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™

Data Growth

## 3GPP 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)**

## 3GPP 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**

## 3GPP Release 17

Functional Freeze: June 2021*

- **TSG SA content & prioritization discussion at SA#85 (September 2019):**
  - 5G System Enhancement for Advanced Interactive Services
  - Cellular IoT enhancement for the 5G System
  - System enhancement for Proximity based Services in 5GS
  - Enhancement of support for 5G LAN-type service
  - Integration of Satellite in 5G Systems
  - Architectural enhancements for 5G multicast-broadcast services
  - Support for 5G Wireless Wireline Convergence
  - Application Awareness Interworking between LTE and NR
  - Extended Access Traffic Steering, Switch and Splitting support in the 5G architecture
  - Enhanced IMS to 5GC Integration
  - Enhancement to the 5GC LoCation Services Phase 2
  - Enablers for Network Automation for 5G Phase 2
  - Enhancement of support for Edge Computing in 5GC
  - Enhanced support of Non-Public Networks
  - Enhancement of Network Slicing Phase 2
  - Enhancement of 5G UE Policy
  - Architecture enhancements for 3GPP support of advanced V2X services - Phase 2
  - Supporting Flexible Local Area Data Network
  - Supporting Unmanned Aerial Systems Connectivity, Identification, and Tracking
  - Enhanced support of Industrial IoT - TSC/URLLC enhancements
  - Multimedia Priority Service (MPS) Phase 2
  - Support for Multi-USIM Devices
  - System architecture for next generation real time communication services
  - Service-based support for SMS in 5GC
  - Smarter User Plane
  - UPF enhancement for control and SBA
  - Usage of User Identifiers in the 5G System
  - Enhancements for cyber-physical control applications in vertical domains
  - Support for Minimization of service Interruption
  - Complete Gap Analysis for Railways Mobile Communication System
- **TSG RAN Work Areas under discussion**

  For final decision on the Rel-17 content 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

Projected *

IoT

10 Billion IoT connections

25 Billion IoT connections

Source: GSMA

- 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

# 5G - IoT driven growth