC5 also being adopted for smartphones, bicycle helmets, etc
  - Need power consumption optimizations for pedestrian UEs for NR V2X
  - Also need a introduction of a new signal for positioning/ranging in unlicensed spectrum

- Infrastructure to Vehicle
  - RSU performing resource allocation & scheduling to help with traffic engineering in complex urban situations
  - Infrastructure based sidelink ranging to improve vehicle position

More details (incl. our views on V2X spectrum) in RP-190839

IAB enhancements

Work Item (proposed as RAN1 lead)



- Spatial multiplexing
  - Going beyond TDM between access & backhaul links)
  - Support for SDM/FDM and SFFD on IAB-nodes
  - Lead RAN1, RAN2
- Support of LTE and non-3GPP backhauling over NR
  - Lead RAN3, RAN2
  - IAB enables wireless backhauling of eNB/eNB-DU/non-3GPP access points
  - Including support of QoS
- Topological redundancy
  - Lead RAN2, RAN3, RAN1
  - Extension to more than two parent nodes
- Enhancements to inter-CU IAB-node migration
  - Lead RAN2, RAN3, RAN1
  - DU context forwarding between source and target CU
  - Configuration by target CU via source CU.
- Reduced latency over multi-hop transport
  - Lead RAN2, RAN1
  - Leverage of mini-slot for latency-critical traffic on backhaul links
  - Scheduling improvements
- Reduced network planning
  - Lead RAN2, RAN3
  - DL and UL transport power management to allow for higher tolerance to node deployment
  - Additional measurement metrics to improve centralized topology optimization
- Network power savings
  - Lead RAN2, RAN3
  - Power-down of IAB-nodes in case of low traffic load
    - Similar to Rel12 LTE Small Cell on/off feature
  - Dynamically configurable periodicity of broadcast channels to reduce overhead

Positioning

Work Item to enable more use cases with greater accuracy & scalability beyond R16

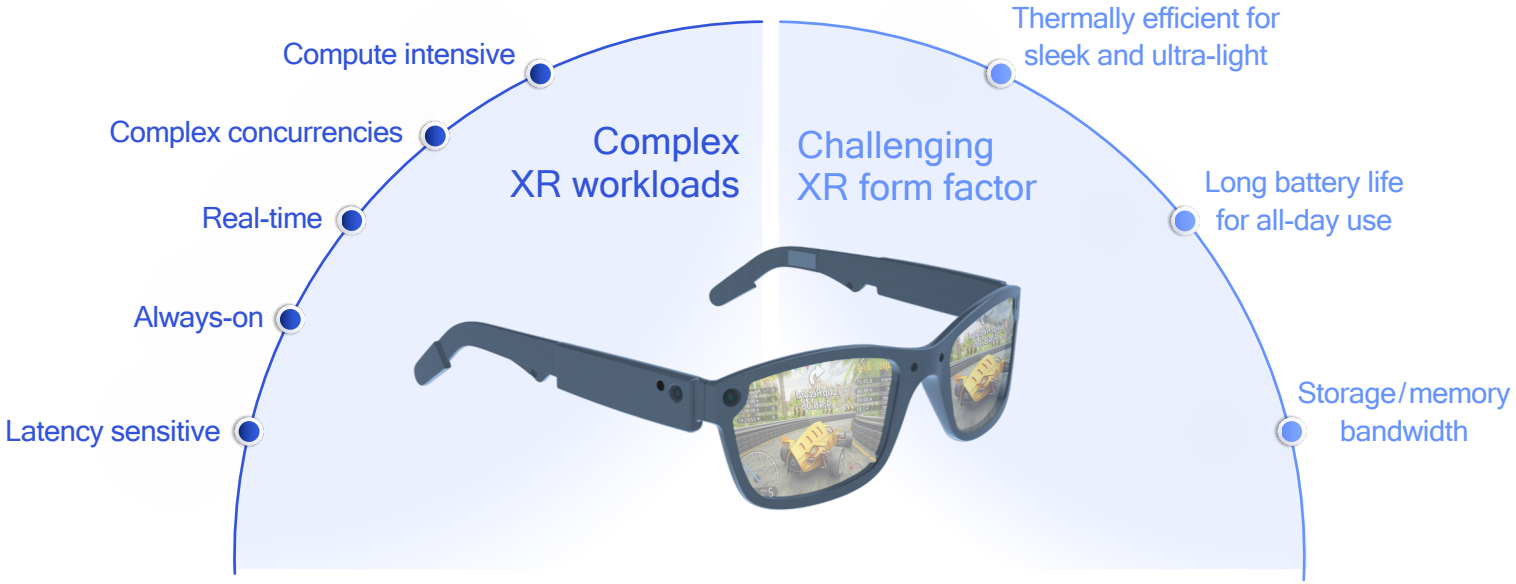
- There is still a delta between the performance achievable in R16 & what the industry would like to see
  - Target Rel-16 positioning: <3m indoor (80%) & <10m outdoor (80%)
  - 5G positioning requirements in TS 22.261: absolute 0.3-10m (95% confidence, 95-99.9% availability) & relative 0.2m (95% confidence)

- Candidate techniques
  - Enable UE-based mode for all Rel-16 positioning methods
  - Higher accuracy
    - Multi-carrier positioning
    - Physical-Layer Non-line-of-Sight Path Discrimination
    - Improving synchronization and accuracy of reference nodes in network
  - Low-latency/high capacity positioning
    - Moving location server closer to the target; already agreed to study this in RAN3

More details in RP-190861

XR in 5G NR

Study Item



- What 3GPP can do?
  - Simulation campaign for various XR applications in different network configurations
  - Field measures of existing XR applications in trial/commercial NR networks
  - Holistic 3GPP studies on XR use cases and potential enhancements in Rel-17

More details & initial performance evaluation in RP-190836

NR UE-UE Sidelink

Study

- In the past, Qualcomm made the point that sidelink design cannot be “generic” but needs to be focused on a specific use case
  - The point still stands
  - See RP-170197

- Opportunities may exist for specific applications: high data rates use cases e.g. (called “NCIS” in SA1/SA2)
  - Already ongoing in SA1, SA2 (S2-1902932)
  - Clusters of UEs using the same applications (eg gaming)
  - UE-UE sidelink under network control as an offload mechanism
  - Leverage NR V2X concepts: NR V2X PC5 should be the basis & the work should identify deltas
  - For example, optimize PC5 for FR2

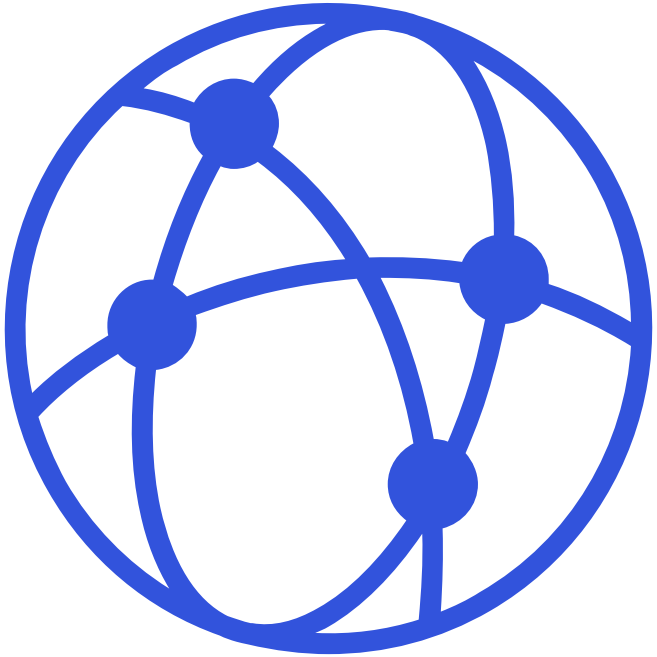
- Public Safety should also be considered as part of the scope with the goal of having PubS maximally reusing concepts from NCIS

NTN (Satellites)

Study item

- ”Adaptation” of NR PHY & protocols to satellite communications

- This is potentially a huge project; it has to be discussed how to manage it in terms of workload



RAN2-led
&
RAN3-led

Qualcomm’s view of RAN Release 17

SA1/2/3 items w/ possible impact to RAN WGs

Including already approved & yet-to-be approved items

Already approved SA2 SIDs with RAN impacts

- SP-181251 (Intel) **Study on system enablers for multi-SIM devices**
  - General enhancements for Dual SIM Dual Standby (DSDS)
- S2-1901392(Huawei) **Architectural enhancements for 5G multicast-broadcast services**
  - Largely what we call “mixed mode” (multicast).
- S2-1906727 (Oppo/CATT) **Study on System enhancement for Proximity based Services in 5GS**
  - “NCIS”: D2D for high-bitrate services
  - Public Safety use cases may be considered also
- **EnTV + 5G Core included in Architectural enhancements for 5G multicast-broadcast services (objectives “set B”)**
  - Connects E-UTRA EnTV to 5GC based broadcast architecture
  - Support for broadcaster requirements (dedicated b’cast network, receive only mode etc)
  - Corresponding work in RAN3
  - SID changes approved in SA2#133 (not yet from SA#84)

Already approved SA3 SIDs with RAN impacts

- SP-181035 (Rapporteur: Vodafone) **New SID on User Plane Integrity Protection**
  - Integrity protecting User Plane, including potential enhancements needed to support User Plane Integrity Protection up to the full data rate
  - Support for Integrity Protection in E-UTRA
  - Corresponding potential work in RAN2, RAN3

Other items (related to either SA2 R16 or SA1 R17)

- **Supporting Unmanned Aerial Systems and 5G Enhancement for UAVs**
  - Drone identification and authorisation
  - KPIs based on communication service
  - KPIs for command and control traffic
  - On-board radio access node (UxNB)

NR Multi-SIM / RAT concurrency

Study

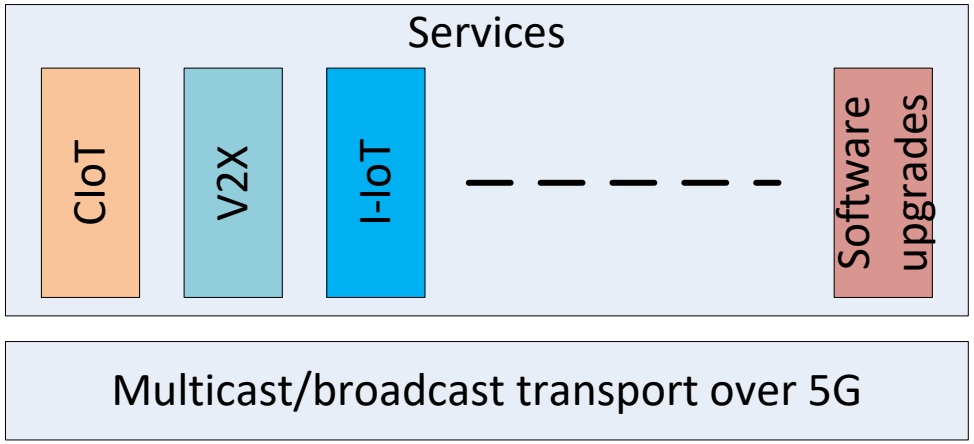
- Enable RAN component of SA2 study - Enablers for multi-SIM device

- Potential related RAN objectives (based on the SA2 agreed objectives)
  - A mechanism for delivering paging destined to SIM A while the UE is actively communicating with SIM B
  - A mechanism for avoidance of paging collisions occurring in the UE between SIM A and SIM B

- Some considerations on RAN requirements
  - Solutions shall apply to multi-SIM for NR/LTE and NR, LTE, 3G, etc. combinations, i.e., any RAT combination plus NR/LTE
  - Solutions shall apply to where not all of the associated MNOs support the multi-SIM feature
    - Some performance degradation may occur if all MNOs do not support the feature
  - Solutions that require inter-MNO coordination, i.e., inter-MNO interface, are excluded

NR Mixed Mode / Multicast

- The current SA2 study includes the following use cases:
  - IPTV
  - Transparent multicast delivery
  - Software update
  - Broadcast/multicast IOT applications
  - V2X applications
  - Public safety



- These different use cases may result in different requirements in the radio, e.g. as follows:

Scenarios/use-cases	Notes
Video/audio-streaming	4K video-stream may require 25Mbps per UE; delay requirements may depend on application (e.g. IPTV vs live stadium)
Software-update	Relatively high-tolerant on latency and data rate
Group-call (MC-PTT)	Higher-reliability is necessary especially for public safety such as MC-PTT (e.g., <= 150ms) [36.890]
Ethernet frame delivery for a factory	Highest is 0.5 ms latency with 99.9999% reliability;
V2X	10-100s ms latency depending on application

- Proposal for Rel-17
  - Study (R1/2/3) to enable different use cases for mixed mode/multicast

More details in RP-190853

Small data NR

Study item

- Motivation:
  - In many applications/scenarios UE generates only a small amount of data in a user session
  - Power inefficient for UE to transition in and out of RRC Connected for small data
  - Transitions have high overhead (e.g. RRC establishment/ reconfiguration, data inactivity timer, etc.)

- Related work already in Rel-16
  - Small data optimizations for NB-IoT/eMTC connected to 5GC.
    - User Plane / Control plane CIoT optimization, Early data transfer, UE release assistance information
  - Not applicable to NR and limited to 5G Massive MTC

- Proposal for Rel-17
  - Enable NR small data transfer optimizations to reduce signaling overhead and maximize battery savings for infrequent/frequent small data in RRC Inactive and RRC Idle modes

Draft Work Item in RP-190838

Industrial IOT enhancements

Work item

- TSN leftovers from Rel-16
  - TSN use cases in wide-area network (e.g. propagation delay compensation)

- Ethernet Broadcast/Multicast
  - Rel-16: Ethernet broadcast/multicast packets are unicast to each UE
  - Rel-17: Enhancements to use airlink more efficiently

EnTV + 5G Core

SA2 modifications agreed in SA2#133, small RAN3 impacts

- Broadcast architecture for EnTV

- Technical content
  - Dedicated broadcast architecture based on 5GC
  - Receive-Only UE
  - Focus on broadcasters owning/operating the network

- RAN3 led component dependent on the SA2 project
  - *Ideally* no UE impacts, hence no RAN2 impacts

More details in RP-190853

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