3GPP™

A GLOBAL INITIATIVE

EC-GSM-IoT

- Long battery life
- Low device cost compared to GPRS/GSM devices
- Extended coverage:
  - 164 dB MCL for 33 dBm UE,
  - 154 dB MCL for 23 dBm UE
- Variable rates:
  - GMSK: ~350bps to 70kbps
  - 8PSK: up to 240 kbps
- Massive number of devices: ~50.000 per cell
- Improved security compared to GSM/EDGE

LTE-M

- 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) modes
- Reuses existing LTE base stations
- Upgraded in Rel-14: Support for positioning, Multicast, Mobility for inter-frequency measurements, Higher data rates, Support for VoLTE

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 for :

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

5G IoT driven growth

by 3GPP

Data Growth

Release 15

- **NR**
- **The 5G System – Phase 1**
- **Massive MTC and Internet of Things (IoT)**
- **Vehicle-to-Everything Communications (V2x) Phase 2**
- **Mission Critical (MC) interworking with legacy systems**
- **WLAN and unlicensed spectrum use**
- **Slicing – logical end-2-end networks**
- **API Exposure – 3rd party access to 5G services**
- **Service Based Architecture (SBA)**
- **Further LTE improvements**
- **Mobile Communication System for Railways (FRMCS)**

Release 16

- **The 5G System – Phase 2**
- **V2x Phase 3:** Platooning, extended sensors, automated driving, remote driving
- **Industrial IoT**
- **Ultra-Reliable and Low Latency Communication (URLLC) enhancements**
- **NR-based access to unlicensed spectrum**
- **5G Efficiency:** Interference Mitigation, SON, eMIMO, Location and positioning, Power Consumption, eDual Connectivity, Device capabilities exchange, Mobility enhancements
- **Enhancements for Common API Framework for 3GPP Northbound APIs (eCAPIF)**
- **FRMCS Phase 2**

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_MCIoT)
- 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 (AAI_LTE_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 (eIMS5G)
- Enhancement to the 5GC LoCation Services-Phase 2 (eLCS_ph2)
- Enablers for Network Automation for 5G - phase 2 (eNA_Ph2)
- 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)

TSG RAN Work Areas under discussion For final decision at RAN#86 (December 2019):

- NR Light
- Small data transfer optimization
- Sidelink enhancements
- NR above 52.6 GHz (inlc 60GHz unlicensed)
- Multi SIM operation
- 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.

10 Billion IoT connections

25 Billion IoT connections
Source: GSMA

IoT

- Self-driving Cars
- Industry Automation
- Smart Cities
- Smart Homes
- Work & Play in the Cloud
- Augmented Reality
- 3D video, UHD screens
- Gigabytes per second

Release15 Release16 Release17

2019 2020 2021 2022 2023 2024 2025

www.3gpp.org/specifications/work-plan