3GPP HIGHLIGHTS

Standards for 5G

🍃 TECHNICAL NEWS

In this issue we have three articles from 3GPP Working Group Chairs, covering diverse topics:

An early look at the Release 17 architecture work, an introduction to Multimedia Codecs, Systems and Services and a look at AI and Machine Learning in the NG-RAN.

We also have a guest interview with the Chief of the ITU-R Study Groups Department.

🍃 PARTNER FOCUS

We are fortunate to have a broad variety of content from the 3GPP Market Partners again this issue.

Topics include: Public Safety procurement, 5G roaming across a variety of access technologies, the satellite perspective on 5G, use of mmWave bands for 5G and the drivers for 6G.

There is also a piece on advanced use cases for transport systems.

🍃 A LOOK INSIDE

In our look inside 3GPP, we show the latest meeting schedule and give a graphical view of the structure of the specification groups.

We also have news of two new partners in 3GPP: The 5G Deterministic Networking Alliance (5GDNA) and the 5G Media Action Group (5G-MAG) and an article from 3GPP TF160, celebrating the 5G conformance test case work from this expert group, based in the ETSI MCC.

FORE - WORD
Looking forward

Welcome to the second issue of 3GPP Highlights, a publication that aims to bring you news from the project and to provide an insight into how 3GPP is opening up to new challenges.

As we start to emerge from COVID-19 lock-downs and restrictions, we can look with some pride at the role that telecommunications has played in keeping people connected with their families, their friends and their broader circles - including work and schooling.

> *"For many the Pandemic has been a personal education in 'keeping in touch' and mobile broadband has played a major part in making that possible."*

As we write, there is no set date for getting back to physical 3GPP meetings. There is optimism in the air, but baby-steps may be needed before we start to plan for a return to full meeting rooms. The Mobile Competence Centre (3GPP MCC) are working hard to keep up with the evolving situation, as meeting venues start to reconsider their offerings in the COVID-19 era. During the March plenaries (TSG#91-e), the TSG and working group leadership will take their next look at the potential for a return to physical meetings from September.

In this issue of Highlights we cover the progress made in the year of e-meetings, with some articles from the Working Groups. In a period of growth for the project, we also hear from the 3GPP Market Representation Partners (MRPs), with their expert perspectives on how 5G continues to expand into new areas.

In the later pages we again look inside 3GPP, to provide some introductory texts

and graphics about the structure and the schedule of the work.

I hope that you enjoy Highlights Issue 2. If so, please consider subscribing to the newsletter at www.3gpp.org/highlights

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If you have any ideas or proposals for future content, please contact the editorial group via **highlights@3gpp.org**

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A RELEASE 17 UPDATE

By Puneet Jain, 3GPP Working Group SA2 Chair.

Technical Specification Group SA Working Group 2 is in charge of developing the Stage-2 specifications of the overall system architecture - including the main functions and entities of the 3GPP network, how these entities are linked to each other and the information they exchange.

The group defined the 5G system architecture as part of 3GPP Release-15 and has continued its progress with the Release-16 work - focusing on following key focus areas:

- **5G System (5GS) enablers for new verticals e.g.**

  - Industrial automation, including Time Sensitive Communication (TSC), Ultra Reliable and Low Latency Communication (URLLC) and Non-Public Networks (NPNs)

  - Cellular Internet of Things (CIoT) support for 5G system

  - Vehicle-to-Everything (V2X) communication

- **5G Wireless Wireline Convergence (5WWC)**

- **Other 5G system enhancements** e.g. enhancements for Network Analytics (eNA), support for Access Traffic Steering, Switching and Splitting (ATSSS), optimized UE radio capability signalling (RACS), enhanced Network Slicing (eNS), enhanced Service Based Architecture (eSBA), Single Radio Voice Call Continuity (5G-SRVCC), enhanced Location Services (eLCS).

> *"Although SA2 kicked off work on Release-17 study items in the fourth quarter of 2019, the major part of the work has taken place after the prioritization exercise for the release... in December 2019."*

Although SA2 kicked off work on Release-17 study items in the fourth quarter of 2019, the major part of the work has taken place after the prioritization exercise for the release at the TSG SA#89 plenary meeting in December 2019.

That prioritization exercise resulted in the following new Release-17 study items and work items, approved as the focus of further enhancements to the 5G system and enablers for new features and services:

Study on enhanced support of non-public networks
(FS_eNPN, TR 23.700-07)
To enable support for Standalone Non-Public Network (SNPN) along with subscription/credentials owned by an entity separate from the SNPN, support for Video, Imaging and Audio for Professional Applications, Support of IMS voice and emergency services for SNPN, and support for UE Onboarding and remote provisioning.

Study on enhanced support of Industrial Internet of Things
(FS_IIoT, TR 23.700-20)
To enhance support of Time Sensitive Communication (TSC), including enhancements for support of deterministic applications and enhancements to IEEE Time-Sensitive Networking (TSN). Key issues addressed in the study include Uplink Time Synchronization, UE-UE TSC communication, Exposure of QoS and related enhancements,

Exposure of Time Synchronization services for activation/deactivation, support for PTP time sync and use of Survival Time for Deterministic Applications in 5GS.

Study on enhancement of support for edge computing in 5GC
(FS_enh_EC, TR 23.748)
To define solutions to enhance the forwarding of some UE application traffic to the applications/contents deployed in Edge Computing Environment, including the dynamic insertion of traffic offloading capabilities, seamless change of application server serving the UE, provide local applications with information on e.g. the expected QoS of the data path, supporting PSA change when the application does not support notifications of UE IP address change.

Study on Access traffic steering, switch and splitting support; Phase 2
(FS_ATSSS_Ph2, TR 23.700-93)
Aims to support additional traffic steering capabilities as well as supporting Multi access PDU Session using 3GPP LTE/EPC resources as a 3GPP access.

Study on enablers for network automation for 5G; Phase 2
(FS_eNA_Ph2, TR 23.700-91)
To address some leftover work from Rel-16, such as data collection from UE for analytics generation; how to ensure that slice SLA is guaranteed. Also new functionality will be supported which includes - Multiple NWDAF Instances in one PLMN including hierarchies, enabling real-time or near real-time NWDAF communication, NWDAF-Assisted UP Optimization, Interaction between NWDAF and AI Model & Training Service owned by the operator.

Study on enhancement of network slicing; Phase 2
(FS_eNS_Ph2, TR 23.700-40)
Identifying the gaps that need to be filled in providing support in the specifications owned by SA WG2 for the Generic Network Slice Template (GST) attributes defined by GSMA 5GJA and captured in document NG.116.

Study on architecture enhancements for 3GPP support of advanced V2X service; Phase 2
(FS_eV2XARC_Ph2, TR 23.776)
This study aims to provide support of QoS aware NR PC5 power efficiency for pedestrian UEs.

Study on system enablers for devices having multiple USIMs
(FS_MUSIM, TR 23.761)
To support enhancements for handling of Mobile Terminated service with a Multi-USIM device, enabling of Paging Reception for Multi-USIM Devices and coordinated leaving for the Multi-USIM device.

Study on system enhancement for proximity-based services in 5GS
(FS_ProSe, TR 23.752)
To provide support for ProSe Direct discovery, ProSe Direct communication, UE-to-Network Relay, UE-to-UE Relay, direct communication path selection between PC5 and Uu, and PC5 Service Authorization and Policy/Parameter Provisioning.

Study on architectural enhancements for 5G multicast-broadcast services
(FS_5MBS, TR 23.757)
Aims to develop 5G architecture for general 5G multicast and broadcast communication services, enabling, e.g., transparent IPv4/IPv6 multicast delivery, IPTV, software delivery over wireless, group communications and IoT applications, V2X applications, public safety.

Study on supporting Unmanned Aerial Systems (UAS) connectivity, identification, and tracking
(FS_ID_UAS; TR 23.754)

Vehicles (UAV) identification, UAV authorization by UAS Traffic Management, UAV authorization revocation and (re) authorization failures, UAV - UAV Controller association and tracking, and User Plane Connectivity for UAVs. It addresses both 5G Core and 4G EPC.

> *"SA2 continues to make good progress on Release-17 work... At the time of writing, most of the Study items are over 95% complete."*

Study on architecture aspects for using satellite access in 5G
(FS_5GSAT_ARCH, TR 23.737)
Addresses following aspects related to integration of satellite access in the 5G system - Mobility Management with large coverage areas, Mobility Management with moving coverage areas, Delay in satellite, QoS with satellite access, QoS with satellite backhaul, RAN mobility with NGSO (Non-Geostationary Satellite Orbit) regenerative-based satellite access, Regulatory services with super-national satellite ground station.

5G system enhancement for advanced interactive services
(5G_AIS)
This Work Item is to define potential QoS parameters e.g. new standardized 5QI(s) corresponding to QoS requirements for interactive services like cloud gaming service.

Enhancement to the 5GC location services; Phase 2
(5G_eLCS_Ph2)
Aims to provide support for very low latency and very high accuracy positioning, including horizontal and vertical positioning service levels, 5G positioning service area. This work item will also enable MCX UE to use the 5G positioning services to determine its position.

Multimedia Priority Service (MPS); Phase 2
(MPS2)
Addresses the impacts to EPS and 5GS core network specifications for supporting MPS for MMTel voice teleconferencing, MPS Data Transport Service (DTS) communications and MPS for MMTel video, MMTel video teleconferencing and streaming video.

Despite the COVID-19 challenges, SA2 continues to make good progress on Release-17 work, thanks to the meticulous work planning and outstanding effort of the meeting participants. At the time of writing, most of the Study items are over 95% complete. SA2 plans to finish the Stage-2 normative work by June 2021. Release-17 Stage-3 target freeze date is March 2022 and ASN.1/Code freeze target is June 2022.
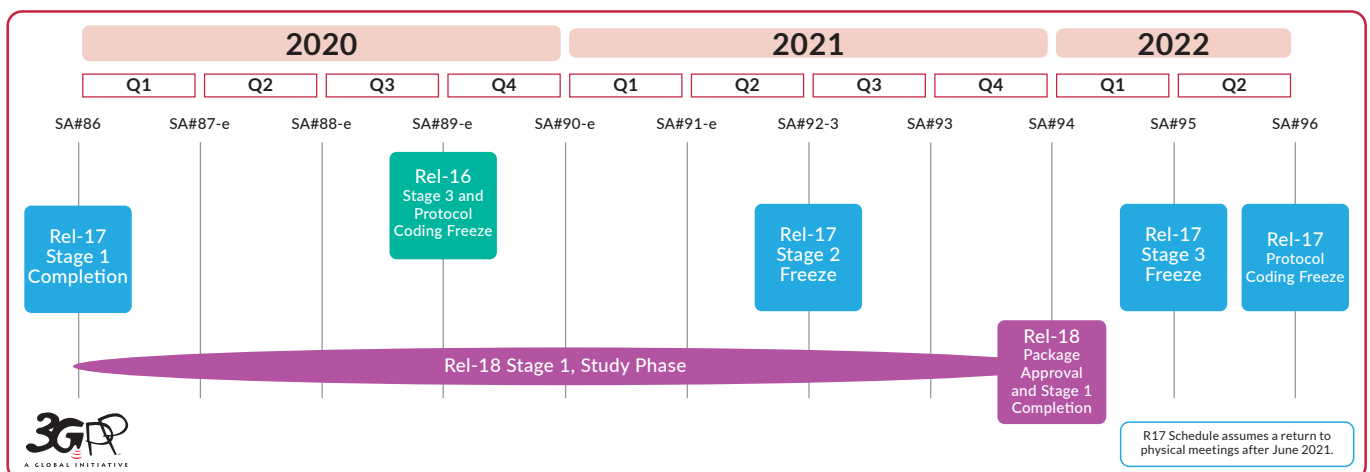
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN NG-RAN: NEW STUDY IN RAN3

*By the 3GPP Working Group RAN3 leadership
(Gino Masini, Sasha Sirotkin, Yin Gao)*

5G brings more stringent requirements for Key Performance Indicators (KPIs) like latency, reliability, user experience, and others; jointly optimizing those KPIs is becoming more challenging due to the increased complexity of foreseen deployments.

Operators and vendors are now turning their attention to Artificial Intelligence and Machine Learning (AI/ML) to address this challenge. For this reason, following RAN plenary approval, 3GPP RAN3 has recently started a new Release-17 study on the applications of AI/ML to RAN.

AI can be broadly defined as getting computers to perform tasks regarded as uniquely human. ML is one category of AI techniques: a large and somewhat loosely defined area of computer algorithms able to automatically improve their performance without explicit programming. AI algorithms were first conceived circa 1950, but only in recent years ML has become very popular partly due to massive advancements in computational power and to the possibility to store vast amounts of data. ML techniques have made tremendous progress in fields such as computer vision, natural language processing, and others.

ML algorithms can be divided into the following types:

- Supervised learning: given a training labeled data and desired output, the algorithms produce a function which can be used to predict the output. In other words, supervised learning algorithms infer a generalized rule that maps inputs to outputs. Most Deep Learning approaches are also based on supervised learning.

- Unsupervised learning: given some training data without pre-existing labels, the algorithms can search for patterns to uncover useful information.

- Reinforcement learning (RL): unlike the other types, which include a training phase (typically performed offline) and an inference phase (typically performed in "real time"), this approach is based on "real-time" interaction between an agent and the environment. The agent performs a certain action changing the state of the system, which leads to a "reward" or a "penalty".

Perhaps the most obvious candidate for AI/ML in RAN is Self-Organizing Networks (SON) functionality, currently part of LTE and NR specifications (it was initially introduced in Rel-8 for LTE). With SON, the network self-adjusts and fine-tunes a range of parameters according to the different radio and traffic conditions, alleviating the burden of manual optimization for the operator. While the algorithms behind SON functions are not standardized in 3GPP, SON implementations are typically rule-based. One of the main differences between SON and an AI-based approach is the switch from a reactive paradigm to a proactive one.

The study has just begun, and at the time of writing we can only provide initial considerations. According to the mandate received from RAN, our study focuses on the functionality and the corresponding types of inputs and outputs (massive data collected from RAN, core network, and terminals), and on potential impacts on existing nodes and interfaces; the detailed AI/ML algorithms are out of RAN3 scope. Within the RAN architecture defined in RAN3, this study prioritizes NG-RAN, including EN-DC. In terms of use cases, the group has agreed to start with energy saving, load balancing, and mobility optimization. Although the importance of avoiding a duplication of SON was recognized, additional use cases may be discussed as the study progresses, according to companies' contributions. The aim is to define a framework for AI/ML within the current NG-RAN architecture, and the AI/ML workflow being discussed should not prevent "thinking beyond", if a use case requires so.

Stay tuned for further updates as the study progresses in RAN3, or consider joining us in our journey into the "uncharted" territory of AI/ML in NG-RAN.

https://www.3gpp.org/specifications-groups

3GPP MULTIMEDIA CODECS
SYSTEMS AND SERVICES

by Frédéric Gabin, 3GPP Working Group SA4 Chair

3GPP TSG SA WG4 (SA4) is responsible for the specification of codecs for speech, audio, video, graphics and other media types related to traditional and emerging media services such as extended reality (XR) and online gaming, as well as the system and delivery aspects of such content.

SA4 is defining the content formats and delivery protocols as well as associated quality assessments, metrics and requirements for broad range of scenarios:

- Unicast streaming;
- Multicast and broadcast streaming;
- Cloud and edge computing architectures;
- Media APIs;
- Media handling in multimedia telephony;
- Terminal acoustics requirements and performance testing;
- End-to-end service performance;
- Objective and subjective quality testing;
- Quality of experience (QoE) metrics;
- Collection of traffic characteristics for 3GPP network optimization;
- Reporting and data collection for all services involving media aspects;
- Use of artificial intelligence and machine learning models for multimedia.

The completion of Release-16 work in June 2020 has laid down solid 5G Media foundations. Among the many features in the release, I would highlight two major enhancements developed and spearheaded:

5G Media Streaming (5GMS) architecture, protocols and codecs

The 5GMS supported services include Mobile Network Operator (MNO) and third-party Downlink Media Streaming Services and MNO and third-party Uplink Media Streaming Services. The 5GMS architecture is functionally divided into independent components enabling different deployment and collaboration scenarios with various degrees of integration between 5G MNOs and Content Providers.
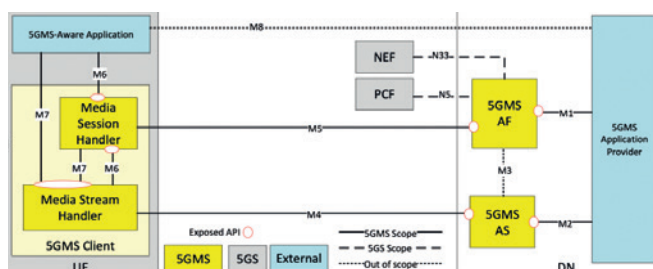
3GPP TS 26.512 specifies the delivery protocols, exposed REST APIs and the means to leverage 5G functionalities. TS 26.511 specifies further client media content interfaces in the client as well as the 5GMS client requirements for media codecs. The codec and format recommendations defined for each profile apply to the 5GMS client components in the User Equipment (UE) as well as the Media Application Server (AS). Profiles are defined to address specific service scenarios. A default profile is defined in the case no other profile is claimed to be supported. 5G Media Streaming protocols and formats are based on the Common Media Application Format (CMAF).

EVS codec enhancements

Rel-16 saw the introduction of the alternative fixed-point Enhanced Voice Services (EVS) codec reference implementation, using updated basic operators (TS 26.452). The EVS codec is at the heart of HD Voice+ services for VoLTE and 5G Voice. This new code enables more efficient processing and improves battery life by leveraging modern DSP architectures.

Release-17 and beyond – 5G Media enhancements

The ongoing Rel-17 study and normative work is focused on the following areas with a foreseeable target completion in March 2022:

- Video coding: Currently specified video codecs (H.264/AVC and H.265/HEVC) are being characterized over 5G scenarios as a preparation for Next Generation Video coding for 5G. We also plan the addition of 8K Virtual Reality 360° Video profiles.
- Terminal acoustic testing: Testing for handsets featuring "non-traditional" earpieces (e.g. vibrating display) and extensions of current tests to the electrical headset interface of UEs are being specified.
- XR services: Collection of various XR use cases have been performed and identification of XR-based services typical traffic characteristics is ongoing; Glass-based Augmented Reality is studied, and Immersive Teleconferencing and Telepresence for Remote Terminals is being specified.
- Extensions of 5G Media Streaming are studied: 5G multicast and broadcast support, Cloud and Edge Media processing, Content Preparation, Traffic Identification, Background traffic, Content Aware Streaming, Network Event usage, Per-application-authorization and Support for encrypted and high-value content.
- Speech & Audio coding: New codec selection work is planned for an EVS Codec Extension for Immersive Voice and Audio Services (IVAS), this work is planned to complete in August 2022. Related specification work for Terminal Audio quality performance and Test methods for Immersive Audio Services will follow in a next step.

SA4 Terms of Reference, contact information, calendar, links to Technical Specifications, Reports and Meeting documents are all publicly available at **https://www.3gpp.org/Specifications-groups/sa-plenary/55-sa4-codec.**

IS HEALTHCARE THE
NEXT BIG THING FOR 5G?

By Brian Dolby, CEO, Proactive International PR

The arrival of 5G has been heralded as a game-changer for sectors across the board. From smart cities to industrial IoT and the transport sector, its potential uses are myriad and have created widespread excitement.

> *"The effect of 5G on the sector, its suppliers and those who use it are predicted to be huge, significantly changing the way healthcare is delivered and having an impact on millions of patients."*

The focus may lean towards the role of 5G within telecoms, but connected benefits have created a number of new frontiers in other areas and the development of standards assist with application, development and innovation across many others.

One such area is healthcare. The effect of 5G on the sector, its suppliers and those who use it are predicted to be huge, significantly changing the way healthcare is delivered and having an impact on millions of patients. From phrases like 'personalised healthcare' to e-health or telehealth, 5G brings the prospect of a whole new landscape in the provision of healthcare. Its attributes when it comes to low latency, high reliability and the capability to support multiple devices and sensors are what will ensure 5G has a significant impact - both when it comes to delivering vital emergency services needed in real time as well as the personalisation of healthcare. Additionally, the possibilities related to network slicing could also prove beneficial when it comes to hospitals or health organisations.

The potential use cases of 5G within healthcare range from remote diagnosis to imaging as well as supporting the application of virtual reality and the potential application of remote haptic, tactile, audio and visual technologies.

The creation of the 'Internet of Medical Things' would allow remote diagnosis and monitoring of patients through medical devices, wearables and remote sensors, as well as the capability to send large imaging files to assist with diagnosis and monitoring.

> *"Additionally, 5G's attributes of enhanced mobile broadband data, ultra-low latency and reliability are key in allowing the delivery of emergency services that need to operate in real-time."*

One example given by the Austin Cancer Center to AT&T1 describes having to wait to send large PET scan files until after hours because of their size, whereas 5G would allow such files to be sent instantly, allowing doctors access to the results they need almost immediately. Another example given in David J Teece's report 5G Mobile: Impact on the Health Care Sector2, which uses research provided by Qualcomm Technologies, is the glucometer. In the pre-5G world, glucometers aren't necessarily used in a way that allows diabetics to understand

and analyse their blood sugar details, the report outlines. But 5G could fundamentally change the way these instruments are used to measure blood sugar levels, continually transmitting the data to a device or server and allowing the patient to receive feedback and advice specifically relevant to them. In this way, e-health will not only improve patient analysis and monitoring but could also help reduce healthcare costs.

Additionally, 5G's attributes of enhanced mobile broadband data, ultra-low latency and reliability are key in allowing the delivery of emergency services that need to operate in real-time. By allowing faster and greater flows of data, medical applications will be able to process content and allow responsive, real-time actions that are vital for emergency elements of telehealth and telemedicine,

with the advent of 'computing at the edge' - something 3GPP is working to support - also allowing real-time responses in emergency situations. This includes the potential for doctors operating on a patient remotely via a robotic counterpart using specialised haptic feedback gloves and virtual reality, as trialled at the Ericsson 5G Tactile Internet Lab in King's College London3. Again, the ultra-low latency and multi gigabit bandwidth of 5G is at the heart of the development of this new frontier.

For all of these potential use cases, interoperability is vital and the work by 3GPP and its members in standardisation is key. As Teece's report suggested, the work undertaken around standards ensure interoperability across the ehealth sector.

Teece writes:
"A fundamental economic characteristic of 5G is that much of the technology will be embedded in standards, i.e., the industry will collaboratively develop a set of technologies and protocols that will then be implemented by every 5G-compliant device. There will not be competing and mutuallyincompatible versions of 5G."

In the realm of e-health, such interoperability is vital. For projects such as that trialled in the 5G Tactile Internet Lab, the standards 3GPP is working on will undoubtedly be a game-changer and vital to such innovative work.

"What we saw when we had healthcare experts join us at various points during Release 16 was that most of the requirements on a technical level are being fulfilled," says Georg Mayer, Chair of 3GPP's Service and System Aspects Technical Specification Group (TSG SA).

"We are in a good place with the base 5G technologies and the additional functionalities which other verticals have so far introduced. Of course, more innovation is important but the tools that we are providing are powerful enough to give you a first entry point. It's important to remember that e-health is not a silo application in 5G. It will be a service making use of the various functionalities of the 5G ecosystem and therefore it will be easy to deeply integrate e-health services with other vertical services such as first responders, transport (ambulance), drones etc."

The possibilities are clearly endless. In the same way standards and interoperability are fundamental for a variety of new verticals using 3GPP systems, such as industry 4.0, vehicle-to-vehicle communications and smart cities, the features developed by 3GPP for 5G will ensure that healthcare can be the next frontier to embrace the technology.

FROM IMT-2020 **TO BEYOND**

Interview with Sergio Buonomo,
Chief, ITU-R Study Groups Department

We invited Sergio Buonomo to answer a few questions, intended to help the 3GPP readership to better understand how our own specifications for 5G are connected to the ITU's IMT-2020 process.

Highlights: Could you sum up the significance of the IMT process and what it means to conform to it?

SB: The ITU-R is responsible for the Radio Regulations, with the latest set being the 2020 version (Image right), which is the essential regulatory document for the service allocation of the frequency bands (8.3 kHz - 275 GHz Range). They define the spectrum allocation for all radiocommunication services in the three ITU-R Regions, including the allocation for the mobile service. Also, there are important "footnotes" in there; defining the identification of IMT in frequency bands for specific countries.

A good starting point for a better understanding of the development of International Mobile Telecommunications-2020 (IMT-2020) would be 'Resolution ITU-R 65' on the "Principles for the process for future development of IMT for 2020 and beyond". It outlines the essential criteria and principles that are used in the process. The IMT track record is impressive over a number of years, with three generations of IMT technology development for "IMT-2000" (related to 3G), "IMT-Advanced" (related to 4G) and now for "IMT-2020" (related to 5G).

The IMT process consists of 4 main phases:

- "ITU-R Vision" and definitions (described in ITU-R Recommendations).

- Minimum requirements and evaluation criteria (described in ITU-R Reports).

- Invitation for proposals, evaluation, and consensus building.

- Specification, approval, and implementation (described in ITU-R Reports & Recommendation and other documents).

One of the key features of the IMT process is that it ensures a proper and neutral handling of the various radio interface technology candidates. When a specific radio interface technology (RIT), or a set of radio interface technologies (SRIT), is approved to be part of a particular IMT family (IMT-2000, IMT-Advanced, IMT-2020), the technology may be deployed in the bands identified for IMT or in bands within ITU-R Radio Regulations, under national and regional regulatory policies.

The ITU Radio Regulations 2020

Highlights: Can you explain the separate identities of the two standards areas, the difference between 3GPP specification work and the IMT process?

SB: It should be noted that the ITU-R Recommendation and IMT-2020 standards accommodate a range of technical terrestrial radio interface solutions that have satisfied the IMT process and is not just aligned to the 3GPP technologies.

The "ITU-R Vision", set out for each IMT process, states what is needed to be accomplished. The standardisation body must define and develop a fitting functional technology. In 3GPP's case, the technology is described in technical specifications, which define a globally applicable industry "standard", via your Organizational Partner's transposition of them into accredited, regional or national standards.

Then, there follows an evaluation process for the IMT candidate technology. This is done in a collaborative process between ITU Member States, equipment manufacturers, network operators, standards development organizations (SDOs) and the academic community. This is a unique global framework, coordinated by ITU-R, for discussion and agreement on the capabilities of the new radio candidate technologies.

Enhanced Mobile Broadband

Gigabytes in a second — 3D video, UHD screens

Smart Home/Building — Work and play in the cloud

Augmented reality

Industry automation

Voice — Self Driving Car

Smart City — Mission critical application e.g. e-health

Future IMT

Massive Machine Type Communications — Ultra-reliable and Low Latency Communications

Smart agriculture

Source: ETSI'
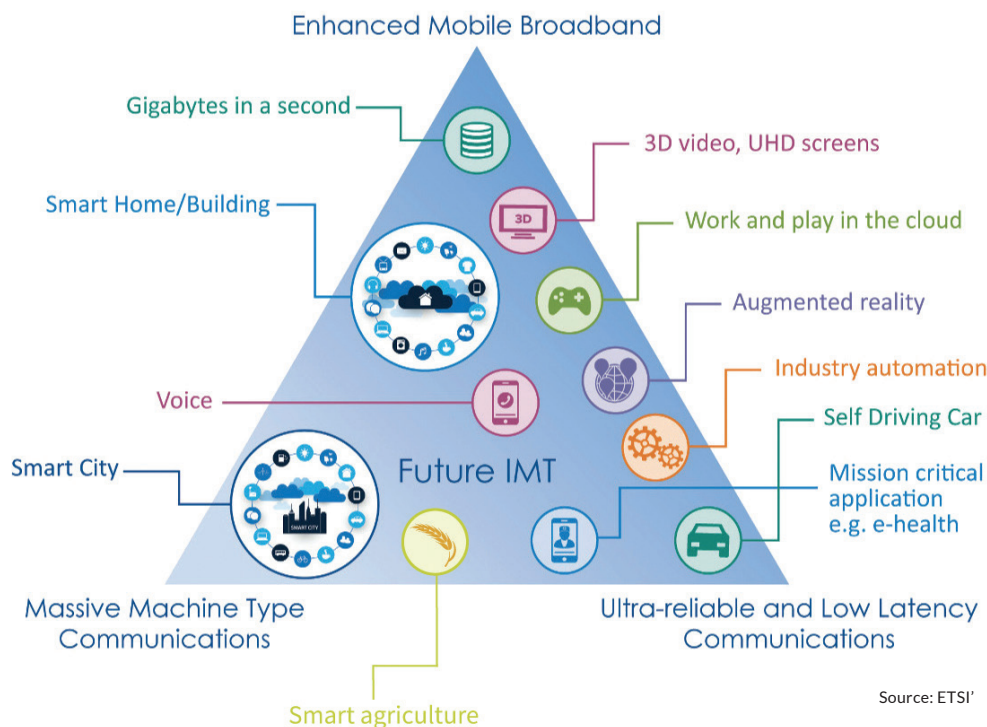
Highlights: How close is the ITU-R work on IMT to the ITU's World Radiocommunication Conference (WRC) Process? Can you tell us a little about how Spectrum or band arrangements are handled?

SB: IMT dovetails with the WRC task to review and, if necessary, revise the ITU Radio Regulations. That said, the IMT process itself is independent from the WRC process, with the specification, evaluation, and approval of a radio interface technology (RIT or SRITs) all done outside of WRC. The work on any IMT family spans over several years - As an example, the process for IMT-2020 has been done over 7 years (2014-2020), during which time there have been two World Radiocommunication Conferences (WRC-15 and WRC-19).

The processes are related to each other as they both seek to ensure the efficient use of the frequency bands identified by previous WRCs for IMT. The two will certainly come together to consider decisions to be taken by WRC-23, on further spectrum identifications for IMT-2020.

Highlights: You have already started to work on the next IMT process, with evolution 'Towards 2030 and beyond'. When will we see more on that?

SB: First, I would stress that future developments for IMT-2020 are very important. I mentioned Resolution ITU-R 65 before and in resolve 6h there is room for further evolution, allowing "an ongoing and timely process where new radio interface technology proposals may be submitted, and existing radio interface specifications can be updated". In 2021, ITU-R will define the schedule for future revisions of the Recommendation ITU-R M.2150, to accommodate any future new, improved, or updated IMT-2020 candidate technology proposals beyond the first release.

Looking further ahead, ITU-R Working Party 5D has initiated work on future technology trends for "IMT towards 2030 and beyond". This work could include anticipating new use cases for IMT and subsequently the identification of any gaps and in particular new technical enablers necessary in the 2030 timeframe. The Working Party has invited organisations also external to ITU-R to provide inputs for its June and October meetings in 2021, to help their work on a new Report on "Future Technology Trends towards 2030 and beyond".

It is fair to say that the well proven IMT process will again be applied for 'towards 2030 and beyond', starting with a clear "ITU-R Vision" and definition phase. ITU-R counts on the mutual cooperation with 3GPP to start the next journey.

ENABLING OPERATIONAL MOBILITY FOR EUROPEAN PUBLIC SAFETY RESPONDERS

By David Lund, President, Public Safety Communication Europe (PSCE) Forum

2021 will be an important year for pan-European operational mobility as a foundational communication capability for public safety is delivered by mobile broadband connectivity. Full operational mobility will make disaster response and recovery more effective, improve coordination between responders and put their mobile capabilities beyond the increasing sophistication and internationalization of organised crime.

BROADWAY PRE-COMMERCIAL PROCUREMENT – COORDINATED BY 3GPP PARTNER PSCE

The EU funded BroadWay project brings together a Group of Procurers to jointly source innovation activities, in line with the BroadWay 'Common challenge for operational mobility'. The challenge's activities are concentrated in the following areas:

- Pan-European: Operational Mobility, Governance, Architecture, Availability, Security
- Practitioner Evaluation
- Technical Validation
- Application Eco-System
- Device Eco-System
- Innovation Eco-system
- Standardised solutions

The BroadWay Group of Procurers are drawn from 11 European countries, each holding a national responsibility to provide communication services to the responders in Belgium, Czech Republic, Estonia, Finland, France, Ireland, Italy, Greece, The Netherlands, Romania and Spain.

Partners ASTRID (Belgium), French Ministry of Interior, Erillisverkot (Finland) and the National Police of the Netherlands are 3GPP members and are active contributors to the Mission Critical Standards through 3GPP SA working groups SA1 (Requirements) and SA6 (MC Applications) in particular.

Those BroadWay project members play a major role in bringing a vital understanding of standardisation of Mission Critical services and the related LTE and 5G specifications into the procurement arena.

INTERCONNECTION OF NATIONAL SYSTEMS

The BroadWay Pan-European architecture objective addresses the necessity to support the national security and sovereignty of each country involved. Solutions to the BroadWay challenge are therefore driven towards a system of systems approach. National Mission Critical Mobile Broadband networks will interconnect, but each country retains control of its own network for its national responders.

Notable activity on a national level sees partners Erillisverkot and the French Ministry of Interior actively procuring their national mission critical networks in 2020 and 2021.

- The first milestones of the deployment in France will be the Rugby World Cup in 2023 and the Olympic games in Paris in 2024.
- In Finland, procurement is ongoing with mission critical services to be provided to users in the 2022-2025 timeframe.
- Astrid already offers prioritised mobile broadband services for responders in Belgium through their Blue Light Mobile service.

Each country across Europe is planning its national system in their own timeframe. As national systems deploy, they can offer operational mobility capability by interconnecting via BroadNet.

Source: olympic.org

BROADWAY **STATUS**

Pre-Commercial Procurement is following three phases; Design, Prototype and Pilot, spanning around three years. We now see supply teams lead by Airbus, Frequentis and Leonardo developing their prototypes due for demonstration and evaluation from April to May 2021. A second call-off competition will be held before summer 2021 where 2 of our supply teams will be selected to deliver live (TRL8 - Actual system completed and qualified through test and demonstration) pilot systems for Evaluation by responder practitioners and our procurers in Spring 2022

THE BROADWAY **TO BROADNET**

Early demonstrations of prototypes in November 2020 inspires strong confidence that technical solutions will be achievable to address the BroadWay challenge. Procurement of the final live solution will be carried out by BroadNet, responsible for initiating a pan-European governance structure for the procurement and initial operation of technical solutions. Discussions are being carried out across the European Commission, and at national level, to define and support this. A governance structure and financial model for BroadNet will be developed during 2021.

May 2018 — 2022

R&D / Pre-commercial Procurement (PCP)

Public Procurement of Innovative Solutions (PPI)

Phase 0 — Curiosity Driven Research

Phase 1 — Solution design
- Supplier A
- Supplier B
- Supplier C
- Supplier D

Phase 2 — Prototype development
- Supplier B
- Supplier C
- Supplier D

Phase 3 — Original development & testing of limited volume of 1st test products/services
- Supplier B
- Supplier D

Phase 4 — Deployment of commercial volumes of end-products. Wide diffusion of newly developed solutions
- Supplier(s) A, B, C, D and / or X

An understanding of the need

TRL8

BroadMap — BroadWay — BroadNet

FOOTNOTE

Market Representation Partner (MRP) and 3GPP member PSCE (www.psc-europe.eu) coordinates the BroadWay project. PSCE works together with fellow MRPs; 5G-AA, 5G-ACIA and 5G-IA to arrange a series of workshops and webinars to encourage other vertical industries to provide their contribution to 3GPP.

www.broadway-info.eu

ONE GLOBAL NETWORK
WITH OPENROAMING™

By Bruno Tomas, Wireless Broadband Alliance

OpenRoaming by the Wireless Broadband Alliance (WBA) is a federation service enabling an automatic and secure Wi-Fi experience everywhere, creating an open connectivity framework for all organizations in the wireless ecosystem to power new opportunities with Wi-Fi in the 5G era.

Effectively, OpenRoaming focuses on ease and scale of adoption by network providers, from the basis of 3GPP Evolved Packet System (EPS) AAA interfaces, it effectively allows SWa interface to operate between those network providers and HPLMN.

**OpenRoaming encompasses three key elements:**

- Cloud federation: creates a federation of networks and identity providers to enable automatic roaming and user onboarding on Wi-Fi. Based on WBA's Wireless Roaming Intermediary eXchange (WRIX) standards to scale and facilitate different business models under a harmonized framework.

- Cyber Security: enables simple, secure and scalable Wi-Fi connections amongst different organizations that are part of OpenRoaming. Allowing automatic and secure roaming between millions of networks, nationally and globally with secured interconnection and encrypted communications.

- Network automation: defines an automated roaming consortium codes framework (RCOI) to support policy provision on devices and networks. Organizations that manage a Passpoint enabled network may become part of the OpenRoaming federation.

OpenRoaming brings together a federation of networks and identity providers, allowing users to join any network managed by a federation member. Companies who join the effort provide assurance that their Wi-Fi networks automatically interoperate between each other to deliver an automatic and secure connected Wi-Fi experience. In the end it enables companies to accelerate and scale roaming relationships. Enabled networks can automatically onboard users securely leveraging established identity providers such as operators, cloud IDs, loyalty membership, bridging the gap between Wi-Fi and cellular networks, enabling new business models. Further, it works across Wi-Fi and cellular network generations, such as 3G, LTE or 5G.

5G includes mandatory authentication options such as: Authentication and Key Agreement (5G-AKA) and Extensible Authentication Protocol (EAP)-AKA', i.e. EAP-AKA'. OpenRoaming leverage EAP authentication and fully realizes the vision of the primary authentication to be radio access technology independent, thus it can run over non-3GPP technology such as IEEE 802.11 WLANs. The OpenRoaming standards group is working to expand OpenRoaming to industry verticals and complementary access networks such as IoT/LPWAN and Private LTE/5G.

WBA is looking forward to closely collaborating with 3GPP and other peers to resolve onboarding and security issues for the industry.

https://wballiance.com
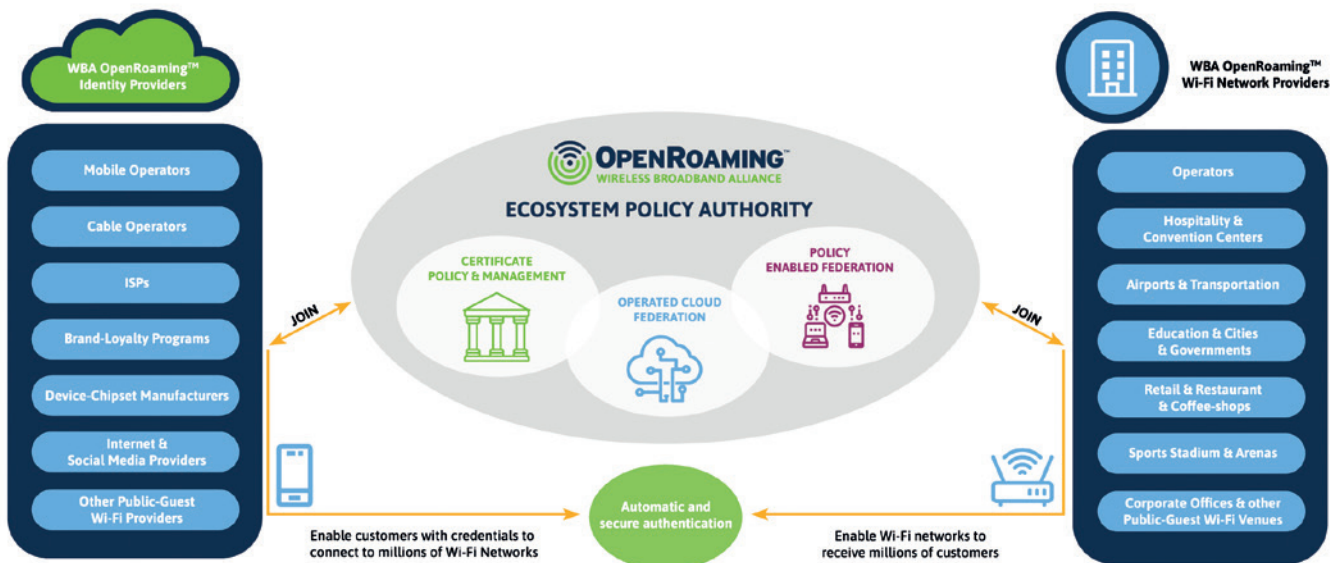
FULFILLING THE PROMISE OF ANYTIME, FROM ANYWHERE AND ON ANY DEVICE & NETWORKS

By Simon Watts, Global Network & Services Policy, ESOA

Satellite communications have demonstrated their critical importance and value in today's world. The substantial value added of satellite to the access technology mix for 5G is becoming increasingly clear, especially for unserved/underserved areas and for mission critical and other applications where ubiquitous coverage and resiliency are crucial.

The 5G ecosystem calls for a flexible, adaptable technology framework, fully capable of supporting multiple access technologies that can best respond to the ever-increasing expectations and demands of the users. Via full integration into 3GPP standards, 5G offers a unique opportunity for the satellite industry to fully establish its place in the global communications ecosystem.

For the past few years, the satellite industry has engaged proactively with the mobile industry and vertical stakeholders at 3GPP and other forums to ensure that satellite technologies can be fully integrated into 5G system at the architecture and the radio access network (RAN) level. The integration will contribute to the AnyTime, from AnyWhere and on Any Device (ATAWAD) goal associated to the provision of 5G services.

3GPP has started the normative activities in support of satellite integration into the 5G system, as part of the Release 17. The work includes developing technical specifications to support transparent payload-based scenarios addressing UE with GNSS capability. These work items have been supported by a wide range of organizations from the satellite and mobile industries as well as professional and governmental stakeholders. This paves the way for the definition of a global standard for satellite networks operating at LEO, MEO or GEO orbits in various frequency bands.

Furthermore, a study to address features necessary to enable LTE NB-IoT/eMTC to support satellite has been started in November as part of Release-17. This work will contribute to better support for vertical businesses and applications requiring global service continuity in various domains such as agriculture, transport and logistics.

Additionally, through collaboration with NGMN, key ESOA members have successfully demonstrated to 3GPP that space-based networks integrated in 5G provide an effective alternative for network connection beyond traditional deployment methods, especially in rural areas. Integrating space-based systems with existing terrestrial networks enables mobile network operators to overcome the challenge of signal quality and roaming capabilities in underserved areas.[1] Much other collaborative work has taken place and ongoing activities working with partners looking at sectors from agri-tech and Connected Vehicles on the ground to

connecting airplanes, drones, and ships. One recent example is Project Darwin that seeks to leverage these different cases of convergence between 5G and Satellite to enable commercial use cases of Mobility as a Service where 5G and Satellite complement each other to ensure continuous connectivity to cloud applications with assured levels of service including leveraging the ATSSS lower layer functionality.

At a time when all of humanity is sharing the experience of the COVID-19 pandemic, a satellite component of 5G offers a compelling case for its central role in helping to realize the full promise and potential of 5G: enabling global collaboration among health communities, expanding access to telemedicine, enabling tele-education and tele-work, facilitating ongoing economic activity and supporting social-distancing.

www.esoa.net

ESOA
EMEA SATELLITE OPERATORS ASSOCIATION

[1] https://www.ngmn.org/ngmn-news/press-release/ngmn-alliance-and-esoa-members-collaborate-to-extend-rural-connectivity-with-non-terrestrial-networks.html
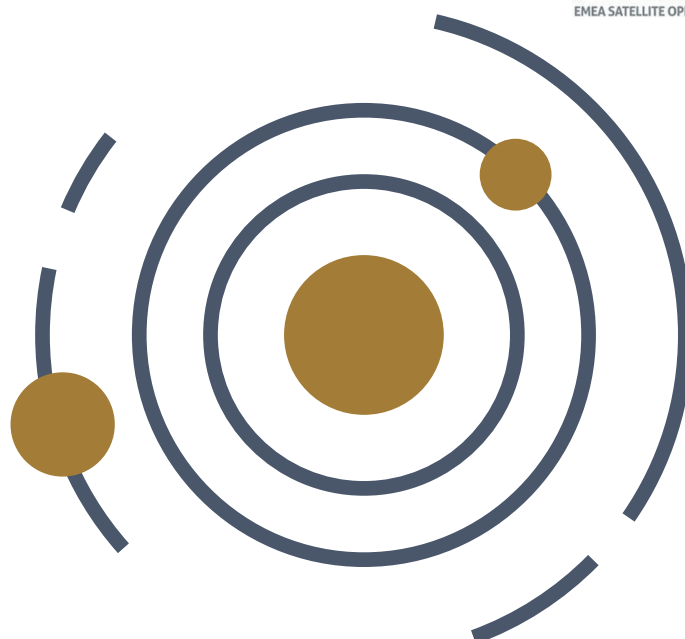
TRUSTED STANDARDS MEAN
TRUSTED COMMUNICATIONS

By Tero Pesonen, Chair, TCCA Critical Communications Broadband Group

Nowhere in the communications market are standards more crucial than for users in the mission and business-critical markets, where interoperability is essential to ensure uninterrupted service in operations where lives may be at stake.

As 3GPP's Market Representation Partner for critical communications, TCCA through its Critical Communications Broadband Group (CCBG) has the ability to offer market advice to 3GPP. It does this by bringing into 3GPP a consensus view of market requirements – services, features and functionality – that fall within the 3GPP scope. By bringing this information to the table, CCBG helps to ensure that the standards development process takes these critical user needs into account.

Since 2012, the work to incorporate mandatory functionality in 3GPP Releases to meet critical communications user needs has grown in depth and breadth.
3GPP Release 13 introduced true critical communications to the 3GPP community. The SA6 Mission Critical Applications working group was established, and as a first outcome Mission Critical Push to Talk (MCPTT) capability was standardised.

Over subsequent Releases a more comprehensive critical communications architecture was defined with additional services such as Mission Critical Data (MCData) and video (MCVideo) and with the prioritization of work to allow mission critical systems migration and interconnection, including efforts to ensure smooth interconnect between LTE and LMR/PMR systems, including TETRA.

SEAMLESS CONNECTIVITY

For Release 17, TCCA together with public safety agencies, industry and other stakeholders highlighted the need to ensure seamless connectivity in terms of coverage, availability and resilience in a secure, safe and taxpayer-friendly manner.

This is translating into further standardisation of device-to-device communication (5G_ProSe) via Sidelink in the V2X (Vehicle to everything) domain, in satellite connectivity (5GSAT_ARCH) and multicast/broadcast capabilities over 5G (5GMBS). All of these are work-in-progress and will be a major benefit to society once deployed.

However, when a standard Release comes out of 3GPP, the journey to field operation is just beginning. In some cases, it forms the basis for further standardisation – an example is the interworking between Land Mobile Radio Systems (LMR) / Professional Mobile Radio (PMR) with 3GPP Mission Critical Systems. With the finalisation of 3GPP Release 16, the ETSI Technical Committee

for TETRA and Critical Communications Evolution (TC-TCCE) can continue to finalise the TETRA element of the interface specification.

This still needs to be implemented and deployed in order to enable governments, in particular, to keep critical communications services running while migrating from narrowband mission critical LMR/PMR systems to 3GPP based broadband services. This migration can take several years.

Beyond the infrastructure, device and service interoperability certification is a key market enabler. Legislation in many countries already requires multivendor supply and interoperability from public procurement.

As an example, many 'mission-critical' products and services are available today which claim to be 3GPP compliant, but one big issue facing all vendors and purchasers of these solutions is that there is no testing and certification process available to prove their 3GPP standards-compliance. The Global Certification Forum (GCF), supported by TCCA, has formed the Mission Critical Agreement Group (MCAG) to look at certification of LTE devices with integrated MCX clients, and is working with the GSMA to define TS.11 Field Trial test cases for MCX features. The MCAG has been established as a permanent GCF group to manage and develop MC certification going forward.

For compliance testing, there are projects under way funded by NIST including the MCS-TaaSting project, in which TCCA is a partner. This Mission Critical Testing as a Service initiative aims to fulfil the specific needs of the mission critical communications community. The goal is to enable cost efficient regular and frequent testing, re-testing, certification and re-certification of the myriad and increasing combinations of devices, operating systems, middleware and applications.

These work items will allow our increasingly heterogeneous industry to prove the 3GPP standards-compliance of their implementations. This will give end-users and operators the confidence to buy certified and interoperable products and services that will enhance the safety and security of us all.

The ultimate goal is to create and build an interoperable multivendor market, pushing boundaries with new ways of working and innovating with enablers for future solutions. The vast majority of progress in the standardisation of critical broadband is enabled by volunteers, and I would like to take this opportunity to thank everyone who contributes to the activities of CCBG, TCCA and 3GPP. There is much work to do in order to ensure truly mission critical products and services, and I would encourage everyone who cares about the safety of their society to become involved.

https://tcca.info/

MMWAVE BANDS **FOR 5G**

By Joe Barrett, President,
Global mobile Suppliers Association (GSA)

As of the end of 2020, 412 operators in 131 countries/territories were investing in 5G, with 5G services now launched in all regions, including 85 networks in EMEA, 35 in APAC and 15 in the Americas.

Look deeper, and it is clear that mmWave spectrum bands are being explicitly opened up to enable provision of 5G services. 132 operators in 43 countries/ territories are investing in 5G (in the form of trials, licences, deployments or operational networks) across the 24.25-29.5 GHz spectrum range.

Of those, 85 operators are known to have been licensed to deploy 5G in this range, while 24 operators are understood to be actively deploying 3GPP-compliant 5G networks using this spectrum.

In addition to the existing IMT bands, the recent WRC-2019 identified several additional new mmWave frequency ranges to enable use by IMT-2020 (5G), including 24.25–27.5 GHz, 37–43.5 GHz, 45.5–47 GHz, 47.2–48.2 GHz and 66–71 GHz.

Of these, it is the 24.25–29.5 GHz range covering the overlapping Bands n257 (26.5–29.5 GHz), n258 (24.25–27.5 GHz) and n261 (27.5–28.35 GHz) that has been the most-licensed/deployed 5G mmWave spectrum range to date.

Band n260, covering 37–40 GHz, is also being used, with 32 companies in six countries / territories investing in licences for, or networks using this spectrum. Of those, 31 hold licences, with the majority of those based in the USA and its territories. Three operators in the USA have launched 5G using Band n260. Europe (CEPT) is also now developing frequency arrangements for 40.5-43.5 GHz which is due to be finalised this year with licensing anticipated to then follow.

However, 5G device support for spectrum bands above 24 GHz remains at an early stage. As the number of announced 5G devices broke the 500 barrier, GSA's GAMBoD database counted 95 announced 5G devices that do or will support mmWave spectrum bands with 46 understood to be commercially available (up from 27 at the end of May).
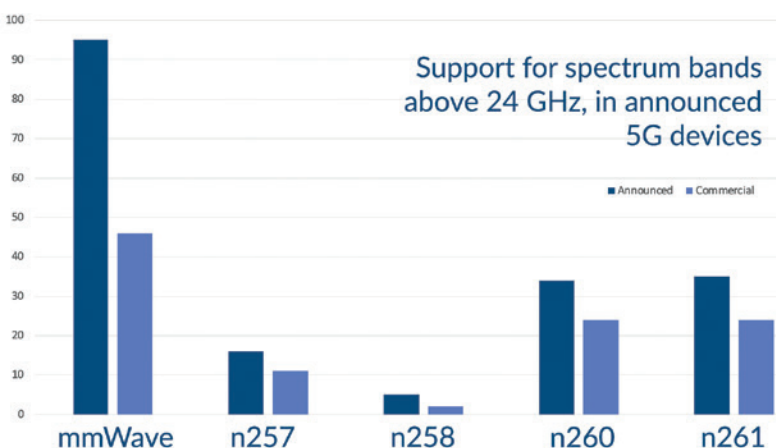
THE MMWAVE OPPORTUNITY: INDIA CASE STUDY

Recent research authored by GSMA Intelligence reveals how India stands to benefit significantly from mmWave-enabled 5G using bands such as 26 GHz and 28 GHz.

Approximately $150 billion in additional GDP is anticipated for India over the period 2025–2040, with the manufacturing sector expected to see the greatest impact, accounting for about a fifth of the gains. The healthcare sector will also benefit greatly from mmWave-enabled 5G, with an impact of approximately $4 billion.

A recent technical report by the GSA shows how terrestrial 5G can be introduced into the 24.25-29.5 GHz frequency range in India while also enabling sharing with satellite systems.

Support for spectrum bands above 24 GHz, in announced 5G devices

Crucially, most of the opportunities mmWave-enabled 5G offer largely depend on how and when the spectrum is made available. Timely access to harmonised and sufficient quantity of spectrum is key to maximising fulfilment of societal and digital.

Access to a broad range of spectrum resources is one of the main growth drivers for the deployment of mobile broadband, IoT, and fixed wireless access services; conversely spectrum can also be a limiting factor for the expansion of services into new markets and industries. It is incumbent upon national authorities, regulators, operators and the vendor community to work together to deliver on the mmWave 5G opportunity.

www.gsacom.com

GLOBAL ALIGNMENT FOR THE BENEFIT OF END-USERS, AS NEW FOCUS AREAS EMERGE

By Anita Döhler, CEO and Klaus Moschner, Executive Programme Manager, NGMN Alliance

NGMN's Work Programme often had and continues to have a very close connection with 3GPP, as one of the important cooperation partners of the Alliance. Most of NGMN's work focuses on pre-standardisation studies and derived requirements which are then for instance input for 3GPP's standardisation activities. Examples are:

- Global alignment and convergence of technology standards to avoid fragmentation and to support industry scale, e.g. for future use cases and requirements, release planning, architecture options - beyond 5G/6G.

- Ensure E2E availability and user experience: e.g. complement 3GPP work on slicing from the Device Operating System aspect, develop a holistic view on high level architecture for a Telco Network based on Cloud Native Infrastructure.

NGMN with its network operators, vendors and research associations has played an important role for the requirements setting of 4G and 5G and will continue to provide impactful guidance for the next generation of mobile networks beyond 5G. As global implementations and further development of 5G continue to maximize its full potential, the Alliance is committed to continue supporting the implementation of 5G through prioritized projects.

NGMN is dedicated to remain at the forefront of next generation mobile networks, as well as committed to providing impactful guidance for the resolution of emerging short- to mid-term industry challenges. Alongside the streamlined projects to support 5G's full potential, NGMN will concentrate on three focus areas:

1) **Mastering the Route to Disaggregation**
2) **Sustainability**
3) **6G**

DISAGGREGATION CHALLENGE

In 2021 NGMN will strategically analyse how to master disaggregation, conclude on requirements and provide impactful guidance to the industry, with focus on the E2E operating model. How to achieve an efficient and sustainable new E2E operating model is complex and a burning ¬¬question for all operators. NGMN identified several activities in the pre-competitive area which will help to address the issue and add value for operators as well as the industry. These include:

- Start preparing now for future-proof operating models that are built on the orchestration of powerful ecosystems of solution partners.

- These models should provide openness and flexibility to integrate new partners and technologies.

- At the same time they require new processes and a highly diverse set of skills and capabilities, technology and tools to drive value and efficiency.

The overall topic includes open, disaggregated, virtualised and cloud native solutions, as well as network automation.

6G VISION AND DRIVERS

Operator's requirements need to be emphasized and considered when a new mobile network generation gets designed, standardised, developed, and deployed. Therefore, now is the right time for an operator-led organisation to start working on 6G. NGMN will give the industry early and timely direction for global 6G activities for a future evolution of networks and services, including guidance to 3GPP when the time is right.

The unique position of the NGMN Alliance allows it to consider the viewpoints, requirements and use cases of end users, including Vertical Industries as well as user groups representing differentiated societal needs.

The NGMN Alliance identified the importance of starting with drivers and to develop a vision for 6G, including the end-user's viewpoints and demands, societal - and ecosystem requirements. For this it is very important to initiate a dialogue with different organisations, representing various interest groups.

NGMN is very excited to work on this future vision project and to set the footprint for generations to come.

JOURNEY TOWARDS GREEN TELCO

The telco industry is putting a high priority on sustainability. To meet sustainability requirements and considering a parallel further significant increase of connected devices globally, NGMN decided to bundle its activities in this area in a project kicked off last September. Placing the focus on different aspects of green technology, NGMN will analyse and derive requirements for network energy efficiency, end-to-end services footprint, eco-design, on-board metering, and other related topics.

> *"The NGMN Alliance identified the importance of starting with drivers and to develop a vision for 6G, including the end-user's viewpoints and demands, societal, ecosystem and operational requirements"*

UNLEASHING THE FULL POTENTIAL OF 5G

Following the highly acclaimed first NGMN 5G White Paper, NGMN published a second 5G White Paper in July 2020 in which the status of 5G is analysed. The new Paper clearly points out that additional work on 5G is required in a number of areas, including achieving a common- cloud native based - operator platform architecture and a focus on sustainability.

We invite all interested parties to contribute to NGMN's outlined Work Programme by joining the Alliance.

www.ngmn.org

5GAA STUDY OF SPECTRUM NEEDS FOR SAFETY RELATED INTELLIGENT TRANSPORTATION SYSTEMS
– DAY 1 AND ADVANCED USE CASES

By Reza Karimi (Huawei, UK), Markus Mueck (Intel, Germany),
Yan Li (Qualcomm, China), Stefano Sorrentino (Ericsson, Sweden)

5GAA has conducted a study[1] in relation to the spectrum needs of use cases for intelligent transport systems (ITS) and advanced driving as implemented by cellular V2X (C-V2X) technologies.

Starting from a list of over 40 use cases, we first categorise these as "initial/day-1" or "advanced". It is the view of the 5GAA that LTE-V2X and NR-V2X are the most suitable technologies for the support of day-1 ITS and advanced driving use cases, respectively. We subsequently classify these as

- use cases which involve direct communications among road users or between road users and ITS roadside infrastructure (so-called V2V, V2I, V2P) as supported by the C-V2X (PC5) interface in the 5.9 GHz band harmonised globally for ITS, and

- use cases which involve network-based communications between road users and mobile network base stations (so-called V2N) as supported by the C-V2X (Uu) interface in bands designated and licensed for use by mobile communication networks,

where the term "road user" includes vehicles and pedestrians.

We further sub-classify the use cases which use direct communications according to whether they employ continual (typically repetitive) messages or event triggered messages, respectively.

For each sub-class of use case, we then estimate the spectrum needs for the relevant V2V, V2P, V2I, or V2N communications by accounting for;

1) road geometries, e.g., freeways and intersections,

2) the geographic density and speed of the road users,

3) the size, repetition rate, data rate, or latency of the required messages for the support of the service, and

4) the effective spectral efficiency of the relevant C-V2X radio access technology.

> *Starting from a list of over 40 use cases, we first categorise these as "initial/day-1" or "advanced"*

"the evaluation of the spectrum needs for advanced use cases is not a trivial task"

Based on the results of our studies of the spectrum needs of C-V2X direct communications (V2V/I/P), we can draw the following conclusions:

a) We expect that the delivery of day-1 use cases via LTE-V2X for the support of basic safety ITS services will require between 10 and 20 MHz of spectrum at 5.9 GHz for V2V/I communications.

b) We expect that the delivery of advanced use cases via LTE-V2X and NR-V2X for the support of advanced driving services will require an additional 40 MHz or more of spectrum at 5.9 GHz for V2V/I/P communications.

The above conclusion with regards to advanced use cases deserves some elaboration:

- Some important advanced driving use cases (e.g. High-Definition Sensor Sharing) involve the ability of road users to share their processed sensor data with other road users on a continual basis for what is known as cooperative perception, to provide advanced driver assistance and to facilitate autonomous driving. The appropriate amount of sensor data which should be shared is an open question for the industry, and directly impacts the required spectrum. Our estimate of spectrum needs for these use cases is 40 MHz or more depending on the extent of information sharing.

- Many other advanced driving use cases are event triggered (e.g. Cooperative Manoeuvres), that is to say, messages are exchanged over the air in response to a desire by a road user to undertake a specific manoeuvre (e.g., changing lanes, joining a freeway, crossing an intersection, or the like). Here, the road user shares its intended trajectory with other road users as part of a handshake exchange of information, in order to provide advanced driver assistance and to facilitate autonomous driving. The contribution of event triggered use cases to the overall ITS spectrum needs is stochastic, in the sense that such use cases may or may not occur at the same time, and this can result in a highly time variable demand for spectrum at any given location.

As a result, the evaluation of the spectrum needs for advanced use cases is not a trivial task. Nevertheless, it is clear that the 70-75 MHz of ITS spectrum in the 5.9 GHz band (as presently allocated in many regions and under consideration in other regions) is needed to support the basic safety and advanced use cases under consideration today. Notably, it is the view of the 5GAA that the choice of using LTE-V2X or NR-V2X in any given channel in the 5.9 GHz band should be market-led. Like any emerging sector, there could be unforeseen ITS use cases that would require even more spectrum as the market evolves.

As the ITS industry develops further, and we begin to better understand the demands of advanced driver assistance and autonomous driving, we will assess the extent to which the 5.9 GHz band (5850-5925 MHz) – which is globally harmonised for ITS by the ITU-R – is sufficient to meet the spectrum needs of the road users, and whether additional spectrum designated for ITS will be required.

Furthermore, based on the results of our studies of the spectrum needs of C-V2X network-based (V2N) communications, we can draw the following conclusions:

a) At least 50 MHz of additional service-agnostic low-band (< 1 GHz) spectrum would be required for mobile operators to provide advanced automotive V2N services in rural environments with affordable deployment costs.

b) At least 500 MHz of additional service-agnostic mid-band (1 to 7 GHz) spectrum would be required for mobile operators to provide high capacity city wide advanced automotive V2N services.

In the above, the term "additional" means availability of spectrum in addition to the bands that are currently identified for IMT use by mobile communication networks.

The 5GAA places great value on the importance of V2N communications in enabling future advanced driving use cases, as supported by the Uu interface of C-V2X. Accordingly, the 5GAA recommends that national and regional administrations ensure the availability of sufficient spectrum for mobile communication networks in the so-called low-bands and mid-bands for the support of services, including ITS, in the coming decade.

It should be emphasised that unless otherwise stated the spectrum needs values estimated in this report are based on the assumption of a 100% penetration of ITS equipment among the population of road users. Furthermore, the characteristics of some advanced use cases, and the approach to their modelling are still under discussion. Finally, the 3GPP specifications on C-V2X allow for a broad range of parameterisations, including different trade-offs between reliability and redundancy levels (e.g., packet retransmissions optionally employing a two transmission time intervals mode); it should be noted that increased levels of redundancy will affect the spectrum needs requirements correspondingly. Refined spectrum needs estimates for these use cases will be included in a future edition of this report.

https://5gaa.org

ENSURING DEVICE COMPLIANCE **TO STANDARDS**

By Olivier Genoud, Task Force 160 (TF160) Leader

Maximizing the chances of a standard being widely adopted not only relies on its technological merit, but also on its testability and on the test methodologies put in place to ensure that the products using it can operate as expected.

3GPP has always recognized the importance of testing within the standards making process, creating a working group dedicated to conformance testing from the outset. TSG RAN Working Group 5 (RAN5) develops and maintains conformance test specifications for User Equipment (UE). In addition to that, RAN5 covers the provision of a standardized reference software implementation of the protocol test cases defined in its conformance test specifications. The software is delivered in the form of Test Suites written in TTCN-3, an advanced language designed for testing protocols, services, APIs and software modules for a variety of uses.

As software development work involves ongoing project management and participation of specialised technical experts, RAN5 has delegated the TTCN-3 work to a 3GPP Task Force. Since June 2000, TF160 has been managed by the 3GPP Mobile Competence Centre (MCC) - located at ETSI - working under RAN5's guidance on the priorities for the implementation of RAN5 protocol test cases.

TF160 is a multi-site collaborative project bringing together 23 protocol and testing experts located around the world, nominated and selected from volunteer 3GPP member companies. IT and administrative support for TF160 is provided by ETSI, where I coordinate the effort as project leader.

TF160 SCOPE AND **ONGOING ACTIVITIES:**

The technologies and features covered by the 3GPP TTCN-3 Test Suites include UMTS, HSPA, LTE, IoT (eMTC, NB-IoT), 5G, IMS, Positioning and Mission Critical.

The bulk of the ongoing activities in TF160 are on writing TTCN-3 for the delivery of the 5G test cases for 3GPP Release 15 - for both EN-DC (Non-Standalone Option 3) and NR/5GC (Standalone Option 2) deployment options, including inter-RAT with 4G, IMS over NR and Positioning over NR.

To date more than 80% of the 570 planned 5G protocol test cases have been delivered by TF160.

Another area where there is considerable activity is the provision of test cases for LTE Mission Critical (MC) for the critical communications sector, which has called for conformance test cases to ascertain MC product compliance in support of that industry's migration towards a mobile broadband based solution.

DEVICE **CERTIFICATION:**

Leading Certification Bodies apply the 3GPP RAN5 conformance test cases in their device certification schemes. The most prominent being GCF (Global Certification Forum) and CTIA/PTCRB. As such, the 3GPP TTCN-3 Test Suites developed by TF160 constitute a key software component that is integrated on the test platforms used by vendors to obtain formal certification of 3GPP compliance for their devices.

TTCN-3

Recently, the GCF reported that more than 150 devices had already been certified, using 5G TTCN-3 Test Suites, for Release 15 compliance by the end of 2020.

UPCOMING TF160 **TECHNICAL PRIORITIES:**

In mid-2020, 3GPP froze Release 16 (Rel-16), used for the final submissions to ITU-R of the 3GPP IMT-2020 proposal. RAN5 has now started specifying new conformance test cases for 5G Rel-16. In 2021, TF160 work will be focused on TTCN-3 implementation and delivery of the 5G Rel-16 protocol test cases. In parallel TF160 will continue progress on Mission Critical test case development.

LAST **WORD:**

TF160 recently celebrated its 20 years of existence. It continues as a critical project for 3GPP, for the users of 3GPP technologies and for Certification Bodies.

For more details on 3GPP TF160, please look for our page in the 'About 3GPP' section of the website (Under 'MCC').

▲ ETSI headquarters in France is the administrative home of TF160

RELEASE 17 TIMELINE AGREED

December's Plenary meetings of the 3GPP Technical Specification Groups (TSG) have resulted in joint approval of a firm Release 17 timeline. In reaching this scheduling decision, TSGs#90-e considered the effects that e-meetings in 2020 had on the work's progress and the pressure that cancellation of all face-to-face meetings has created.
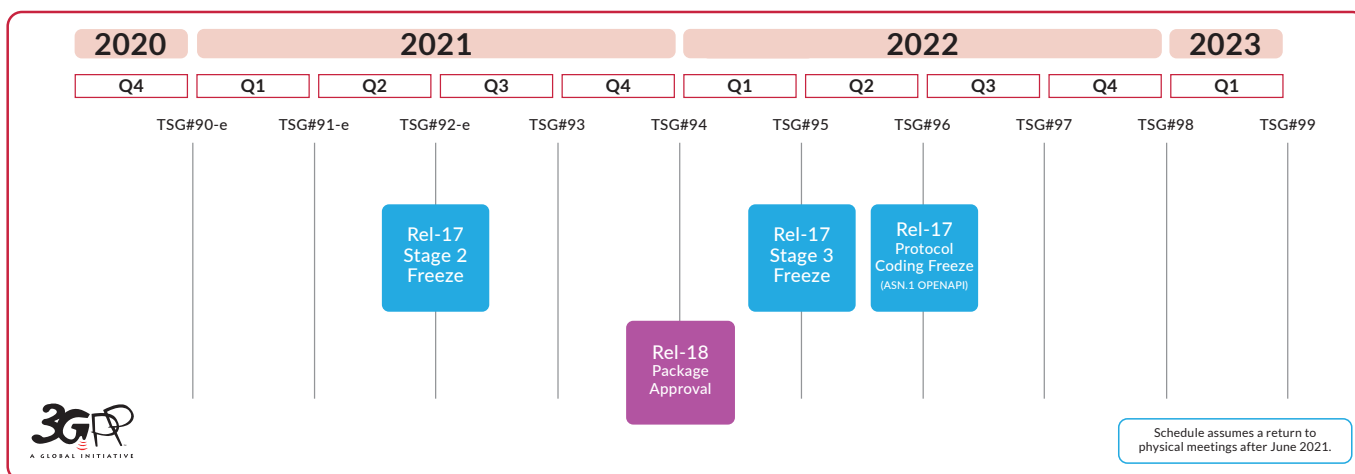
With remote working now confirmed as the norm until June 2021, the delegates took guidance from the Chairs of the Working Groups and the three TSG Chairs, that delegates participating in both the actual e-meetings and discussions in-between meetings need more time to be able to comfortably and accurately consolidate the results of their work. This guidance takes into account the fact that in the busiest groups the stream of contributions can peak at over 1000 emails a day.

At last week's Plenary, the TSG RAN, TSG SA and TSG CT Chairs have co-proposed a new schedule for the completion of Release 17 work.

New Release 17 Schedule:

- **Rel-17 Stage 2 Functional Freeze, June 2021 (TSGs#92-e)**
- **Rel-17 Stage 3 Protocol Freeze, March 2022 (TSGs#95)**
- **Rel-17 Protocol coding Freeze (ASN.1, OpenAPI), June 2022 (TSGs#96)**

Only the timeline for the work has changed; the content of Release 17 remains as approved during the December 2019 TSG#86 meetings. With this revised timeline, the broader 5G industry can rely on an informed and well-considered schedule that takes into account the peculiar situation created by life during a pandemic.

2020	2021				2022				2023
Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
TSG#90-e	TSG#91-e	TSG#92-e	TSG#93	TSG#94	TSG#95	TSG#96	TSG#97	TSG#98	TSG#99

Rel-17 Stage 2 Freeze

Rel-18 Package Approval

Rel-17 Stage 3 Freeze

Rel-17 Protocol Coding Freeze (ASN.1 OPENAPI)

Schedule assumes a return to physical meetings after June 2021.

The new commitment will greatly help companies advance their plans for network roll-out and new product development. The Release 17 schedule will now allow 3GPP the time it needs to complete the maintenance of Release 16 specifications as they become very stable.

At the same time, it allows the groups to switch priority to some exciting Release 17 features.

Studies in several key areas are already in the pipeline. These include: coverage and positioning enhancements, NR and slicing QoE work, adding new frequency ranges, NR reduced capacity devices, enhanced support of non-public networks, supporting unmanned aerial systems, support for edge computing in 5GC, proximity-based services in 5GS, network automation for 5G (Phase 2) and for access traffic steering, switch and splitting (ATSSS), among others.

Release 17 features to look out for include new work and enhancements for: URLLC for industrial IoT over NR, NR support over non-terrestrial networks, MIMO, integrated access and backhaul (IAB), MBS positioning, NR multicast and broadcast services, RAN slicing for NR, NR sidelink, multi-RAT dual-connectivity, support for multi-SIM devices for LTE/NR, NR small data transmissions in inactive state and multimedia priority service, to name a few.

At the March 2021 (TSG#91-e) meetings, the membership will evaluate the possibility to resume physical meetings in the second half of the year – as soon as possible after the June 2021 TSG e-meetings.

(First published December 14, 2020 - 3GPP Press Release)

▲ Rel-17 discussions during TSG RAN#86 - December 2019

INITIATIVE TO REMOVE NON INCLUSIVE TERMS IN SPECIFICATIONS

3GPP groups have started the process of replacing terminology in our specifications that is non-inclusive. The entire leadership proposed jointly a change request (CR) to the specification drafting rules (TR21.801), following an initiative led by several individual members.

In their joint proposal to the TSG SA#90-e meeting, the leaders wrote: "While there are potentially numerous language issues that could be considered offensive, there are two that are most acknowledged and focused on in the industry and applicable to the 3GPP Specifications. These terminologies are "Master / Slave" and "Whitelist / Blacklist" that are often used in 3GPP and other telecommunications technical documents."

Non-inclusive terms and alternatives:

Non-inclusive term	Examples of alternative terms
master (when used in "master / slave" context)	primary, controller, main
s**lave**	secondary, standby
white list, whitelist, white-list	allow list, accept list
black list, blacklist, black-list	block list, drop list, forbidden list
grey list, greylist, grey-list (a term which has been used in conjunction with white list and black list) should be replaced with e.g. track list, inspect list.	

What next? - Change requests will now follow on any Release 17 reports and specifications that need their content brought in line with this policy.

Further reading:

SP-201042: Tdoc from the leadership - Inclusive Language in 3GPP Specifications

SP-201142: Change Request to Specification drafting rules.

SP-201143: Liaison Statement on: Use of Inclusive Language in 3GPP.

TR21.801: 3GPP Specification drafting rules

NEW 3GPP MEMBERS
2020 – 2021

A full list of the companies in 3GPP, who qualify through membership of one or more of the seven Organizational Partners (OPs) is available online at www.3gpp.org/about-3gpp/membership.

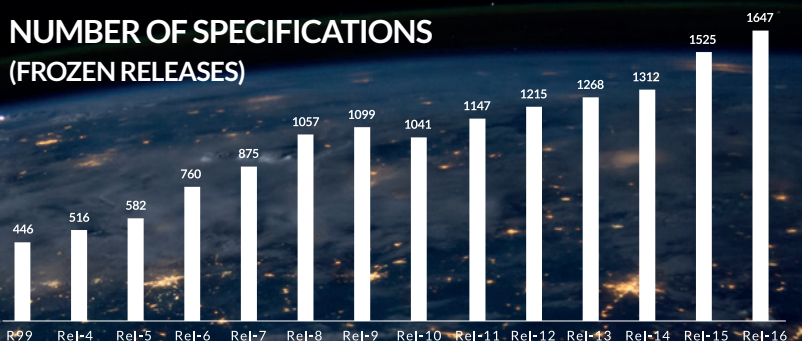New members - The project has welcomed the following 59 organisations during 2020 and so far in 2021.

3GPP
A GLOBAL INITIATIVE

690
December 2020

3GPP MEMBERSHIP

ETSI	433
CCSA	122
ATSI	54
ARIB	27
TTA	24
TSDSI	20
TTC	10

New 3GPP IM 2020 - 2021	OP	Country	New 3GPP IM 2020 - 2021	OP	Country
3In	CCSA	CN	Langbo	CCSA	CN
ABP, NRTA	CCSA	CN	Lenovo Future Communications	CCSA	CN
albis-elcon system GermanyGmbH	ETSI	DE	Lenovo Information Technology	CCSA	CN
Anterix	ATIS	US	Luxshare-ICT, Inc.	ATIS	US
Avanti	ETSI	GB	Maxar	ATIS	US
BOE	CCSA	CN	Mercedes-Benz	ETSI	DE
Cambridge Consultants	ETSI	GB	NEMERGENT	ETSI	ES
CEPRI	CCSA	CN	NERCDTV	CCSA	CN
CICT	ETSI	CN	OPPO	ETSI	CN
Consort Digital	ETSI	IN	OQTEC	ETSI	LU
CUC	CCSA	CN	Orope Germany GmbH	ETSI	DE
DanKook University'	TTA	KR	Polte	ATIS	US
DECT Forum	ETSI	CH	Qualcomm Europe Inc. Sweden	ETSI	SE
DIGITAL CATAPULT	ETSI	GB	Qualcomm Technologies Ireland	ETSI	IE
EDF Recherche et Développement	ETSI	FR	Samsung Guangzhou Mobile R&D	CCSA	CN
Elbit Systems	ETSI	IL	Schindler	ETSI	CH
ESSEN INNOVATION	CCSA	CN	SITA	ETSI	CH
Eurofins Digital Testing Belgium NV	ETSI	BE	SmarterMicro Inc.	CCSA	CN
EUTC	ETSI	BE	SnT - University of Luxembourg	ETSI	LU, CH
Gatehouse Satcom A/S	ETSI	DK	Spark NZ Ltd	ATIS	NZ
GDCNI	CCSA	CN	SS8	ETSI	US
GEESPACE	CCSA	CN	SSNS	ETSI	HU
Hexagon Autonomy & Positioning	ATIS	US	SyncTechno Inc.	TTA	KR
HISPASAT SA	ETSI	ES	Transsion Holdings	CCSA	CN
Honor Device Co., Ltd.	CCSA	CN	UMA	ETSI	ES
Huizhou Speed Wireless	CCSA	CN	UNIBO	ETSI	IT
IPLOOK Networks Co., Ltd.	CCSA	CN	Verizon	ETSI	DK, ES, SE, CH
ISED	ETSI	CA	VIVO TECH GmbH	ETSI	DE
ISRO	TSDSI	IN	Western Digital	ETSI	US
Landis+Gyr	ETSI	CH	Zhejiang Lab	CCSA	CN

atis

ARIB

CCSA

TTC Telecommunication Technology Committee

ETSI

TTA

tsdsi

MARKET GROWTH

- 365 commercial 5G devices
- +46.6% over last three months
- 113 5G vendors
- 125 operators in 52 countries/territories have announced 3GPP-compatible 5G service launches

NUMBER OF SPECIFICATIONS
(FROZEN RELEASES)

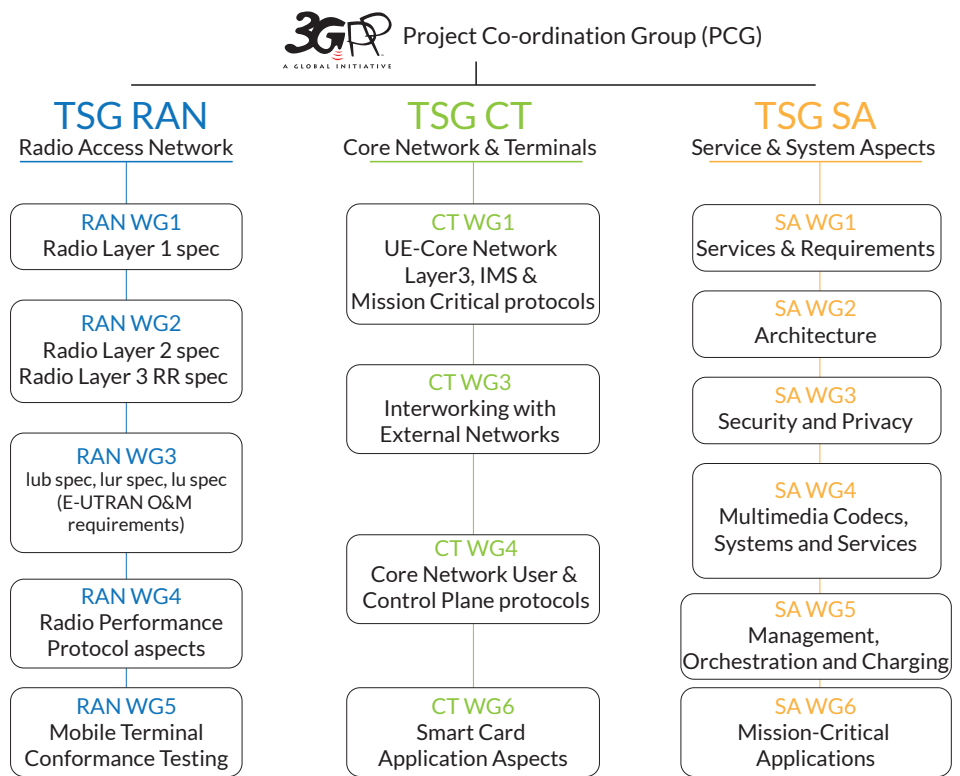| Release	Count
R99	446
Rel-4	516
Rel-5	582
Rel-6	760
Rel-7	875
Rel-8	1057
Rel-9	1099
Rel-10	1041
Rel-11	1147
Rel-12	1215
Rel-13	1268
Rel-14	1312
Rel-15	1525
Rel-16	1647

THE 3GPP GROUP STRUCTURE:

The Reports and Specifications that define 3GPP technologies are contribution-driven, by member companies, in Working Groups and at the Technical Specification Group level.

The Working Groups arrange their schedule to be able to bring the work for approval at the quarterly TSG Plenary meetings, which take place in March, June, September and December.

Since early 2020, all meetings have been virtual, using email and GoTo meeting sessions to progress the work, within scheduled time slots, and organised by agenda item.
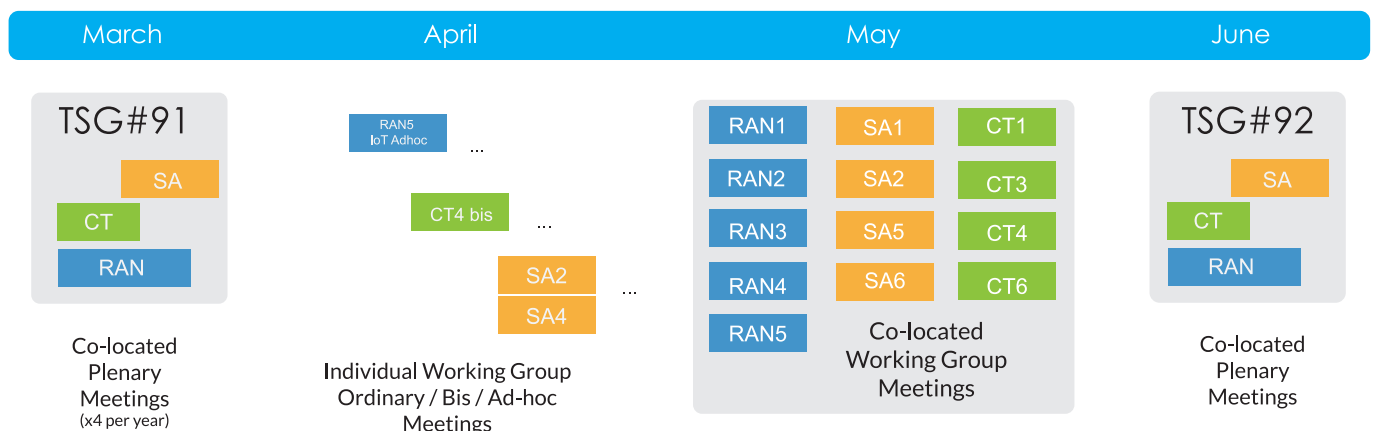
At TSG#89-e, the TSG Chairs agreed that the first half of 2021 meetings will be e-Meetings, by default. At that meeting, the leadership hoped that in the new year we would start to have a clearer sighting on whether we can start to plan for getting back to face-to-face meetings.

At the time of writing, no decision has been taken on meetings beyond June 2021. The Pandemic continues and there may well be solid reasons for caution. The March Plenaries will look again at the meeting schedule and give guidance on the possible continuation of e-meetings beyond June (See Rel-17 article in this issue).

3GPP Project Co-ordination Group (PCG)

TSG RAN
Radio Access Network

- **RAN WG1** — Radio Layer 1 spec
- **RAN WG2** — Radio Layer 2 spec Radio Layer 3 RR spec
- **RAN WG3** — Iub spec, Iur spec, Iu spec (E-UTRAN O&M requirements)
- **RAN WG4** — Radio Performance Protocol aspects
- **RAN WG5** — Mobile Terminal Conformance Testing

TSG CT
Core Network & Terminals

- **CT WG1** — UE-Core Network Layer3, IMS & Mission Critical protocols
- **CT WG3** — Interworking with External Networks
- **CT WG4** — Core Network User & Control Plane protocols
- **CT WG6** — Smart Card Application Aspects

TSG SA
Service & System Aspects

- **SA WG1** — Services & Requirements
- **SA WG2** — Architecture
- **SA WG3** — Security and Privacy
- **SA WG4** — Multimedia Codecs, Systems and Services
- **SA WG5** — Management, Orchestration and Charging
- **SA WG6** — Mission-Critical Applications

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3GPP's Meeting Cycle (Q2 example)*

March	April	May	June

TSG#91
- SA
- CT
- RAN

Co-located Plenary Meetings (x4 per year)

RAN5 IoT Adhoc ...
CT4 bis ...
SA2 / SA4 ...

Individual Working Group Ordinary / Bis / Ad-hoc Meetings

RAN1 | SA1 | CT1
RAN2 | SA2 | CT3
RAN3 | SA5 | CT4
RAN4 | SA6 | CT6
RAN5

Co-located Working Group Meetings

TSG#92
- SA
- CT
- RAN

Co-located Plenary Meetings

* Based on F2F meeting schedules - Does not show how e-meetings may have to be used, due to the on-going Corona virus disruption.

These examples are to demonstrate the principle and are not based an actual meeting dates.

CALENDAR
OF MEETINGS

*A selection of the major meetings
for the period March – December.*

TSG	RAN#91-e	2021-03-16	- 2021-03-26
TSG	CT#91-e	2021-03-18	- 2021-03-24
TSG	SA#91-e	2021-03-18	- 2021-03-29
WG	SA4#113-e	2021-04-06	- 2021-04-14
WG	SA2#144-e	2021-04-12	- 2021-04-16
WG	RAN1#104-bis-e	2021-04-12	- 2021-04-20
WG	RAN2#113-bis-e	2021-04-12	- 2021-04-20
WG	RAN4#98-bis-e	2021-04-12	- 2021-04-20
WG	SA6#42-bis-e	2021-04-12	- 2021-04-20
WG	CT3#115-e	2021-04-14	- 2021-04-23
WG	CT4#103-e	2021-04-14	- 2021-04-23
WG	CT1#129-e	2021-04-19	- 2021-04-23
WG	RAN3#111-bis	2021-04-19	- 2021-04-23
WG	SA3#102-bis-e	2021-04-19	- 2021-04-23
WG	CT6#105	2021-04-20	- 2021-04-23
WG	SA5#137-e	2021-05-10	- 2021-05-19
WG	SA1#94-e	2021-05-10	- 2021-05-20
WG	SA2#145-e	2021-05-17	- TBD
WG	RAN3#112-e	2021-05-17	- 2021-05-28
WG	RAN5#91-e	2021-05-17	- 2021-05-28
WG	SA3#103-e	2021-05-17	- 2021-05-28
WG	RAN1#105-e	2021-05-19	- 2021-05-27
WG	RAN2#114-e	2021-05-19	- 2021-05-27
WG	RAN4#99-e	2021-05-19	- 2021-05-27
WG	CT3#116-e	2021-05-19	- 2021-05-28
WG	CT4#104-e	2021-05-19	- 2021-05-28
WG	SA4#114-e	2021-05-19	- 2021-05-28
WG	CT1#130-e	2021-05-20	- 2021-05-28
WG	SA6#43-e	2021-05-24	- 2021-06-02
WG	CT6#106-e	2021-05-25	- 2021-05-28
TSG	CT#92-e	2021-06-14	- TBD
TSG	RAN#92-e	2021-06-14	- TBD
TSG	SA#92-e	2021-06-15	- TBD
TSG	CT#93	2021-09-13	- TBD
TSG	RAN#93	2021-09-13	- TBD
TSG	SA#93	2021-09-15	- TBD
TSG	CT#94	2021-12-13	- TBD
TSG	RAN#94	2021-12-13	- TBD
TSG	SA#94	2021-12-15	- TBD
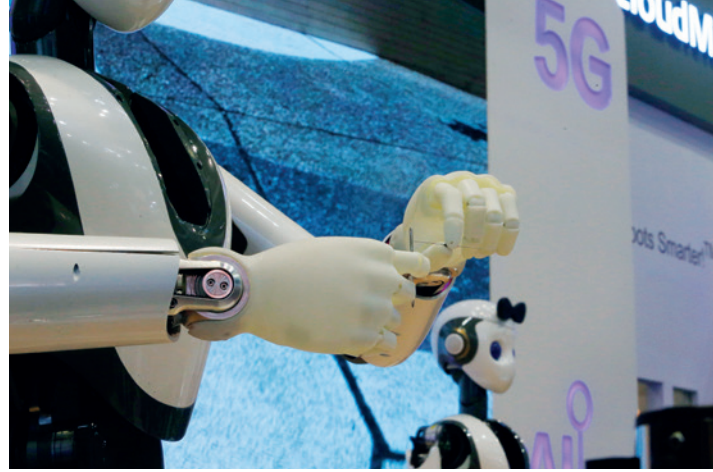
NEWS IN BRIEF

ATIS' FUTURE 5G
OPERATIONAL AND REGULATORY REQUIREMENTS INITIATIVE

New 5G service types, integration with vertical industries, and new regulations mean that as 5G becomes operational, mobile operators are going to face a wealth of new regulatory requirements that must be fulfilled. Timelines for mobile standardization and deployment mean that U.S.- specific requirements need to be factored into the process as early as possible. This newly launched ATIS initiative will work to ensure that all U.S. regulatory requirements and related operational needs that impact mobile standards are known, and that standards roadmaps in 3GPP and ATIS allow operators to fulfil the requirements.

https://www.atis.org/tops-council/5gorr/

E-MEETINGS GET THE VOTE

The December e-meeting Plenaries successfully tested a new remote voting tool, by holding multiple dry-runs for the Chair and Vice-Chair elections. The tests were a success and now the tool will be used for the real CT, RAN and SA elections to be held during the extended online TSG#91-e Plenaries – Scheduled between March 18 – 27, 2021.

- **Voting tool now fully e-meeting ready**
- **e-Proxy voting integrated, with online proxy set-up**
- **Voting list feature shows voting rights**
- **Suitable for elections and technical votes**
- **Emails generated for vote-related milestones**
- **Security via the 3GU portal (Authenticated Users only)**
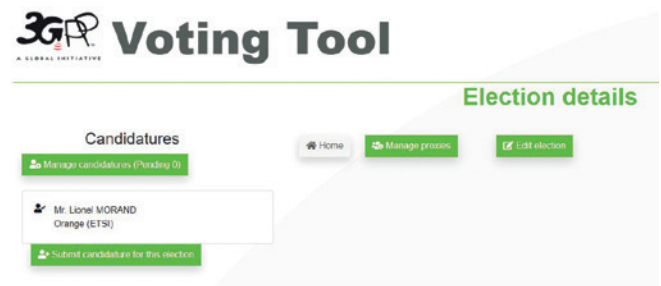
NEW MARKET REPRESENTATION PARTNERS (MRPS)

In the past six months, two new organizations have requested and have been granted MRP status in 3GPP.

The 5G Deterministic Networking Alliance (5GDNA) was accepted as MRP at the 3GPP Organizational Partners meeting (OP#44-e), in October 2020.

The Alliance will contribute work that will help tune 3GPP technologies into more diverse industry needs, with a focus on horizontal (scenario-based solutions) and vertical (slicing/ MEC) business models.

The 5G Media Action Group (5G-MAG) is the latest MRP addition, formally approved by the partners in January 2021.

5G-MAG represents major stakeholders in the production and distribution of audio-visual media content and services, driving their collaboration on the implementation of 5G solutions, aligned to 3GPP standards.

They represent stakeholders across the media sector, including:

- **Content and service providers**
- **Network operators**
- **Suppliers & equipment manufacturers**
- **R&D**
- **Regulators and policy makers**

The media sector is one where the benefits of 5G are set to be felt along the entire industry value chain.

3GPP's MRPs: