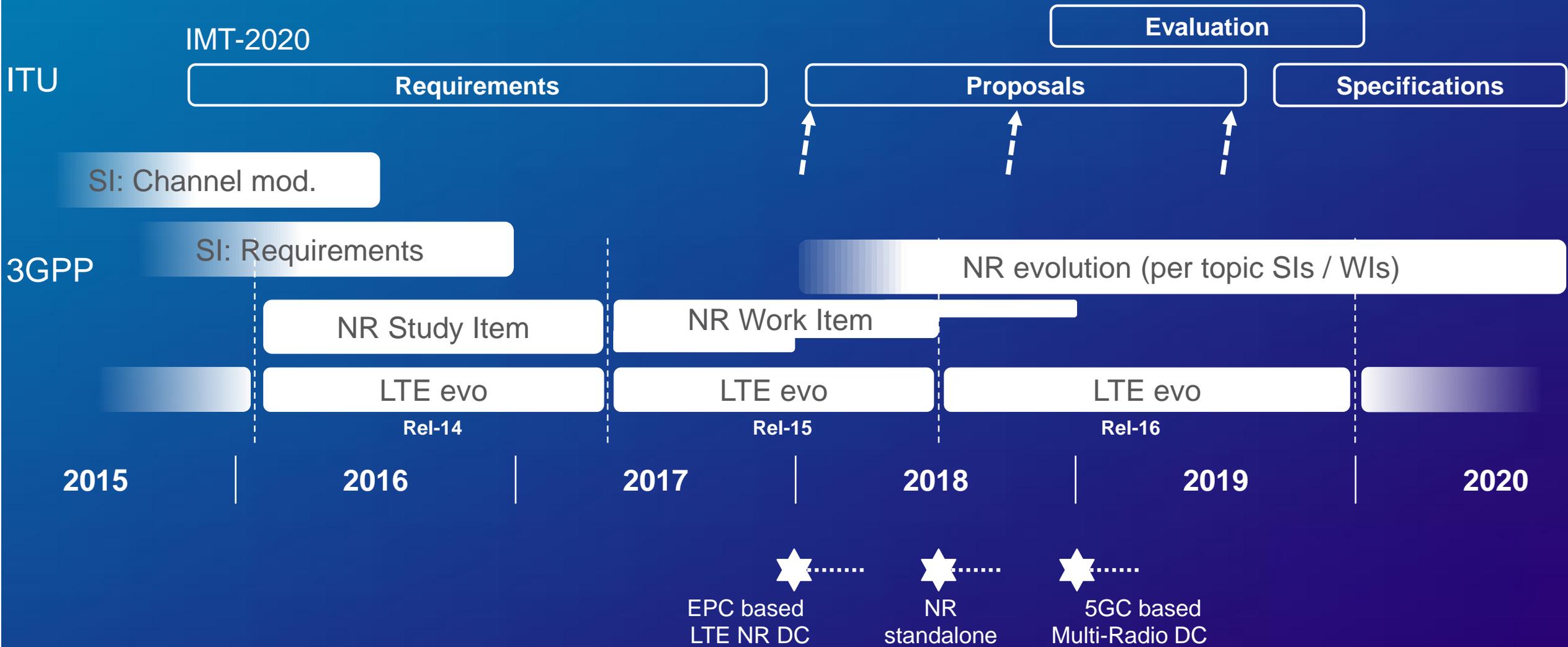


3GPP RAN

OVERALL REL-16 SCOPE



3GPP 5G TIMEPLAN



OVERALL REL-16 AMBITION



> NR

- Return to reasonable work load (after acceleration) for high-quality and sustainable standardization
 - > Time spent during meetings and number of (adhoc) meetings
- Consolidate Rel-15 features, maintenance and correction
- Continue already approved phase 2 work, small functional additions only
 - > There is no real market pull for NR enhancements (as there is no market yet)
 - > SIs preferred over WIs
- Objectives:
 1. High/competitive MBB performance
 2. Continue to address new use cases, e.g., IIOT

> LTE

- Continue adaptation of work load
- Objectives:
 - > Continue evolution targeting eMBB, mMTC and URLLC/IOT where needed
 - Backwards compatible, leverage existing LTE networks and UEs



eMBB

cMTC

mMTC

- › NR MIMO
- › MR-DC enhancements
- › NR mobility enhancements
- › NR IAB
- › NR SON/MDT

- › NR unlicensed

- › NR V2X
- › NR URLLC (L1)

- › NR IIoT (HL)
- › NR positioning

- › LTE-M
- › NB-IOT

REL-16 WIS/SIS

ERICSSON'S HIGH PRIORITY ITEMS



REL-16 NR PACKAGE – RAN1

ALREADY EXCEEDING TIME BUDGET...

Legend: TUs per meeting = Work Item

TUs per meeting = Study Item



	2018			2019			
	Q2 RAN#80	Q3 RAN#81	Q4 RAN#82	Q1 RAN#83	Q2 RAN#84	Q3 RAN#85	Q4 RAN#86
NR Maintenance (prio 1!)		14	12	4	4	2	2
Late drop: opt. 4/4a		1	1				
IMT-2020		0.5	0.5	0.5	0.5	0.5	0.5
NR-U		3	3	4	4	4	4
NOMA		3	3	3	3	3	3
V2X		3	3	4	4	4	4
Positioning		2	2	2	2	2	2
MIMO			2	3	3	3	3
UE energy efficiency			1	2	2	2	2
NR URLLC (L1)				2	2	2	2
Remote Interference Management				1	1	1	1
Integrated Access Backhaul (RAN2-led)		1	1	1	1	1	1
Mobility enh. (RAN2-led)			-	1	1	1	1

REL-16 NR PACKAGE – RAN2

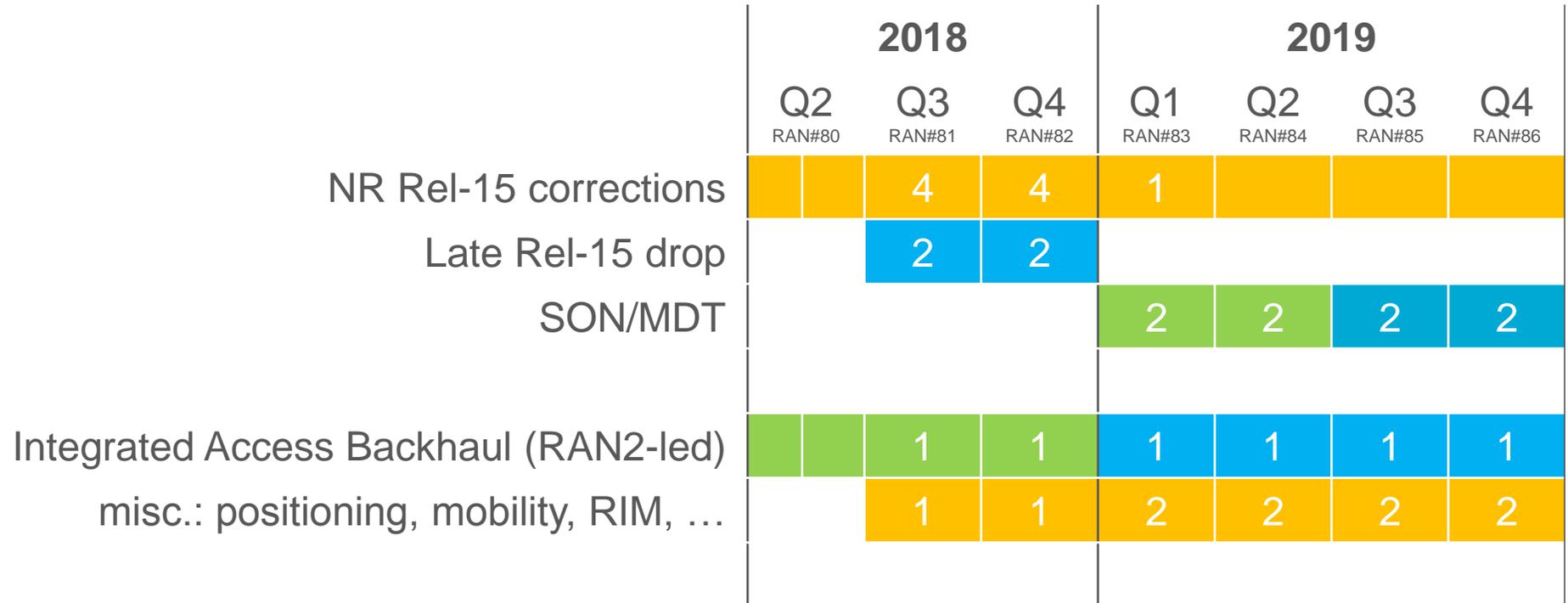


	2018			2019			
	Q2 RAN#80	Q3 RAN#81	Q4 RAN#82	Q1 RAN#83	Q2 RAN#84	Q3 RAN#85	Q4 RAN#86
Maintenance & ASN.1		15	13	10	6	6	6
Late Rel-15 drop		3	3				
Integrated Access Backhaul		3	3	3	3	3	3
Mobility enh.			0.5	1	2	2	2
MR-DC			0.5	1	2	2	2
NR IIOT (HL)				1	2	2	2
NR-U (RAN1-led)		1	1	2	2	2	2
V2X (RAN1-led)		-	1	2	2	2	2
UE energy eff. (RAN1-led)			-	1	1	1	1
others: IMT-2020, NOMA, positioning, SON		1	1	2	3	3	3

Legend: TUs per meeting = Work Item

TUs per meeting = Study Item

REL-16 NR PACKAGE – RAN3



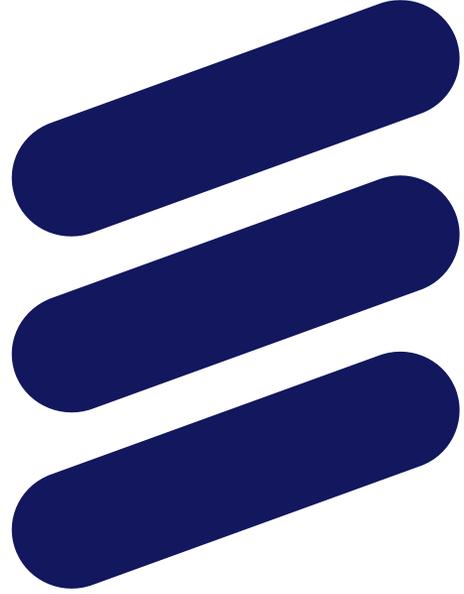
REL-16 LTE PACKAGE



	2018				2019			
	Q2		Q3	Q4	Q1	Q2	Q3	Q4
	RAN#80		RAN#81	RAN#82	RAN#83	RAN#84	RAN#85	RAN#86
Maintenance			4	3	2	2	2	2
LTE-M			3	3	3	3	3	3
NB-IOT			3	3	3	3	3	3
MIMO or Aerials?					2	2	2	2

Legend: TUs per meeting = Work Item

TUs per meeting = Study Item



ERICSSON

NR POSITIONING



INDUSTRIAL APPLICATION
& CONTROL



AUTONOMOUS CAR



TRAFFIC SAFETY & CONTROL



› High Accuracy / Low Latency Enablers

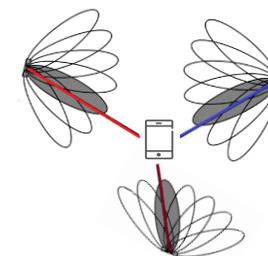
- Targeting positioning requirements in TS 22.261, TS 22.804, TR 22.862, TR 38.913

› Exploiting wider band reference signals for NR

› Studying the triangulation of beam angles and TOA based on massive antenna systems

› On-demand positioning reference signal transmission

› Hybrid GNSS-3GPP positioning



› Scenarios:

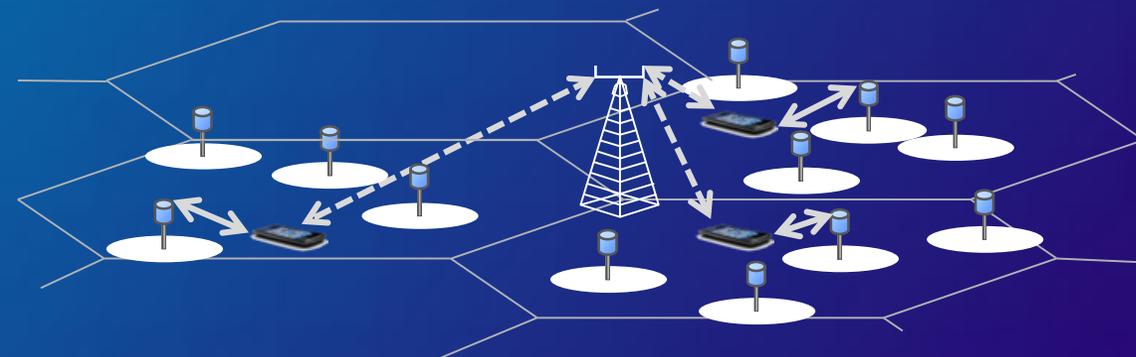
- Optimized for controlled “small” cell deployments, e.g.
 - › Factory automation indoor, automotive
- Based on available deployment models , e.g.
 - › Below rooftop urban deployment

NR UNLICENSED SPECTRUM OPERATIONS



- › Unlicensed spectrum considered by cellular operators as a complementary tool to augment their service offering

- › Adapt initial access (incl. 2-step RACH), channel access, scheduling/HARQ, and mobility operations for unlicensed spectrum regulation & characteristics
 - Reuse existing NR as much as possible
- › Existing bands and potentially new bands
 - Preferred band is 5/6 GHz
 - Fast track for existing bands re-using same coex. solution (i.e., LBT) as LTE-LAA
 - › Let's not replicate the LAA study
 - Coexistence study for new bands
- › Support diverse deployment cases
 - Carrier aggregation NR + NR-U
 - Dual connectivity LTE/NR + NR-U
 - Standalone NR-U



NR VEHICLE-TO- EVERYTHING (3GPP V2X PHASE 3)



- › Improved support for V2X services
 - LTE-V2X enables day-1 safety
 - NR-V2X is a complementary technology addressing new use cases and tighter requirements
 - › (But technically also suitable for day-1 safety)
- › Study NR design for V2X
 - Sidelink interface for broadcast ITS traffic, and with lower prio unicast, focusing on 5.9GHz
 - Cellular (Uu) enhancements for high mobility scenarios and improved efficiency when delivering ITS traffic
- › Ensure optimal NR-LTE coexistence
 - Deployment of NR and LTE UEs in separate channels in the ITS 5.9 GHz band
 - Enable control of NR UEs using LTE infrastructure to leverage on existing deployments (and vice versa)



NR MIMO ENHANCEMENTS



› DMRS and CSI-RS

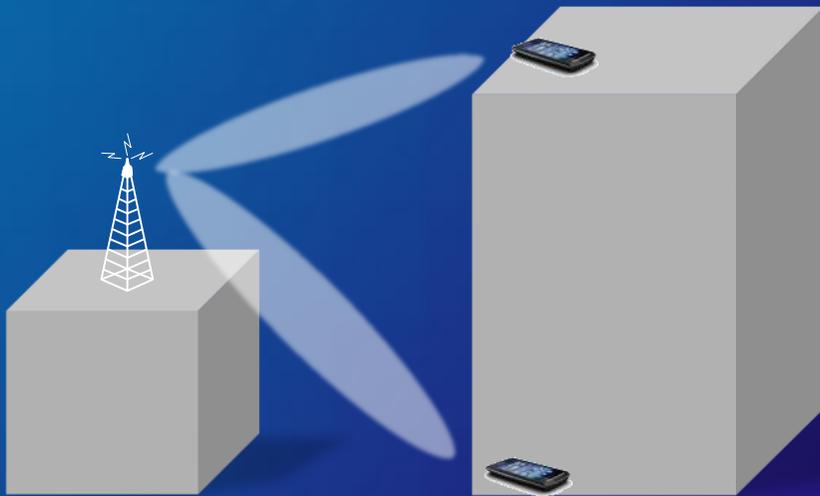
- Sequence mapping to REs leading to excessive PAPR of DMRS and CSI-RS relative to data
- Correct the design to achieve PAPR of RSs on par with data

› Enhanced Type II codebooks

- Type II codebooks has proven to be a powerful tool for operating MU-MIMO schemes with high spectral efficiency
- Consider further enhancements for type II codebooks, mainly targeting signalling overhead reduction

› Beam management enhancements

- Current BM is clunky to operate and has large signaling overhead
- Target streamlined BM with lower RRC/MAC CE signaling overhead, unified BM across channels and signals



LTE-M



- › Enhanced network management tools
 - Traffic spikes due to timed device reporting:
 - › Load distribution for preventing load spike, Connected Mode access barring, ...
- › Further improved efficiency & signaling reduction
 - Improved efficiency targeting reduced MBB capacity displacement and improved device battery life:
 - › CE mode improvements for non-BL UE, single DCI scheduling multiple TBs, improved measurement abilities, ...
- › Rel-15 leftovers

NB-IOT



- › Further improved cell edge performance
 - Improve coverage and battery life for UEs operating in coverage extension modes:
 - › Support 4 NRS ports for NPDCCH/NPDSCH

- › Enhanced network management tools
 - Introduce LTE SON/ANR tools, load distribution for preventing load spikes, Connected Mode access barring.

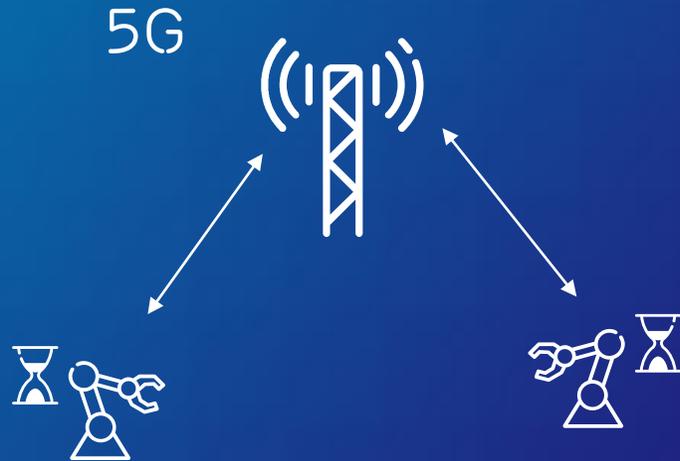
- › Further improved link efficiency
 - Closed-loop UL power control, UE channel quality and PHR feedback, improved efficiency of non-anchor carrier

- › Support new use cases
 - Public warning system (ETWS, CMAS), basic Idle mode inter-RAT mobility

- › Complete leftovers from previous releases

NR URLLC

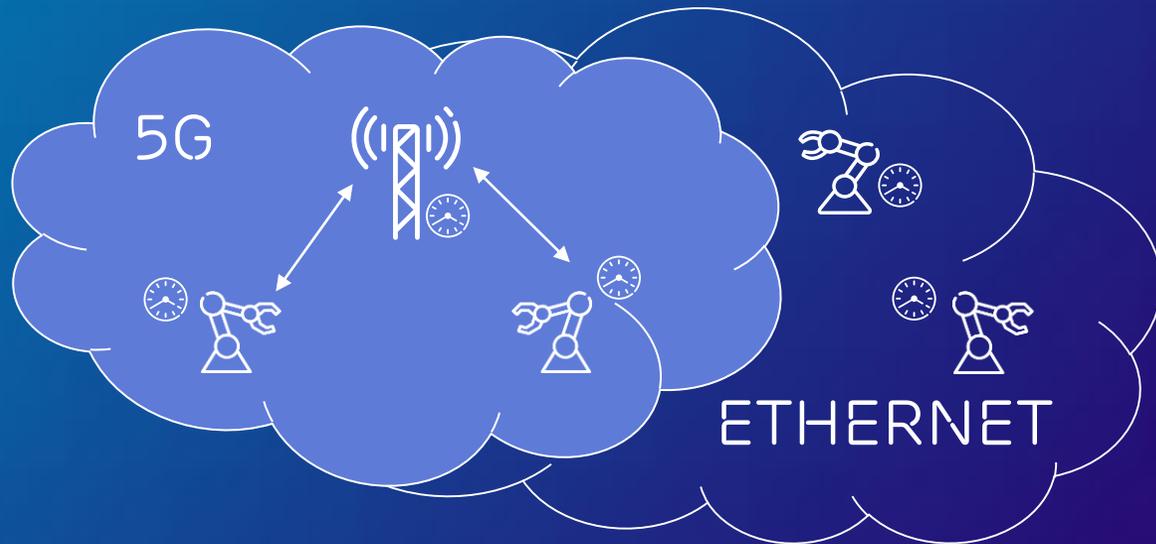
RAN1-LED, L1/L2 FOCUSED



- › Improved reliability (connectivity and operations) and latency
 - Enhance radio channel reliability
 - Decrease end-to-end latency via faster access
- › Improve full automation and flexibility
 - Scheduling enhancements

NR INDUSTRIAL IOT

RAN2-LED, HIGHER LAYER FOCUSED



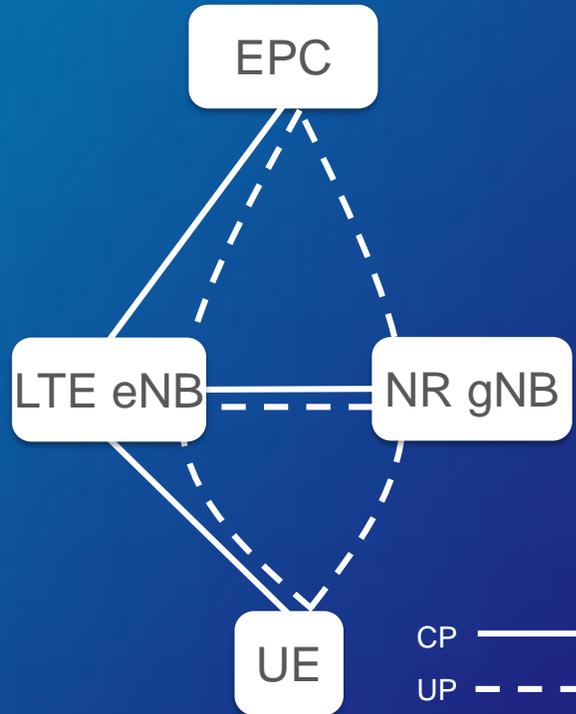
Use cases in TS 22.261 and TS 22.804



> Industry-grade NR for Industrial IoT

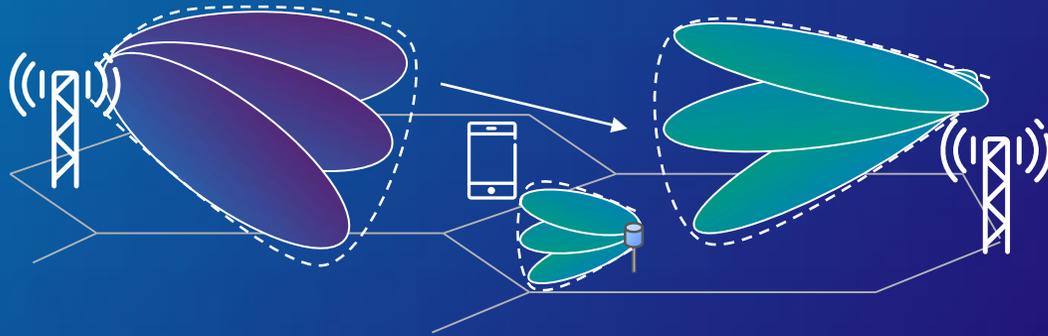
- Ethernet and IEEE 802.1 (e.g. TSN) features often the basis in such networks. 5GC introduces Ethernet-type PDU Session.
 - > Optimizations for Ethernet PDU Sessions
 - Header compression
 - Possible QoS enhancements
- Enabling time-synchronized operations of devices (e.g., time synchronized UEs to enable synchronized operating on joint tasks)
- Support for redundant PDU sessions
 - > aligned with SA2
- Study and define mid-tier NR UE (no new design)

MR-DC ENHANCEMENTS (JOINT LTE AND NR?)



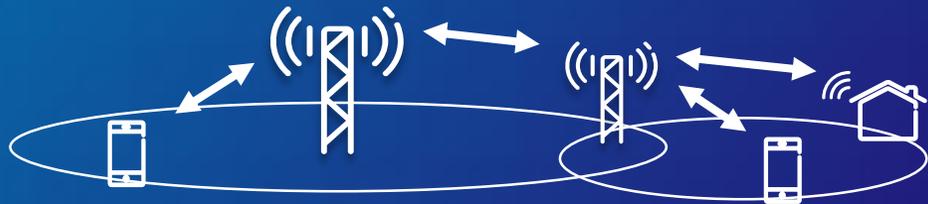
- › Further improvements to Rel-15 EN-DC to improve end user performance as well as increased NR utilization
- › Speed up transition to EN-DC
 - Support early measurement on NR
 - Keep EN-DC configuration when UE is in suspended state
- › Robustness enhancement, e.g.,
 - allowing RRC recovery via any RAT
- › Possible further evolution of other MR-DC cases (opt. 4, opt. 7, NR-NR DC)...

NR MOBILITY ENHANCEMENTS



- › Mobility is a cornerstone of 3GPP networks, commercially and in IMT-2020:
 - 500 km/h, 0ms interruption time, etc.
- › Rel-15 supports
 - Basic mobility procedure
 - 0ms interruption time - at least in one deployment
- › Rel-16 to enhance robustness and latency
 - Conditional HO and HO command diversity are good solutions for robustness improvement in both FR1 and FR2
 - Similar solutions can be applied to aerials as well (both LTE and NR)

INTEGRATED ACCESS BACKHAUL



- › Expected benefits:
 - Coverage extension for >6GHz
 - Easy and cost-efficient deployment

- › Most relevant deployment scenarios
 - Outdoor, small-cell relay nodes (targeting FWA & eMBB)
 - Fixed relays, but forward compatible to nomadic/mobile
 - Limited number of hops (≥ 2)
 - Star / tree deployment (no mesh)
 - Inband and outband relaying using >6GHz
 - IAB transparent to UEs (Rel-15 backwards-compatible)
 - Support SA and NSA operations

- › Design aspects
 - Architecture, protocols, and interfaces needed for decode and forward relaying
 - › Layer 2 forwarding (PDCP PDUs) reusing F1 (CU/DU split); PDCP & RRC in CU/anchor
 - Potential radio optimizations for inband relaying (if needed)
 - › NR timing relations and resource utilization already flexible enough

SON / MDT



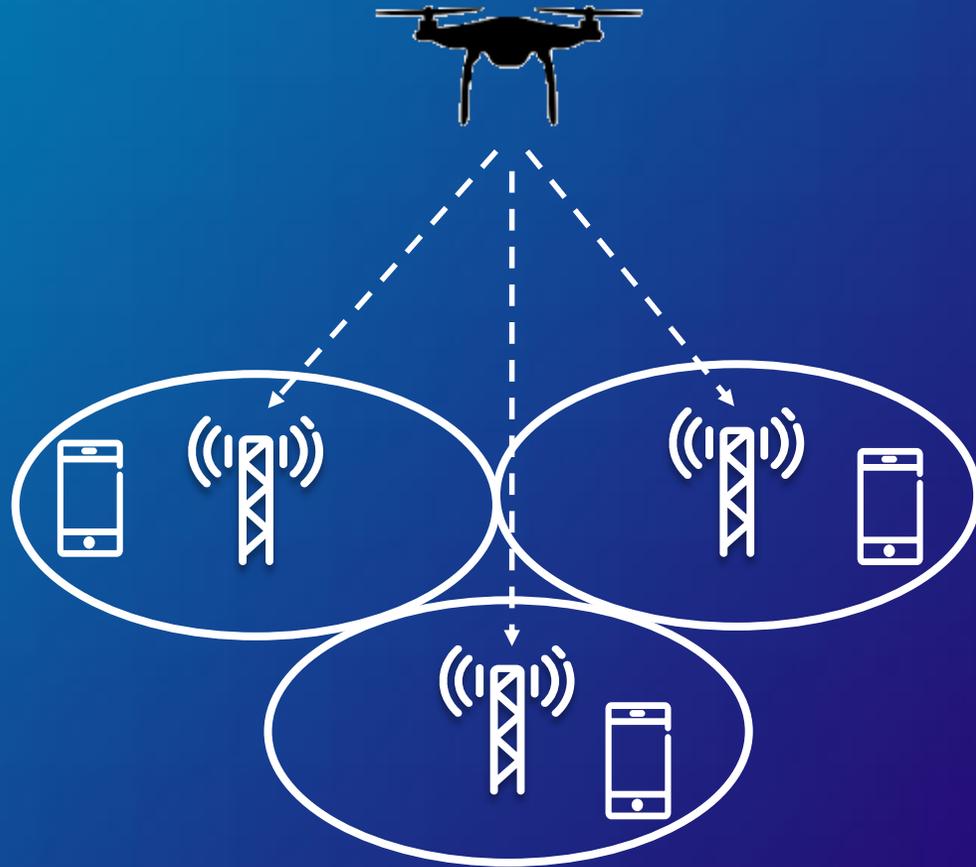
- › NR has many more possible configurations than LTE
 - self-optimization/organization needed

- › ANR is the only SON feature in Rel-15

- › Prioritize SON features relevant for early network roll-out
 - Improved UE feedback
 - › RLF report content including additional beam information, beam level measurement logs from idle mode
 - Prioritized optimization areas:
 - › Mobility robustness optimization
 - Cell individual offsets in reporting configurations, beam group based events
 - › Random access channel optimization
 - SS Block level reporting during failed RACH attempts

- › Need to standardize L2 measurements

LTE AERIALS



- › General direction: Maximize commonalities of “aerial networks” and “MBB networks”
 - as both will be served by the same deployment
- › LTE: Focus on Rel-15 RAN2 leftover (if any)
 - Idle mode enhancements
 - RRM parameter scaling
 - Increased step size for TPC command
 - PRACH interference mitigation