A GLOBAL INITIATIVE

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NR

Data

Growth

3GP Release 15

The 5G System – Phase 1

Vehicle-to-Everything

Mission Critical (MC)

networks

API Exposure –

Massive MTC and Internet of Things

Communications (V2x) Phase 2

interworking with legacy systems

WLAN and unlicensed spectrum

3rd party access to 5G services

Service Based Architecture (SBA)

Mobile Communication System

Slicing – logical end-2-end

Further LTE improvements

for Railways (FRMCS)

Variable rates: GMSK: ~350bps to 70kbps 8PSK: up to 240 kbps

164 dB MCL for 33 dBm UE,

154 dB MCL for 23 dBm UE

EC-GSM-IoT

Long battery life

Extended coverage:

devices

Massive number of devices: ~50.000 per cell Improved security compared to GSM/EDGE

35P Release 16

The 5G System – Phase 2

V2x Phase 3: Platooning,

driving, remote driving

Industrial IoT

enhancements

NR-based access to

unlicensed spectrum

extended sensors, automated

Ultra-Reliable and Low Latency

Communication (URLLC)

• 5G Efficiency: Interference

Mitigation, SON, eMIMO,

Mobility enhancements

Enhancements for Common

Northbound APIs (eCAPIF)

API Framework for 3GPP

FRMCS Phase 2

Location and positioning, Power

Device capabilities exchange,

Consumption, eDual Connectivity,

Low device cost compared to GPRS/GSM

### LTE-M

for VoLTE

- Long battery life Low device cost
- Extended coverage: >155.7 dB maximum
- coupling loss (MCL) Variable rates: ~10 kbps to 1 Mbps
- Deployment: In any LTE spectrum
- Coexists with other LTE services within the same bandwidth
- Supports FDD, TDD and half duplex (HD)
- Reuses existing LTE base stations
- Upgraded in Rel-14: Support for positioning, Multicast, Mobility for inter-frequency measurements, Higher data rates, Support

## NB-IoT

- Even lower cost than LTE-M
- Extended coverage: 164 dB maximum coupling loss (at least for standalone)
- Long battery life
- Support for massive number of devices: ~50.000 per cell
- Main simplification: Reduced data rate/bandwidth, mobility support and further protocol optimizations
- 3 modes of operation: Stand-alone carrier, LTE carrier Guard
- band, In-band Upgraded in Rel-14: Agreement on NB-IOT positioning, Support for Multicast, Power consumption and latency

reduction, Mobility and service continuity enhancements

(without the increasing of UE power consumption), New Power Class(es)

### 5G Cellular IoT

 Release 15 has completed work to ensure Cellular IoT support and evolution for the 5G System.

See updates to:

TS 23.501 - System architecture for the 5G System (5GS) TS 23.502 - Procedures for the 5G System (5GS)

### NR IIoT

Four use cases have been identified as drivers for NR evolution for the Industrial Internet of Things (IIoT):

- Augmented reality and Virtual reality
- Factory automation
- Transportation Electrical Power Distribution

In Rel-16 the RAN study 'NR Industrial Internet of Things' (TR38.825) describes the NR enhancements

- Data duplication & multi-connectivity,
- Intra-UE prioritization/multiplexing and Time Sensitive Networking support (TSN)

TSG RAN Work Areas under discussion

# Release 17 Content Approval

### TSG SA Work Areas under discussion at SA#85 (September 2019):

- 5G System Enhancement for Advanced Interactive Services (5G\_AIS)
- Cellular IoT enhancement for the 5G System (5G\_MCloT)
- System enhancement for Proximity based Services in 5GS (5G ProSe)
- Enhancement of support for 5G LAN-type service 5GLAN enh)
- Integration of Satellite in 5G Systems (5GSAT\_ARCH)
- Architectural enhancements for 5G multicast-broadcast services (5MBS)
- Study on enhancement of support for 5G Wireless and Wireline Convergence (5WWC\_enh)
- Application Awareness Interworking between LTE and NR
- Extended Access Traffic Steering, Switch and Splitting support in the 5G system architecture (eATSSS)
- 5G Enhancement for unmanned aerial vehicles UAVs (EAV)
- Enhanced IMS to 5GC Integration (elMS5G)
- Enhancement to the 5GC LoCation Services-Phase 2
- Enablers for Network Automation for 5G phase 2 (eNA\_Ph
- Enhancement of support for Edge Computing in 5GC (enh\_EC)
- Enhanced support of Non-Public Networks (eNPN) Enhancement of Network Slicing Phase 2 (eNS\_Ph2)
- Enhancement of 5G UE Policy (eUEPO)
- Architecture enhancements for 3GPP support of advanced V2X services - Phase 2 (eV2XARC\_Ph2)
- Supporting Flexible Local Area Data Network (FLADN)
- Supporting Unmanned Aerial Systems Connectivity, Identification and Tracking (ID-UAS)
- Enhanced support of Industrial IoT TSC/URLLC enhancements (IIoT)
- Support for Minimization of service Interruption (MINT)
- Multimedia Priority Service Phase 2 (MPS2)
- Support for Multi-USIM Devices (MUSIM)
- System architecture for next generation real time communication services (NG\_RTC)
- Service-based support for SMS in 5GC (SB\_SMS)
- Smarter User Plane (SUP)
- UPF enhancement for control and Service Based Architecture (UPCAS)
- Usage of User Identifiers in the 5G System (UUI5)

Small data transfer optimization

Sidelink enhancements

For final decision at RAN#86

- NR above 52.6 GHz (inlc 60GHz unlicensed)
- Multi SIM operation

(December 2019):

NR Light

- NR multicast broadcast
- Coverage enhancements
- NB-IoT and eMTC enhancements
- Industrial IoT & URLLC enhancements
- MIMO enhancements
- NR for Non Terrestrial Networks
- Integrated Access and Backhaul enhancements
- Generic enhancements to NR-U
- Power saving enhancements
- RAN data collection enhancements
- Positioning enhancements
  - Mainstream Rel-17 specification work will start at the beginning of 2020, with the functional freeze of physical layer aspects scheduled for the second quarter of 2021.

The ASN.1 freeze should follow in September 2021.

There are a large number of work areas to be discussed. Realistically, we will only be able to take on board a sub-set of them within Rel-17.

Billion IoT connections Source: GSMA

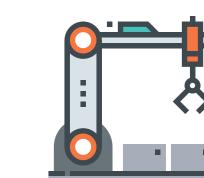


**Self-driving Cars** 

loT driven

growth

by 35P



**Industry Automation** 



**Smart Cities** 



**Smart Homes** 



Work & Play in the Cloud



**Augmented Reality** 



3D video, UHD screens



Gigabytes per second

2019

Billion IoT

connections

Release15

2020

Release16

2021

2022

2023

2024

2025