

Agenda Item: 8

Source: Samsung

Title: Motivation for NR-lite: IoT over NR

Document for: Discussion

Background

- ◇ Rel-15/16 NR focused mainly on the performance aspects such as throughput, latency, and reliability requiring high level of implementation complexity on the UE side
 - ◆ For example, on 3.5GHz, UE is mandated to support a BW of 100MHz and 4 RX antennas
- ◇ In LTE, eMTC and NB-IoT focused on the lower end of the IoT market for Low Power Wide Area Network.
 - ◆ ~1 Mbps/~158 Kbps peak data rates
 - ◆ 15dB/20dB coverage extension
 - ◆ Up to 10 years battery life
- ◇ To expand the NR market, the specification needs to be tailored for UEs such as smart watches, video surveillance cameras, industrial sensors, etc

	NB-IoT	eMTC	LTE Cat1	Type-1 <i>NR-lite</i>
UE RF bandwidth	200kHz	1.4MHz	20MHz	5MHz (for SCS=15kHz)
Peak data rate	≤160kbps	≤1Mbps	10Mbps	[10]Mbps

◇ Motivation

- ◆ For those mid-market IoT devices, the required peak data rate is expected to be similar as that supported by LTE Cat 1, i.e., 10 Mbps.
- ◆ Service coverage should at least not be worse than NR Rel-15/16 and preferably there should be some improvement.
- ◆ The battery life should be much longer than for MBB, e.g., a week or even months.
- ◆ The device complexity should be comparable to LTE Cat-1 or lower.

◇ Objectives

- ◆ Study the feasibility and identify solutions of creating a type of UE with low complexity, low peak data rate for both TDD and FDD considering at least for FR1, with the existing solutions for NR as the starting point.
- ◆ The study will investigate solutions to meet the following requirements:
 - Up to [10 Mbps] peak data rates.
 - Service coverage that is not worse than NR Rel-15/16 (e.g. compensate for a reduced number of receiver antennas)
 - [4-8 times] longer battery life than NR UEs with solutions specified in Rel-16 UE power saving WI.
 - Target operation of NR-lite UEs and legacy NR UEs on the same carrier.

◇ Motivation

- ◆ Bandwidth reduction can reduce UE complexity and in order to avoid significant specification change, Rel-15 NR SS/PBCH blocks can be reused.
- ◆ Reduce number of antennas reduce UE complexity for both RF and baseband. In addition, single antenna can be easier to integrated into wearable device.

◇ For complexity reduction, the following can be studied:

- ◆ Reduced UE RF bandwidth that can directly reuse Rel-15 NR SS/PBCH blocks.
- ◆ Reduced support of bands/ RF chains/panels/antenna ports including relaxation of the mandatory support of 2 MIMO layers.
- ◆ Reduced cost and power consumption for UEs with low data rate applications by having the maximum modulation order as a UE capability
- ◆ UE processing relaxations, including:
 - Reduced maximum transport block size.
 - Relaxation of physical data channel processing and/or CSI processing.
 - Reduced and simplified CSI measurements and reporting compared to the mandatory features from Rel-15/16.

NR-*lite*: Coverage compensation

◇ Motivation

- ◆ Service coverage should be same as NR Rel-15/16 or even better.
- ◆ Reduced number of receiver antennas may cause 3~6dB coverage loss for downlink.
- ◆ UL coverage seems to be bottleneck for NR coverage.

◇ For coverage compensation, the following can be studied:

- ◆ Enable DMRS interpolation across repetitions PDCCH repetitions
- ◆ PRACH repetitions

◇ Motivation

- ◆ Power consumption is critical for wearable device and some IoT sensors, e.g., weeks or even months.
- ◆ Optimization considering IoT traffic can provide significant power saving, e.g., small data transmission in IDLE/INACTIVE state.
- ◆ Some further enhancements of Rel-16 UE power saving can be carried on.

◇ For power saving, the following can be studied:

- ◆ UP data transmission in RRC-IDLE and/or RRC_INACTIVE state for both 2-step RACH and 4-step RACH.
- ◆ Reduced PDCCH monitoring requirements by re-using and potentially enhancing Rel-16 support for UE power savings.

Thanks!