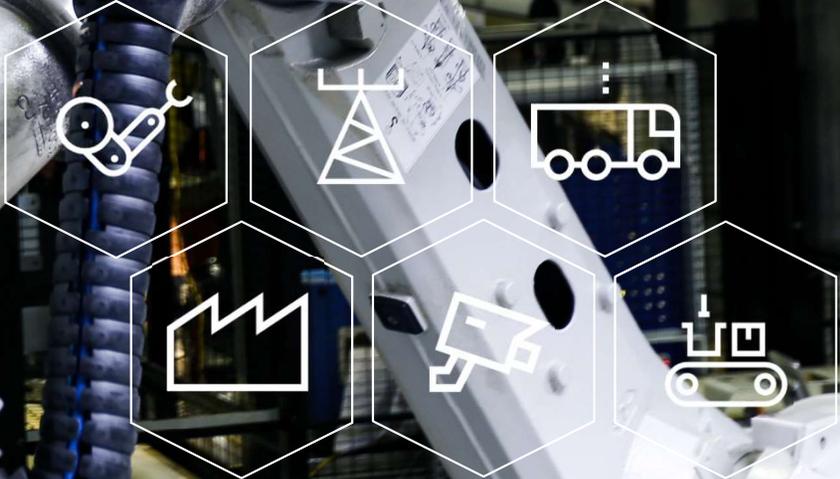


3GPP TSG-RAN Meeting #84
Newport Beach, CA, USA, 3 – 6 June 2019
Agenda item: 8

RP-191061

Further IIoT and URLLC Enhancements



Ericsson

5G for Connected Industries



- One of the 5G objectives is to enable connected industries
 - for digital transformation of industries
 - for improved flexibility
 - for improved productivity and efficiency
 - for improved operational safety
- NR Rel-15 established a solid foundation and Rel-16 introduces further enhancements for better serving various industry verticals
 - Many on-going 3GPP WIs in Rel-16, in both SA and RAN
 - In RAN
 - NR V2X (RAN1-led): automotive industry, transport industry
 - NR eURLLC (RAN1-led) and NR-IIoT (RAN2-led): factory automation, transport industry, electrical power distribution
- Rel-17 would further strengthen NR for the industry verticals and URLLC use cases

Rel-17 Further IIoT and URLLC Enhancements



- URLLC enhancements
 - Improve spectral efficiency and capacity for URLLC
 - Enhancements for wide-area operation
 - Enhancements for FR2
 - Keep maximum synergies with NR and carefully justify enhancement features
- IIoT and URLLC for unlicensed band operation
 - Consider both license-assisted access and stand-alone
 - Keep maximum synergies with Rel-16 NR and NR-U
- Enhancement for TSN-5G integration and non-public network (NPN) support

URLLC Spectral Efficiency and Capacity Enhancement



- Motivation
 - Requirements on reliability and latency are achieved at the cost of spectral efficiency
 - Minimizing impact on network capacity is highly desirable
 - Reduce required bandwidth for operating a stand-alone industrial IoT system
 - Reduce impact on eMBB capacity when URLLC features are enabled in an MNO network
- Rel-17 scope
 - Improve capacity through **enhanced multiplexing efficiency and scheduling flexibility** (e.g., eMBB/URLLC multiplexing)
 - Improve spectral efficiency through **soft HARQ feedback and enhanced CSI estimation and reporting**
 - Improve spectral efficiency through **processing timeline enhancements** → allow more HARQ retransmissions within targeted latency
 - Improved capacity through **traffic offloading to unlicensed spectrum** (see next slide)

Unlicensed Spectrum



- Motivation
 - Unlicensed spectrum can be used for providing URLLC services
 - In interference-controlled environment
 - For URLLC services with less stringent requirements
 - In licensed-assisted scenarios, work jointly with licensed carriers
- Rel-17 scope
 - [Adapt Rel-16 NR-U](#) for URLLC use cases
 - [Dynamic licensed carrier traffic offloading](#) by serving some UEs or LCHs of UE in unlicensed
 - Move eMBB to decrease interference
 - Move URLLC with relaxed requirements (or with favorable radio conditions) to unlicensed carriers, keep demanding UEs in licensed
 - [PDCP duplication or other reliability enhancements utilizing both licensed and unlicensed carriers](#)

Cell-Edge and Wide-Area Enhancements



- Motivation
 - URLLC use cases are not only limited to deployments in factory or industrial campuses
 - Wide-area URLLC use cases in MNO networks are of significant commercial interests
- Rel-17 scope
 - Enhancements for multi-TRP operation
 - Multi-TRP scheduling for better handling of, e.g., inter-cell interference
 - Improved CSI for better handling, e.g., inter-cell interference, including pre-coded interference (also covered in slide 4)
 - Improve the performance of cell-edge UEs, including UEs corresponding to lower Q values than what have been considered in Rel-15/16
 - Improve spectral efficiency and capacity (also covered in slide 4)
 - Enhancements for accurate reference time signaling in RAN for wide-area use cases

TSN and 5G integration



- Motivation
 - Rel-16 IIoT work on TSN and 5G integration is an important step toward supporting high performance Ethernet applications for industrial automation
 - Room for further enhancing the support and integration of TSN
 - Need to continue to work with industrial alliance such as 5G-ACIA and IIC to drive the Industry 4.0 agenda
- Rel-17 scope
 - Further enhancements for system capacity while satisfying QoS for TSC traffic patterns
 - Efficient multiplexing of single/multiple UEs with multiple TSC traffic patterns, e.g. flexible SPS & configured grant (CG) configurations
 - Enhancements for better alignment of TSC traffic pattern and UL CG pattern
 - Enhancements for accurate reference time signalling in RAN, e.g. downlink propagation delay compensation, in particular for wide-area use cases (also covered in slide 7)

