



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

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Views on Release 17

Motorola Mobility, Lenovo



R17 NR Overview

- Left-over Items in R16 NR WIDs
 - Avoid exhausting R17 NR TUs on left-over R16 NR items.
 - WIs with left-overs: MIMO, NR-U, V2X, URLLC/IoT
- NR Enhancements
 - NR-U, URLLC, MIMO, V2X/Sidelink(public safety, NR flavor), IAB; FR2 Coverage; FR4 Coverage;
 - Indoor Positioning (IoT positioning needs 20cm. Inbound logistics for manufacturing (for storage of goods))
- New NR Topics
 - ‘>52.6GHz’ : i) 60GHz (R15 waveform - 120kHz SCS) in R17, ii) New RAT/WF in R18 mainly considered for >71GHz
 - NR-Lite/NR-MTC
 - Industrial Sensors (**low latency**, long battery life, 3-5 Mbps → **5 MHz**, complexity<eMBB, **ultra-low tx power**, 15kHz)
 - NR 5MHz ‘Cat0’ : (single/dual antenna (low complexity), long battery life, **20dBm**, 15kHz) → supports video
 - Smart Watch, Surveillance Camera
 - June 2016, Single Antenna CAT1 (10Mbps DL, 5Mbps UL) devices recognized as valid design choice to facilitate LTE smart watch, etc. Device Form factor not able support more than 1 useful antenna. More than 2 antennas may not be cost effective.
 - NTN WI



R17 LTE Overview

- New LTE Topics
 - Industrial Sensors (not only NR, LTE IoT technology (NB-IoT/eMTC) lifetime at least 10 more years)
- LTE Enhancements
 - NB-IoT, eMTC, MIMO



R17 : RAN Feature list preferences

FR4

- Low cost backhaul
- Verticals
- NRU, IAB, IIoT

Industrial Sensors

- 5G IoT hole: NR-Lite
- URLLC, NB-IoT/eMTC
- S-IoT

VERTICAL RELATED

- URLLC/IIoT
- Positioning
- Drones/UAVs/ATG
- V2X/Sidelink
- NRU,
- NR-Lite

FR1: 0.4 - 7GHz

FR2: 24 - 52.6 GHz

FR3: 7 - 24GHz

FR4: 52.6 -114 GHz

FR5: 114 - 275 GHz

>52.6GHz (FR4)

- SI/WI R15 waveforms up to 71GHz in R17.
- New waveforms R18

52.6 GHz – 114 GHz

NRU

- FR2 (Spatial LBT e.g.)
- Leftover (6GHz)
- FR4(R17, R18)

URLLC/IIoT

- FR2, FR4(R17, R18)
- Time Synchronous
- CSI, DL pre-emption enh

Positioning

- 20 cm accuracy
- Factory: goods storage
- UE-based, Low Latency

(GPS, GNSSS, IMU, WLAN) + NW assist. + NR RS + BF + UE-based (always on) for low latency

NR-Lite/mMTC

- Sensors(**ULTP**), 'CAT0'
- 5MHz BW, Video, 15kHz
- LowLat, 1-2 Antennas
- Unlicensed Operation

CAT0/1: Smartwatch, surveillance camera

NB-IoT/LTE-M

- Relays, Async UL
- L2 enhancements
- ...

V2X/Sidelink

- FR2, Beam Mgmt
- Relay, Public Safety
- Positioning, Multicarrier,
- Unlicensed Operation

MultiSIM

Drones/UAVs/ATG

- Mobile IAB, FR4(R18)
- FDM/SDM, CLI
- 256QAM, 1024QAM

MIMO

- Multi-panel UL
- UL Beam Management
- >52.6GHz BF issues

Small Data

- Fast transition for RRC inactive and Idle modes
- 2-step RACH needed

LTE S-IoT

- Sensors(**ULTP**)
- 5MHz BW, Video, 15kHz
- LowLat, 1-2 Antennas

?

NTN

- NR for satellite link
- GEO, LEO, HAPs

NR LTE

New Feature

—

LTE

Leftover areas

—

or Enhancement

—

AI/ML – 3GPP provides interfaces to NW; Improve QoS predictability in Smart Factory, automation, data retrieval, data management/inference;



R17 : '>52.6GHz'

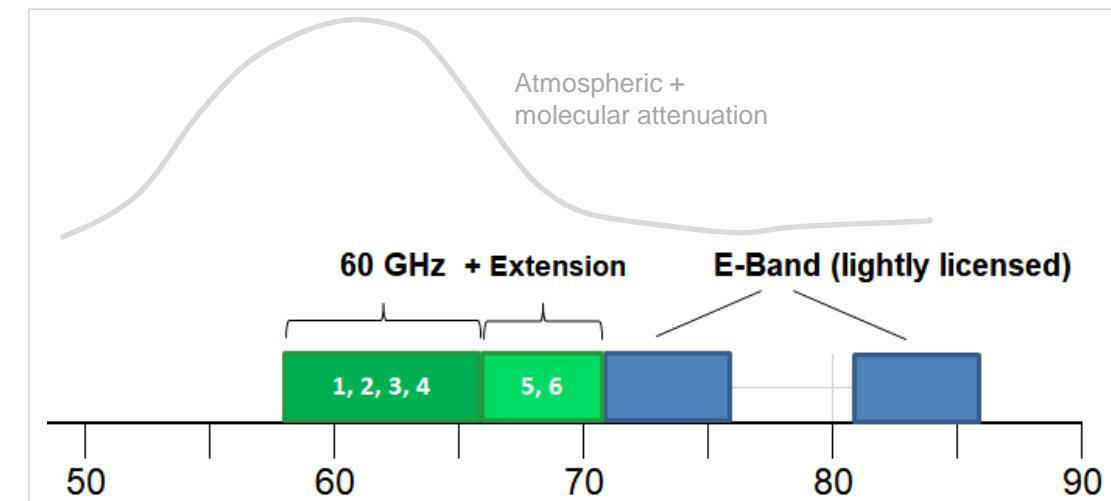
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- Existing 5G waveform (SCS 120kHz, OFDM, 16QAM) may be adequate for 60GHz indoor
 - Use of PTRS improves 16QAM and may better enable 64QAM; Add 240/480kHz SCS support.
 - permits NR-U 60GHz band SI/WI to start in late R17 TF once '>52.6GHz' completed for R15 waveforms
- '>52.6GHz' R18 SI : Single Carrier Waveform, SCS \geq 480kHz for >71GHz (E, W-Band) → New RAT
 - Also address beamforming differences and consider new control as needed (or in NR MIMO SI)

SCS (kHz)	Achievable SIR (dB) per LO frequency				Guard Int. (μs)
	20 GHz	40 GHz	60 GHz	80 GHz	
120	47.5	42.0	38.0	35.5	0.59
240	48.5	43.0	39.0	36.5	0.29
480	49.5	44.0	40.0	37.5	0.15
Indoor Max D.S. (μs)	0.8	0.7	0.6	< 0.6	

Region	lower frequency	upper frequency	usable channels
USA	57.05 GHz	71.00 GHz	1, 2, 3, 4, 5, 6
Canada	57.05 GHz	64.00 GHz	1, 2, 3, 4, 5, 6 (2021)
South Korea	57.00 GHz	64.00 GHz	1, 2, 3
EU	57.00 GHz	66.00 GHz	1, 2, 3, 4, 5, 6 (RSPG recommended)
Japan	57.00 GHz	66.00 GHz	1, 2, 3, 4
Australia	57.00 GHz	66.00 GHz	1, 2, 3, 4
China	59.00 GHz	64.00 GHz	2, 3

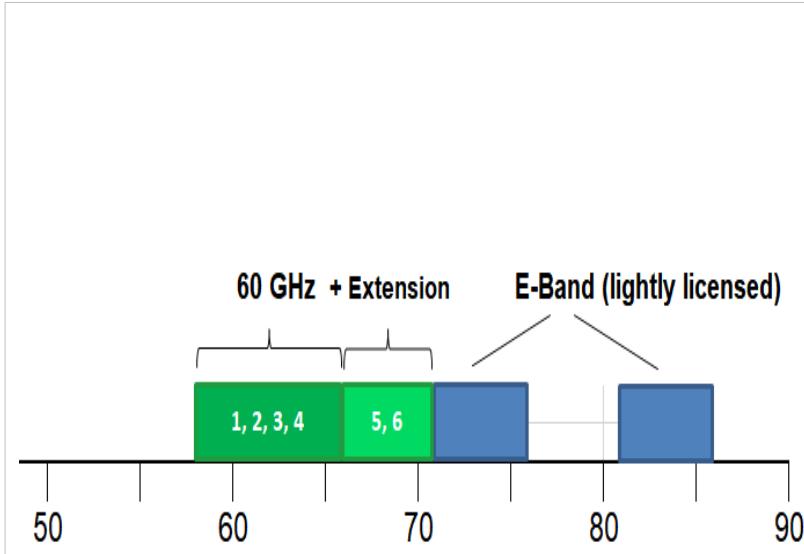
60 GHz Band





R17 : NR-U

- Left-over R16 NR-U items: Support of 10 MHz LBT and system bandwidth – R17 WI
- Potential New Item: 60GHz band NR-U – R17 SI
 - NR-U coexistence, channel access (e.g. directional LBT), control, ... for 60GHz band
 - Existing 5G waveform (120kHz SCS, OFDM, 16QAM) may be sufficient for 60GHz indoor
 - NR-U can progress unlicensed 60GHz band in late R17 time frame after '>52.6GHz' addresses R15 waveforms
 - Single Carrier Waveform and >=480kHz SCS addressed by '>52.6GHz' R18 SI especially for >71GHz (E,W-band)



	Units	NR	NR	NR	802.11ad	802.11ay	802.11ay
TTI Duration	ms	0.125	0.03125	0.03125	1	1	1
FFT Size	samples	4096	4096	4096	512	512	512
OFDM Sample rate	MspS	491.52	1966.08	1966.08	2640	2640	2640
Tu	us	8.33	2.08	2.08	0.194	0.194	0.194
Inter-carrier Separation	kHz	120.0	480.0	480.0	5156.25	5156.25	5156.25
Guard Period (CP)	us	0.59	0.15	0.15	0.04848	0.04848	0.04848
OFDM Symbol Duration	us	8.92	2.23	2.23	0.2424	0.2424	0.2424
OFDM Symbols Per TTI	syms/TTI	14.015	14.015	14.015	4125.0	4125.0	4125.0
#Subcarriers	sc	17100	4272	17100	355	355	1420
#Resource Blocks (12 sc)	RBs	1425	356	1425			
Channel Bandwidth	MHz	2160	2160	8640	2160	2160	8640
total subcarriers/TTI	sc/TTI	239400	59808	239400	1464375	1464375	5857500
Bandwidth occupancy		0.9500	0.9493	0.9500	0.85	0.85	0.85
Rank (#streams per channel)	#s/chann	1	1	4	1	4	4
Modulation	bits/msym	4	4	6	4	6	6
peak data rate (FDD)	Mbps	5816	5812	139575	4521	27128	108510



R17 : URLLC/IoT

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- Potential new Items
 - Reliability enhancement in FR2
 - Fast recovery of link failure
- Left-over R16 eURLLC and eMIMO items
 - Enhancement of aperiodic CSI report
 - DL DCI based A-CSI triggering; A-CSI reporting on PUCCH;
 - PDSCH/DM RS based A-CSI measurement and reporting (e.g. delta CQI)
 - PDCCH/PUCCH reliability enh. (i.e. repetition) if not specified under R16 NR eMIMO multi-TRP contexts
 - Enhanced DL pre-emption indication if not specified under R16 NR eMIMO
 - Spatial-layer based pre-emption



Photo credit Worcestershire 5G Consortium



R17 : MIMO

- Potential New Items (R17/18 SI)
 - Address beamforming/MIMO issues for >52.6GHz if not addressed in '>52.6GHz' R17/18 SI
- Left-over R16 Items (R17 WI)
 - Multi-panel UL transmission (simultaneous)
 - Low power RS
 - Power imbalance in frequency and time domain
- Enhancements
 - Overhead reduction
 - Beam management
 - CSI measurement and feedback
 - Interference management for dynamic TDD
 - Cross-UE interference estimation and feedback for DL-UL interference
 - UE/TPMI pairing



R17 : V2X/Sidelink

- Potential New V2X Items (R17 SID)
 - Beam Management for FR2 [RAN1, RAN2, RAN4]
 - FR2 support for V2X [RAN1, RAN2, RAN4]
 - Support of rank>2 SL MIMO for V2X, CSI feedback [RAN1]
 - Introduction of remote UE to NW relay and UE to UE relaying [RAN1,RAN2]
 - Mode 2d – support of relaying resource pool configuration to member UEs [RAN1, RAN2]
 - Support of V2X message delivery over Uu interface [RAN1,RAN2,RAN3]
 - Group HO
- Left-overs/enhancements to R16 V2X Items (R17 WID)
 - MR-DC based NR V2X, in which SN (secondary node) is control of the SL [RAN2]
 - Support of Interworking between R17 and R16 V2X UEs [RAN1, RAN2, RAN4]
- Potential New Sidelink items (R17 SID)
 - NR based SL Enhancement to support VR/AR-like services (based on NR V2X outputs)
 - Support Relay scenario
 - Support of rank>2 SL MIMO, CSI feedback [RAN1]
 - Public safety
 - Sidelink in unlicensed; Multicarrier;
 - Enhancement for group HO