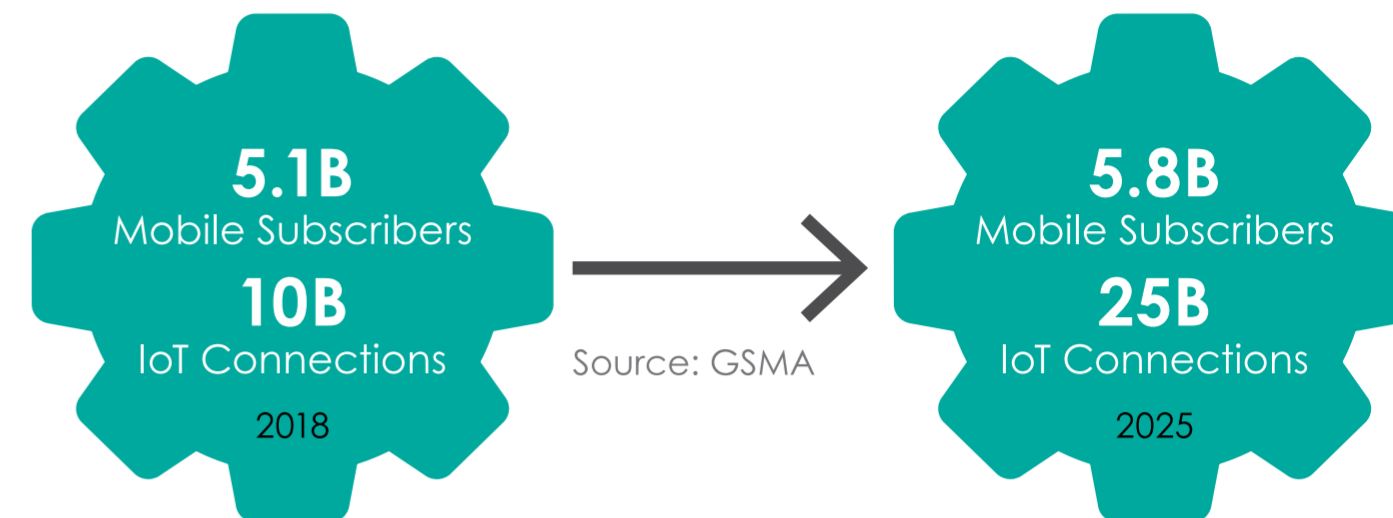# The 5G standard

Since the completion of 3GPP Release 15 – the first phase of 5G specifications - the cellular industry is expanding the capability of the network to deliver on the full promise of the Internet of Everything. Release 18 will deliver 5G-Advanced, as the mid-point of 5G standardization.

5G ADVANCED

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

5.1B Mobile Subscribers
10B IoT Connections
2018

Source: GSMA

5.8B Mobile Subscribers
25B IoT Connections
2025

Release 18

SA2 led - System Architecture & Services

XR (Extended Reality) & media services
Edge Computing Phase 2
System Support for AI/ML-based Services
Enablers for Network Automation for 5G Phase 3
Network Slicing Phase 3
5GC LoCation Services Phase 3
5G multicast-broadcast services Phase 2
Satellite access Phase 2
5G System with Satellite Backhaul
5G Timing Resiliency and TSC & URLLC enh.
Evolution of IMS multimedia telephony service
Personal IoT Networks
Vehicle Mounted Relays
Access Traffic Steering, Switching & Splitting support in the 5G system architecture Phase 3
Proximity-based Services in 5GS Phase 2
UPF enh. for Exposure & SBA
Ranging based services & Sidelink positioning
Generic group management, exposure & communication enh.
5G UE Policy Phase 2
UAS, UAV & UAM Phase 2
5G AM Policy Phase 2
RedCap Phase 2
Support for 5WWC Phase 2
System Enabler for Service Function Chaining
Extensions to TSC Framework to support DetNet
Seamless UE context recovery
MPS when access to EPC/5GC is WLAN

SA3 led - Security & Privacy

Privacy of identifiers over radio access
SECAM and SCAS for 3GPP virtualized network products and Management Function (MnF)
Mission critical security enhancements Phase 3
Security and privacy aspects of RAN & SA features

SA4 led - Multimedia Codecs, Systems and Services

Systems & Media Architecture:
5G Media, Service Enablers
Split-Rendering
5G AR Experiences Architecture
Media:
Video codec for 5G
Media Capabilities for Augmented Reality Glasses
AI / ML Study
Real-Time Communications:
XR conversational services
WebRTC-based services and collaboration models
Immersive Voice & Audio:
EVS Codec Extension for Immersive Voice and Audio Services (IVAS_Codec)
Terminal Audio quality performance and Test methods for Immersive Audio Services (ATIAS)
Streaming & Broadcast Services:
5GMS Enh. (Network slicing, Low latency, Background traffic, 5GMS Uplink)
Further MBS Enh. (Free to air, Hybrid unicast/broadcast)

SA5 led - Management, Orchestration & Charging

Intelligence and Automation:
Self-Configuration of RAN NEs, Enh. and evaluation of autonomous
network levels, Enh. intent driven management services,
AI/ ML management, Enh. of the management aspects related to NWDAF, Enh. of MDA, Fault supervision volution, Management support of RAN intelligence
Management Architecture and Mechanisms:
Network slicing provisioning rules, Enh. service based management architecture, URLLC/5GLAN/Cloud native VNF/MOCN/IOT NTN/Edge computing management, 5G PM and KPIs; QoE, MDT/Trace, Data collection management
Support of New Services:
Enh. Energy Efficiency for 5G Phase 2, Network slice management capability exposure, Enh. management of Non-Public Networks, Network and Service Operations for Energy Utilities, Key Quality Indicators (KQIs) for 5G service experience, Deterministic Communication Service Assurance
Charging Management:
Enhancement of Network Slicing Phase 2, Nchf charging services phase 2, 5G roaming charging architecture for wholesale and retail scenarios, Enhanced support of Non-Public Networks, Time Sensitive Networking

SA6 led - Application Enablement & Critical Communication Applications

Critical Communications:
MCX Enhancements – MC over 5GS (5MBS, ProSe)
Adhoc group comm., MCPTT Enh.
Railways - Gateway UE, Interworking
Service Frameworks:
Edge App Architecture Enh., SEAL Enh., Subscriber-Aware API (CAPIF Enh.)
Fused location, Application Data Analytics, App Layer NW Slicing
Enablers for Vertical Applications:
Enhancements to V2X, UAS application-enablement, 5G Messaging, Future Factories, Personal IoT networks, Capability exposure for IoT platforms

RAN1 led - Radio Layer 1 (Physical layer)

MIMO Evolution for Downlink and Uplink
Study on Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface
Study on Evolution of NR Duplex Operation
NR sidelink evolution
Study on expanded and improved NR positioning
Further NR RedCap UE complexity/cost reduction
Study on network energy savings
Further NR coverage enhancements
NR Network-Controlled Repeaters
Enh. of NR Dynamic spectrum sharing (DSS)
Study on low-power Wake-up Signal and Receiver for NR
Multi-carrier enhancements for NR

RAN2 led - Radio Layer 2 & Layer 3 Radio Resource Control

NR Mobility Enh.
Study on XR Enh. for NR
NR sidelink relay enh.
NR NTN (Non-Terrestrial Networks) enh.
IoT NTN enh.
NR Support for UAV
Dual Tx/Rx MUSIM
In-Device Co-existence (IDC) enh. for NR and MR-DC
Mobile Terminated-Small Data Transmission (MT-SDT) for NR
Enh. of NR Multicast and Broadcast Services

RAN3 led - UTRAN/E-UTRAN/ NG-RAN Architecture & Related Network Interfaces

Mobile IAB
Artificial Intelligence (AI)/Machine Learning (ML) for NG-RAN Further enh. of data collection for SON (Self-Organising Networks)/MDT (Minimization of Drive Tests) in NR and EN-DC
Enh. on NR QoE management and optimizations for diverse services
Study on enh. for resiliency of gNB-CU

RAN4 led - Radio Performance & Protocol Aspects*

Further RF requirements enh. for NR Frequency Range 1 (FR1)
NR RF requirements enh. for Frequency Range 2 (FR2), Phase 3

Req. for NR Frequency Range 2 (FR2) multi-Rx chain
DL reception RRM enh. for NR and MR-DC
Enh.on NR and MR-DC Measurement Gaps and Measurements without Gaps
NR demodulation performance evolution
Study on simplification of band combination specification
Study on enh. for 700/800/900MHz band combinations
NR BS RF requirement evolution
Study on NR Frequency Range 2 (FR2) Over-the-Air (OTA) testing enh.
Support of intra-band non-collocated EN-DC/NR-CA deployment
Enh. NR support for high-speed train scenario in frequency range 2 (FR2)
BS/UE EMC enh.
Air-to-ground network for NR
NR support for dedicated spectrum less than 5MHz for FR1

* There are other approved items related to Rel-17 continuation; more spectrum-related items are expected to be approved later.

TSG CT Stage 3 work

CT will wait for stable output from the stage 2 work in SA and RAN before initiating the stage 3 work on Rel-18 - expected by TSG#99, March 2023.

In parallel, CT will work on technical improvements and enhancements to APIs and protocols under the CT remit, to add new capabilities, improve efficiency and flexibility.

Completion of stage 3 work is targeted for **TSG#103** March 2024.
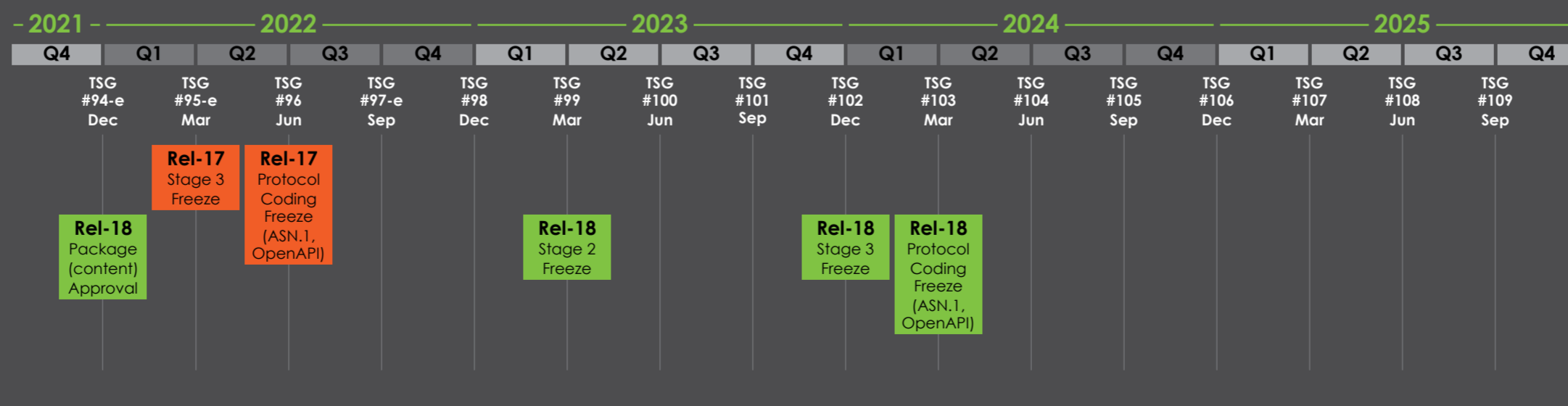
https://bit.ly/3GPP-Work-Plan

Early Release 19 Studies

SA1 - Services

Network of Service Robots with Ambient Intelligence
Energy Efficiency as service criteria
Upper layer traffic steering, switching and split over dual 3GPP access
Uncrewed Aerial Vehicles (Phase 3)
Satellite Access (Phase 3)
Roaming value added services
AI/ML Model Transfer (Phase 2)
Integrated Sensing and Communication
Ambient power-enabled Internet of Things
Localized Mobile Metaverse Services
Network Sharing Aspects
Future Railway Mobile Communication System (Phase 5)
Supporting Railway Smart Station Services

The detailed content of Rel-19 will be decided in September 2023 (TBC)

Release Timelines

	2021		2022				2023				2024				2025		
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	TSG #94-e Dec	TSG #95-e Mar	TSG #96 Jun	TSG #97-e Sep	TSG #98 Dec	TSG #99 Mar	TSG #100 Jun	TSG #101 Sep	TSG #102 Dec	TSG #103 Mar	TSG #104 Jun	TSG #105 Sep	TSG #106 Dec	TSG #107 Mar	TSG #108 Jun	TSG #109 Sep	

Rel-17 Stage 3 Freeze
Rel-17 Protocol Coding Freeze (ASN.1, OpenAPI)
Rel-18 Package (content) Approval
Rel-18 Stage 2 Freeze
Rel-18 Stage 3 Freeze
Rel-18 Protocol Coding Freeze (ASN.1, OpenAPI)

Specification Groups

TSG CT Core Network and Terminals
- **CT1** User Equipment – Core Network Protocols
- **CT3** Interworking with External Networks & Policy and Charging Control
- **CT4** Core Network Protocols
- **CT6** Smart Card Application Aspects

TSG RAN Radio Access Network
- **RAN1** Radio Layer 1 (Physical Layer)
- **RAN2** Radio Layer 2 and Radio Layer 3 Radio Resource Control
- **RAN3** UTRAN/E-UTRAN/ NG-RAN Architecture and Related Network Interfaces
- **RAN4** Radio Performance and Protocol Aspects
- **RAN5** Mobile Terminal Conformance Testing

TSG SA Service and System Aspects
- **SA1** Services
- **SA2** System Architecture and Services
- **SA3** Security & Privacy
- **SA4** Multimedia Codecs, Systems and Services
- **SA5** Management, Orchestration and Charging
- **SA6** Application Enablement and Critical Communication Applications