




5G Standards for Industrial Applications: *Status, Opportunities and Challenges*

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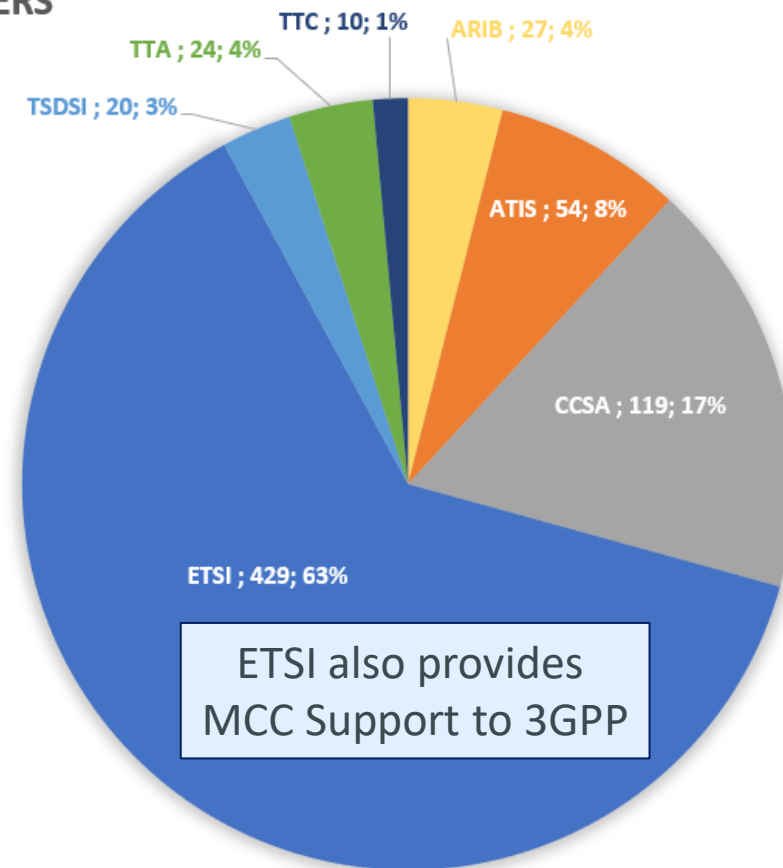
For: **Workshop on 5G for Smart Manufacturing**

28 January 2021

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- ✔ Independent, non-profit standards organization
 - ✔ Officially recognized by the European Union to support EU regulation
 - ✔ **30** year track record of technical excellence in the ICT sector
 - ✔ Founding Partner Member of both **3GPP** and **oneM2M**
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- ✔ Over **900** members from **62** countries and **5** continents
 - ✔ Diverse community: private companies, research and academia, governments, public bodies, societal stakeholders
 - ✔ Over **48 000** standards published to date, **2 600** annually
 - ✔ **17.5 million** downloads annually – All standards are free of charge
 - ✔ Over **90** technical groups, with more than **4 000 (e)** meetings per year
 - ✔ More than **50** (virtual) conferences and interop events per year

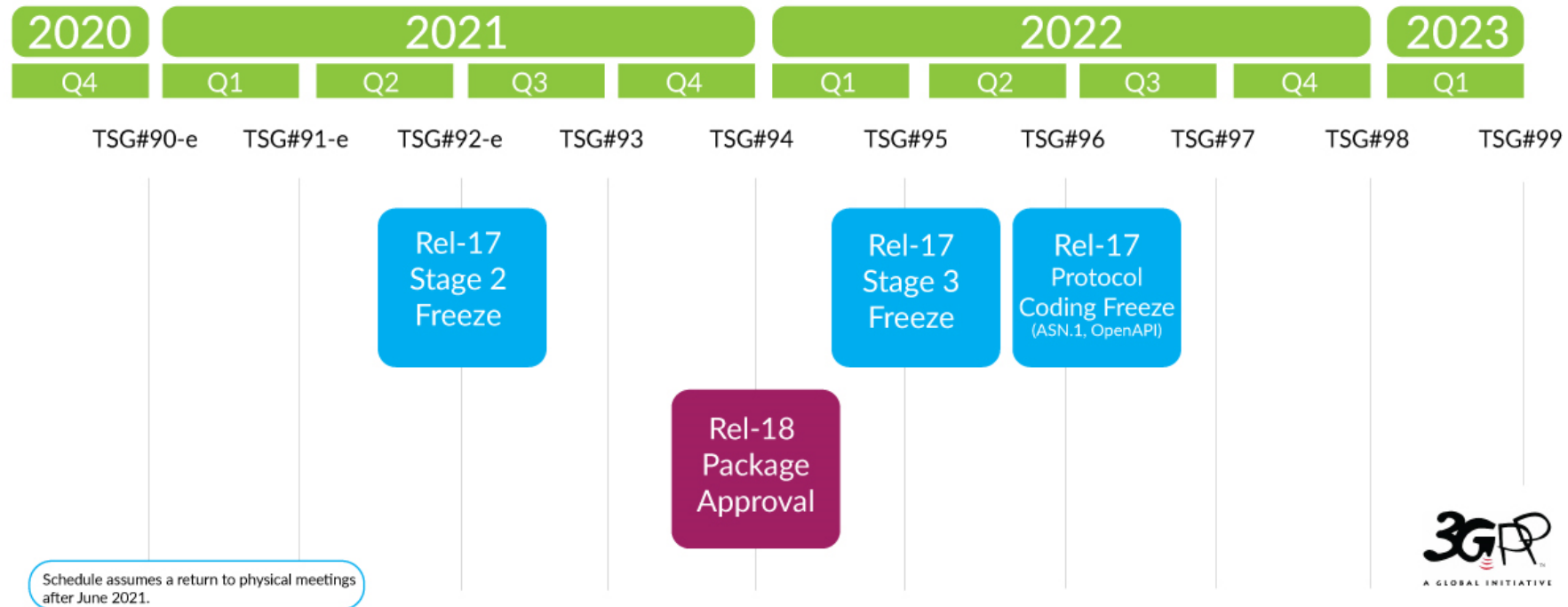
3GPP MEMBERS



Taken from January 2021 edition of the ETSI Enjoy! magazine
<https://www.etsi.org/newsroom/magazine>

5G Release 17 & 18 schedule

- Massive effort was made to complete Rel-16 on time in 2020.
- COVID-19 has challenged the ability to complete Rel-17 (with no F2F meetings).
- Revised Rel-17 schedule has now been set (with fully electronic meetings)
- Rel-18 studies underway. Final timeline and content to be determined in December 2021.



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) enh.
- NR-based access to unlicensed spectrum (NR-U)
- 5G Efficiency: Interference Mitigation, SON, eMIMO, Location and positioning, Power Consumption, eDual Connectivity, Device capabilities exchange, Mobility enhancements
- Integrated Access and Backhaul (IAB)
- Enh. Common API Framework for 3GPP Northbound APIs (eCAPIF)
- Satellite Access in 5G
- Mobile Communication System for Railways (FRMCS Phase 2)

Release 17

- NR MIMO
- NR Sidelink enh.
- 52.6 - 71 GHz with existing waveform
- Dynamic Spectrum Sharing (DSS) enh.
- Industrial IoT / URLLC enh.
- Study - IoT over Non Terrestrial Networks (NTN)
- NR over Non Terrestrial Networks (NTN)
- NR Positioning enh.
- Low complexity NR devices
- Power saving
- NR Coverage enh.
- Study - NR eXtended Reality (XR)
- NB-IoT and LTE-MTC enh.
- 5G Multicast broadcast
- Multi-Radio DCCA enh.
- Multi SIM
- Integrated Access and Backhaul (IAB) enh.
- NR Sidelink relay
- RAN Slicing
- Enh. for small data
- SON / Minimization of drive tests (MDT) enh.
- NR Quality of Experience
- eNB architecture evolution, LTE C-plane / U-plane split
- Satellite components in the 5G architecture
- Non-Public Networks enh.
- Network Automation for 5G - phase 2
- Edge Computing in 5GC
- Proximity based Services in 5GS
- Network Slicing Phase 2
- Enh. V2x Services
- Advanced Interactive Services
- Access Traffic Steering, Switch and Splitting support in the 5G system architecture
- Unmanned Aerial Systems
- 5GC LoCation Services
- Multimedia Priority Service (MPS)
- 5G Wireless and Wireline Convergence
- 5G LAN-type services
- User Plane Function (UPF) enh. for control and 5G Service Based Architecture (SBA)

These are some of the Rel-17 headline features, prioritized during the December 2019 Plenaries (TSG#86)

Start of work: January 2020

Full details of the content of Rel-17 are in the Work Plan: www.3gpp.org/specifications/work-plan

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Much more than just “More” Broadband



Evolved Mobile Broadband is important

- ✔ The main priority for some early deployments
- ✔ Business models and revenue streams are well understood
- ✔ 3GPP 5G Phase 1 addresses very well this use case family

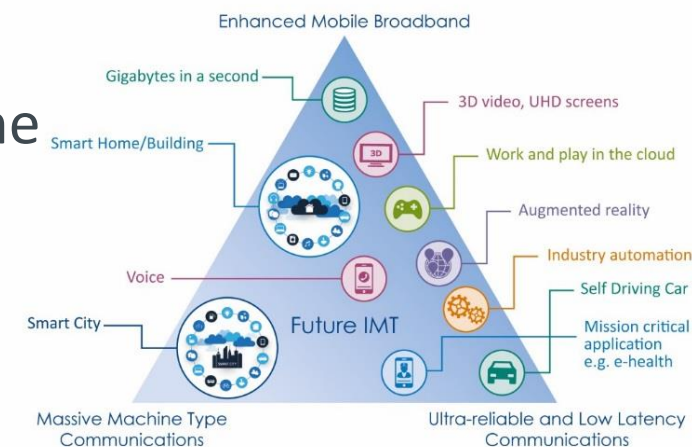


Ultra-Reliable Low-Latency Communications & Massive Machine Type Communications bring new value and use cases.

- ✔ Some URLLC features are contained in 3GPP 5G Phase 1
- ✔ URLLC and mMTC to be fully covered in 3GPP 5G Phase 2 and will evolve

Many industry sectors will benefit from all three of the 5G use case families:

- ✔ 1) Mobile Broadband, 2) URLLC and 3) mMTC

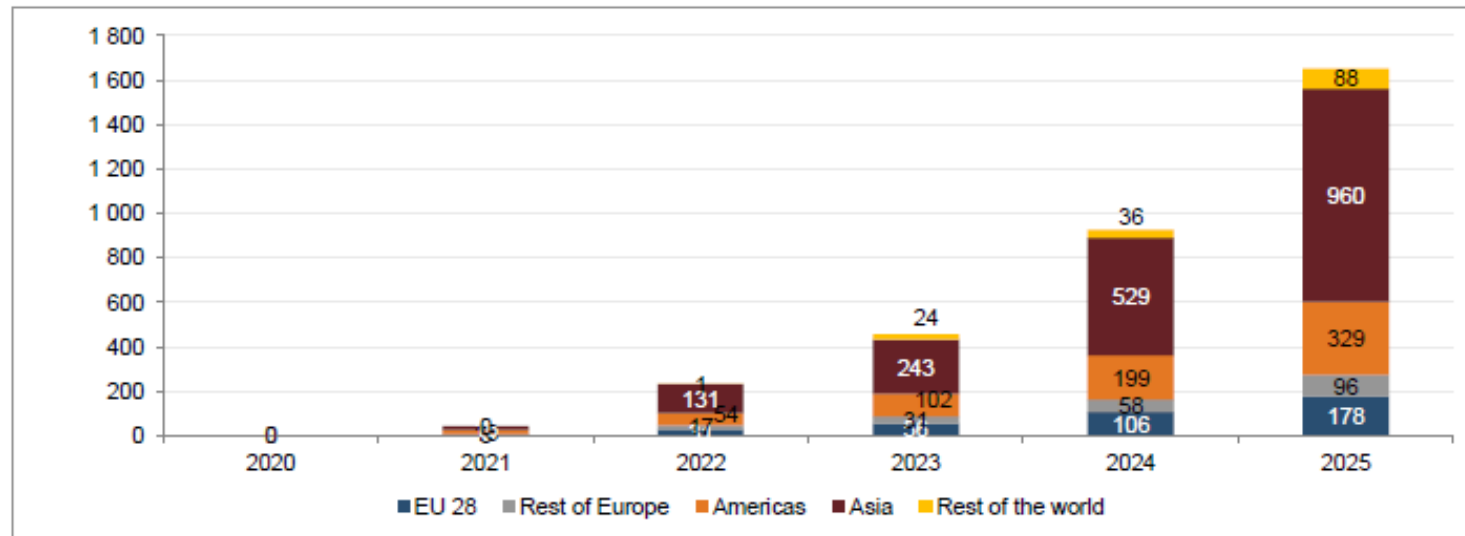




Where and When?



Figure 5: 5G subscribers forecasts (million)



Source: IDATE DigiWorld, METIS-II

GSA has identified **392** operators (and operators-to-be) investing in 5G mobile and 5G FWA networks, in the form of tests, trials, planned and pilot deployments, and launches.

92 commercial 5G networks were launched in **38** countries (as of August 2020).

86 vendors producing 5G equipment.

50 countries planning 5G spectrum auctions by end 2022.

47 countries have already assigned 5G spectrum.

Industrial Participation in 3GPP

3GPP Membership now includes the following sectors:

- Aerospace
- Agriculture
- Asset Tracking
- Automotive
- eCommerce
- Broadcasting
- Energy
- Environment
- Factory Automation
- Maritime
- Mining and Exploration
- Public Safety
- Rail
- Retail
- Satellite
- Social Media

3GPP is more than a standards activity, it is a community of interest

Full listing available here:

<http://www.3gpp.org/about-3gpp/membership>



5G System support for Industrial IoT (Vertical-LAN in Rel-16)

To be able to deploy 5G for new and diverse use cases, including industry 4.0 and factory automation, the 5G system must work in harmony with the communications technologies already used in such industries.

3GPP has made significant progress towards the integration of the 5G system with IEEE 802.1 working group specifications covering Time Sensitive Networking (TSN).

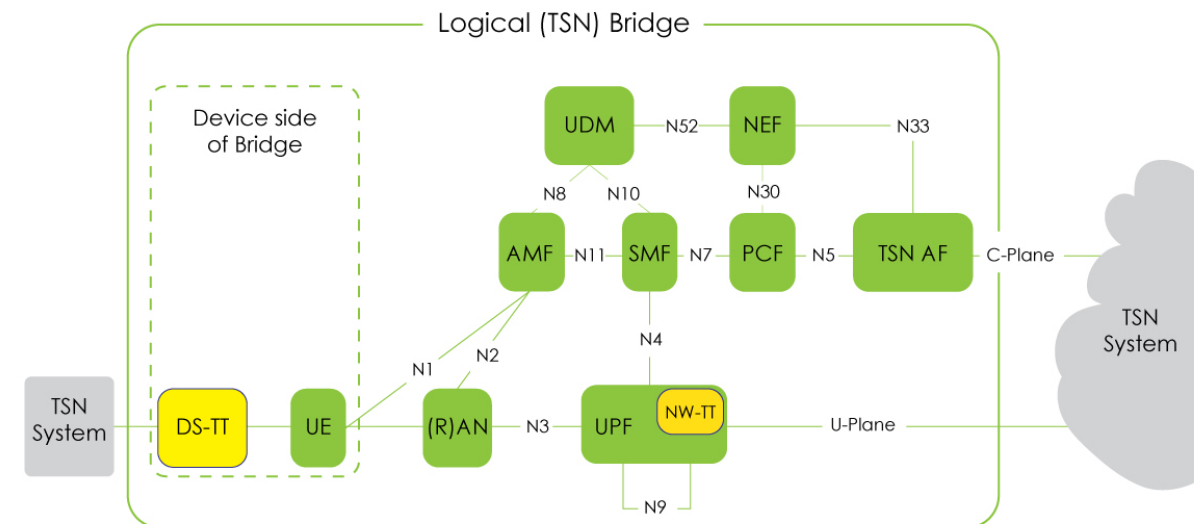
3GPP Rel-16 work item on 'Vertical_LAN' work item introduces three new and distinct 5G enablers for Industry 4.0;

Support for Time Sensitive Communications by seamlessly integrating the 5G system as a bridge to IEEE TSN

Support for Non-Public Networks

Support for a 5G-LAN type service

https://www.3gpp.org/news-events/2122-tsn_v_lan



3GPP System architecture view with 5GS appearing as a Time-Sensitive Networking bridge

5G Opportunities

5G is already being deployed for Industrial Applications today:

5G has been specifically *designed* for Industrial IoT use
(*ultra-reliable, low latency, low power consumption and massive capacity*)

5G has been specifically designed to work in both licensed and unlicensed spectrum

5G enables deployment as both Public and non-Public (Private) networks

3GPP has growing participation from a wide range of Industrial IoT users/customers, providing confidence that these solutions will meet the customer-defined needs

5G is rolling out much quicker than first predicted, it is ready for Industrial applications

5G Challenges

5G will become a critical infrastructure for future applications serving multiple Industries:

It is essential to get feedback from 5G deployments to continually improve the standard

Essential to fully understand the needs of industrial sectors by fostering their continued engagement in standards setting

Maintaining momentum as demanded by industry in the face of global pandemic, need to adapt working methods to ensure standards are delivered on time

5G standards will mature with deployments and as we see more global 5G networks being deployed they will provide experience and improvements to the 5G standard

Retain the focus on 5G as we begin to see more announcements on 6G technology roadmaps and research projects. 5G will be serving the industry for many years to come.