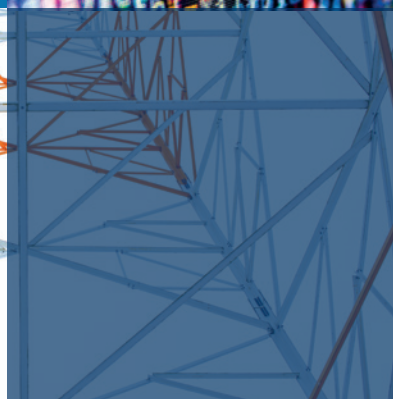
3GPP A GLOBAL INITIATIVE

3GPP Highlights

ISSUE 05
November 2022

3GPP - the 5G Standard



Technical News

Issue 5 will introduce the advantages of Authentication and Key Management for Applications (AKMA), look into the benefits of augmenting the air interface with features enabling improved support of AI/ML and review SA4 efforts on the latest audio codec for Immersive Voice and Audio Services (IVAS).

There is also an overview of SA2 Stage-2 work following the Rel-18 content definition and prioritization in December 2021...and a lot more.

Partner Focus

The 3GPP Market Representation Partners (MRPs) have again provided original content.

We have an article from 5G-MAG on Developing open software tools for 5G Media, The TSDSI and the IIT in India have written on Non-IAB based Mobile Base Station Relays and the TCCA's Tero Pesonen looks back on his first 25 years in critical communications.

The GSA tell us why their work has already started on the spectrum allocations for future 6G.

A look inside

We have saved some of the best content until last this edition, with an Interview with a 3GPP founder – Adrian Scrase of ETSI. He talks about changes in the scale of the project and the new ideas coming in to 3GPP.

We also have a joint contribution from the 3GPP TSG Chairs, on the return to face-to-face meetings and the rise of the e-meeting. This article has details of the plan for 2022 and 2023 meetings...

Will this edition have a happy ending? Read on to find out.

FORE - WORD

Inside Issue 5

This is the fifth issue of the 3GPP newsletter, aimed at allcomers, but reaching high to try and catch the interest of delegates and experts by taking complex topics and shaping them into short articles that give a taste of what is going on across the groups and the extended 3GPP community.

There is a strong broadcast feel in three of our articles this issue. Immersive voice and audio services are introduced, then 5G Media Streaming (5GMS) is held up as an early use case for UE data collection, reporting and exposure. The third article is from the 3GPP market partner 5G-MAG, covering the development of open software tools for 5G Media. Their work is an example of the 3GPP group and an industry body walking in step for the benefit of the broadcast industry as a whole.

Elsewhere - the new 3GPP website is now up-and-running and all of our technical articles from Highlights will now be put on the new site. This will enrich the website, but also give an extended life and readership to the Highlights content.

Release 18 in full flight as 5G reaches its mid-point

We have a description of the AKMA security feature from SA3, its architecture and related procedures. There is also a piece on Artificial Intelligence and Machine Learning (AI/ML) for the new radio (NR) Air Interface and a short introduction to 5GS Support for AI/ML. Our 3GPP Working Group SA2 Chair has given us an overview of Rel-18 Stage-2 work - listing the study items based on new requirements and others that are created as a result of Rel-17 requirements that need further work.

SA5 have provided an overview of their Rel-17 Achievements.

The partners have again contributed to the new issue and we thank them for their market and standards expertise, reflected in their articles in the 'Partner Focus' section.

Finally, we have our 'look inside'. I took some of Adrian Scrase's time last week, to gather his views on how the project has stood up to recent challenges and asked him to identify one or two areas for growth in the project. Adrian was in at the start of 3GPP and as Head of MCC and ETSI CTO he has a hands-on perspective on how we are doing.
So too do the 3GPP TSG Chairs. In this issue, our elected leadership explain the steps that they are taking to bring 3GPP back to face-to-face meetings as the norm. Things are less than straightforward, but there is a meeting plan in place and strong optimism that we will build on the happy reunions of June (plenaries) and August (RAN1#110) this year.

We hope that you enjoy Issue 5 of 'Highlights'. If so, please tell a friend to subscribe. If not, please tell me and I will work to be better next time.

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This publication is supplied free-of-charge.

The PDF version and subscription is online at: www.3gpp.org/highlights

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AUTHENTICATION AND KEY MANAGEMENT FOR APPLICATIONS (AKMA) IN 5G

By Suresh Nair, 3GPP Working Group SA3 Chair, Saurabh Khare & Jing Ping (Nokia)

3GPP have introduced many novel security features in 5G. These security features address the need to enhance the existing 4G security in different domains, such as access stratum (AS) between the UE and the base station or the Non Access Stratum (NAS) between the UE and the AMF, secure the PLMN 5G Core interface involving multiple network Functions (NFs) which use a Service Based Architecture (SBA) interface or the end to end interface between the UE and the UDM. 3GPP also defined security procedures for new industry segments and vertical markets such as Network Slicing, Non Public Networks (NPN), inter PLMN roaming, etc. One of the new security features defined is 'Authentication and Key Management for Applications (AKMA)', to enable applications to leverage the authentication of the UE performed by the PLMN and to use it for further authentication and authorization by an application and to bootstrap the necessary application security keys to the UE.

A full description of the AKMA feature is not intended here. Only a short description of the feature and its unique benefits are briefly mentioned. A full technical specification is contained in 3GPP TS 33.535.

Primary Authentication of the UE and AKMA:

When a UE registers with the PLMN for the first time, the network performs a primary authentication of the UE. Only after the successful primary authentication of the UE, the UE is authorized for additional network services. 3GPP has specified two protocols 5G-AKA and EAP-AKA' for primary authentication, both of which can be executed over 3GPP access and non-3GPP access. In the primary authentication, the subscription credentials and the shared secret stored in the USIM of the UE and the same stored in the UDM/UDR of the operator network is verified. Please note that in 5G, unlike in earlier 3G and 4G, the subscription permanent identifier SUPI is encrypted and sent to the UDM/UDR as a concealed subscription permanent identifier (SUCI). At the end of a successful primary authentication, the UE is admitted to network and the connection is secured using the derived session keys. In 5G, a new security network function, Authentication Server Function (AUSF) has been introduced in the 5G core (5GC) to manage the UE authentication using the SUCI or the SUPI and to manage the root session key KAUSF. The AUSF stores the root session key KAUSF and further keys are derived from this key. The UE and network derive further keys from the KAUSF. The radio connection between the UE and the base station is secured using the derived access stratum (AS) keys and the connection between the UE and core network is secured using the derived non access stratum (NAS) keys. The availability of the key KAUSF at the AUSF and the UE, as a result of the successful primary authentication has become an advantage since this key could be used to generate further keys that could be bootstrapped to secure different applications. AKMA key hierarchy as specified in TS 33.535 is shown in ***figure-1.***

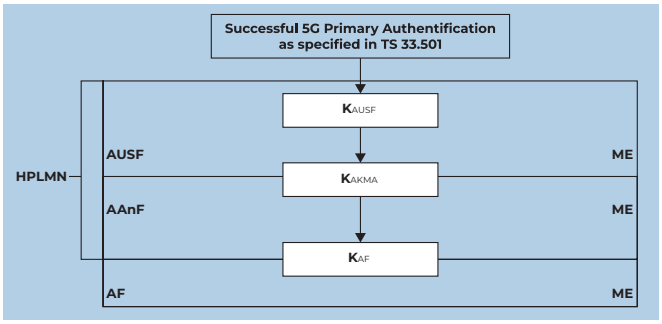
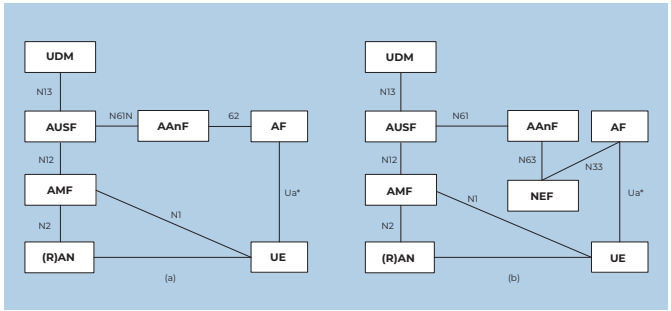


Figure-1: AKMA key heirarchy

From the key KAUSF, an AKMA specific key KAKMA is derived. To secure individual applications, an application specific key KAF is derived from the KAKMA.



AKMA Architecture:

In 4G, 3GPP defined the Generic Bootstrapping Architecture (GBA) in TS 33.220 to bootstrap keys to secure the application between the UE and an application server, after authenticating the UE using LTE-AKA protocol. A similar approach is taken in AKMA, but because of the 5G core service-based architecture, the AKMA architecture becomes entirely different compared to GBA.

Figure-2: AKMA Architecture in reference point representation for (a) internal AFs and (b) external AFs

A new logical entity, called the AKMA Anchor Function (AAnF) has been introduced to support the AKMA feature. From the KAUSF, the AUSF generates AKMA key KAKMA and sends it to the AKMA Anchor function AAnF. When UE tries to connect to an application server, the UE provides the AKMA temporary identifier to the application server. Based on this temporary identifier, the application server interacts with the AAnF to receive the specific session key KAF and UE identifier. The AF can use received session key KAF or further derive the keys based on the session key KAF to secure the communication between the UE and the application server. Thus AKMA provides a reliable framework for applications to authenticate the UE and secure the communication between the UE and the application server, leveraging the highly secure HPLMN based primary authentication. Please note, there is no separate authentication of the UE to support AKMA functionality. Instead, AKMA reuses the 5G primary authentication procedure for the sake of implicit authentication for AKMA services. Figure-2 above provides the architecture (a) where the Application Function (AF) is within the 5GC and part of the PLMN, whereas (b) provides the scenario where Application Function (AF) is outside the 5GC and the Application Function (AF) interacts with AKMA Anchor Function (AAnF) via the Network Exposure Function (NEF).

AKMA Procedures:

Figure 3: Overview of AKMA procedures, the following section provides a high-level view of the AKMA procedures. The stage1 shows that after the primary authentication of the UE, the AKMA key KAKMA is derived from the key KAUSF. Correspondingly, a AKMA Key ID A-KID is also generated at the UE and AUSF. The A-KID is also used as a temporary identifier for AKMA. The main SBA procedures between the AUSF, NRF and the AAnF are also shown, resulting in the creation of a UE context within the AAnF.

The second stage of the diagram shows how a trusted AF within the trusted PLMN core interacts with the AAnF and a key KAF is generated to secure the communication between the UE and the AF.

The third stage of the diagram shows how an untrusted AF outside the PLMN core interacts with the AAnF via the network exposure function NEF and a key KAF is generated to secure the communication between the UE and the AF.

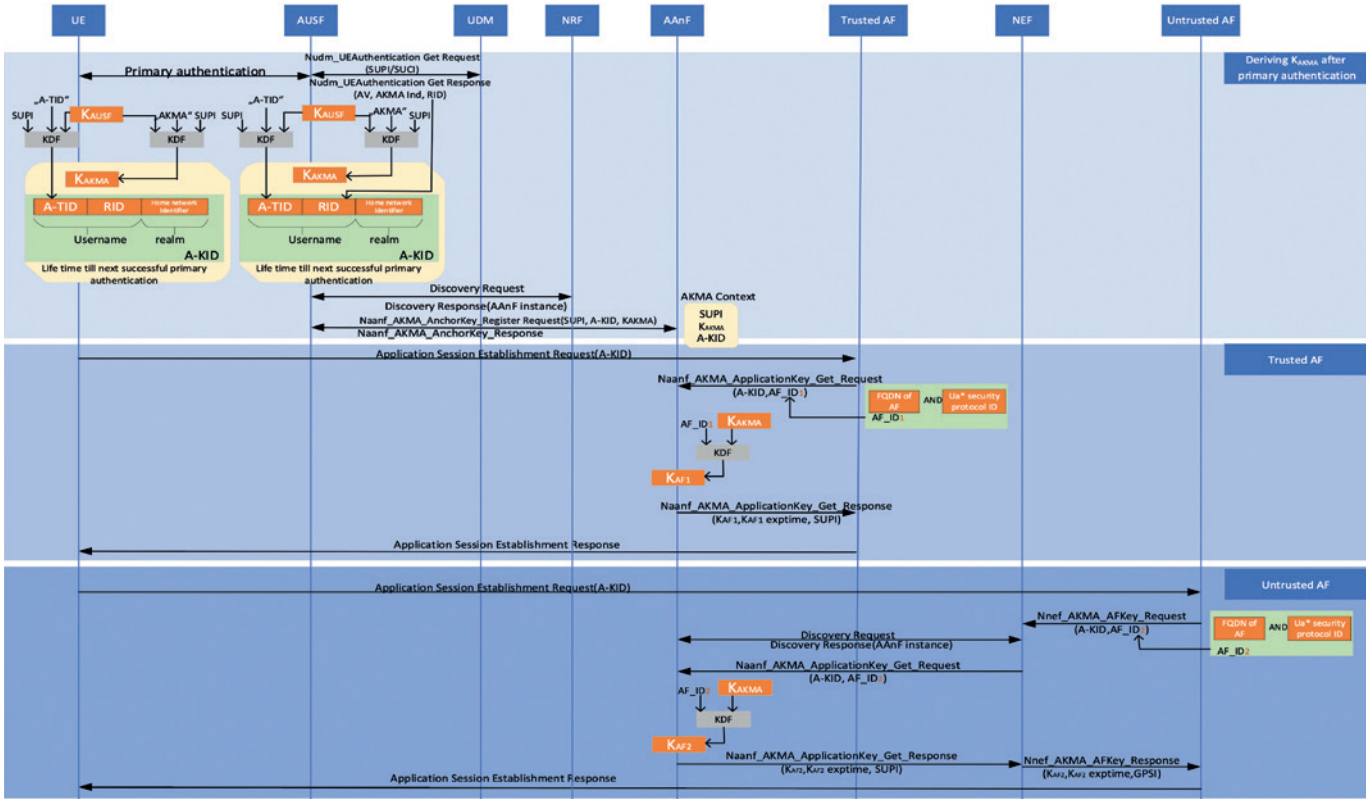


Figure 3: Overview of AKMA procedures

Please note that the application specific protocol between the UE and the application function AF, Ua* is left unspecified in TS 33.535. Applications can develop this protocol specific to their needs.

AKMA Advantages:

- Since the AKMA framework uses authentication and authorization of the UE leveraging the PLMN credentials stored on the USIM, this becomes as strong as the network primary authentication and subsequent keys derived further to UE and Application Function (AF) interface.
- The Application Functions can leverage the authentication service provided by the AKMA Anchor Function (AAnF) without additional CAPEX and OPEX.
- The architecture provides a direct interface between the UE and the AF where a customized application-specific interface can be built, including the key management, key lifetime extension, etc.

AI/ML FOR NR AIR INTERFACE

By Juan Montojo, Rapporteur for the RAN1-led study on AI/ML for NR Air Interface, Qualcomm Inc.

Before Rel-18, Artificial Intelligence (AI) and Machine Learning (ML) related projects in 3GPP focused on enabling network automation or data collection for various network functions.

The Network Data Analytics Function (NWDAF) was introduced in Rel-15 providing network slice analysis capabilities. It was later expanded to providing data collection and exposure in 5G core in Rel-16, and to enable UE application data collection in Rel-17.

Similarly, projects on Self Organizing Network (SON) and Minimization of Drive Tests (MDT) have been defining data collection procedures for various NR features over releases starting from Rel-16. How the network would use that collected data has always been left to implementation.

In Rel-17 a RAN3-led study on further enhanced data collection investigated the high-level principles of RAN intelligence enabled by AI. This project laid out the functional framework for RAN intelligence and the benefits of AI enabled NG-RAN examining various use cases. The Technical Report (TR) of this study can be found in 37.817 and constitutes an excellent reference for the findings of the project. This study led to the approval of a Rel-18 normative project on AI/ML for NG-RAN focusing on enhancements to data collection and signaling to support AI/ML based Network Energy Savings, Load Balancing and Mobility Optimizations.

The Rel-18 RAN1-led study on AI/ML for NR Air Interface, as the central subject of this article, explores the benefits of augmenting the air interface with features enabling improved support of AI/ML based algorithms for enhanced performance and/or reduced complexity or overhead.

The project description has identified three promising areas which will be used as a pilot to deepen the understanding of the solution space and corresponding performance evaluation comparisons with pertinent non-AI/ML based implementations and across companies:

- **Channel State Information (CSI)**
  For CSI enhancements, frequency domain compression has already been agreed, with other enhancements, e.g., time-domain prediction, being still considered.
- **Beam Management (BM)**
  Spatial and temporal prediction seem to be promising areas of focus.
- **Positioning**
  Direct AI/ML positioning (e.g., fingerprinting) and AI/ML assisted positioning (e.g., the output of the AI/ML model inference is a new measurement and/or an enhancement of an existing measurement) are the most popular areas for further investigation.

The AI/ML model is assumed to be running at one of the two sides of the communication link, i.e., gNB or UE, for most of the use cases. However, the CSI use case will explore the possibility of having two-sided AI/ML model with a tight interplay between the UE and gNB. Whether and how that interaction will be enabled by the 3GPP is subject of discussion.

This project will also identify the relevant AI/ML notation and nomenclature which will be necessary for describing AI/ML models and their life cycle in conjunction with various levels of collaboration between the network and the user equipment, and including descriptions on training, inference, testing, and verification of the models. All those concepts will have to be investigated in light of their exposure to 3GPP specifications.

> The ultimate objective of this study is the characterization of the specification impact that will enable the deployment and inter-operation of these AI/ML based techniques

Performance evaluations and comparisons with a meaningful non-AI/ML baseline are an integral part of the project to measure the true potential of the AI/ML techniques. Clearly, there will be various Key Performance Indicators (KPIs) identified for the different use cases. In turn, AI/ML based techniques will be identified in terms of performance and associated complexity. Complexity, in addition to computational requirements, will relate to power consumption and memory utilization.

The ultimate objective of this study is the characterization of the specification impact that will enable the deployment and inter-operation of these AI/ML based techniques.

While specific AI/ML models are not expected to be specified and will be left to implementation, enabling AI/ML for air interface will require specification impacts at various levels which we briefly describe next.

In addition to the air interface enabling aspects involving physical layer and protocol areas, the interoperability and testability (e.g., requirements and testing frameworks) of such implementations is an important aspect that will also be considered. The possible need and implications for AI/ML processing capabilities definition will be also assessed during the study.

Physical layer aspects to study along with potential specification impact include, e.g., AI model lifecycle management (LCM), dataset construction for training, validation and test for the given use case, new signaling required to enable specific use cases, means for training and validation, assistance information, measurement, and feedback.

Protocol aspects to study along with potential specification impact include, e.g., capability indication, configuration and control procedures (training/inference), and management of data and AI/ML model, and collaboration level specific specification impact per use case.

Lively discussions are already taking place in areas such as AI/ML model training, i.e., offline vs. online, along with their actual meaning and feasibility. Also, the concept of model transfer has shown to be a controversial topic requiring more aligned understanding of the implications and consequences.

To conclude, this study item spanning the entire duration of Rel-18 is expected to provide a solid understanding of 3GPP's role in enabling an improved support of AI/ML for air interface problems which is expected to lead to normative projects in future Releases of 5G-Advanced. At the same time, the findings of this project are expected to be leveraged in future generations of wireless systems that 3GPP will develop.

For details on the Study on Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface (FS_NR_AIML_Air) see: RP-221348 and 3GPP TR38.843.

5GS SUPPORT FOR AI/ML

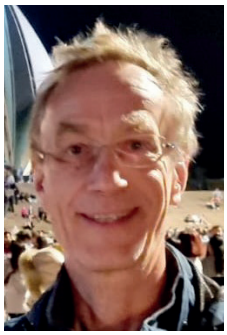
By Tricci So, Rapporteur for the 3GPP WG SA2 Study on 5G System Support for AI/ML-based Services (FS_AIMLsys), OPPO.

The Release 18 (Stage 2) study TR 23.700-80 - Study on 5G system (5GS) support for AI/ML-based services - is based on the Stage 1 requirements specified in TS 22.261 (Clauses 6.40 and 7.10) for 5GS assistance to support Artificial Intelligence (AI) / Machine Learning (ML) model distribution, transfer, training for various applications, including video & speech recognition, robot control and automotive.

The scope of the study is to enable AI/ML service providers to leverage the 5GS as the intelligent transmission platform to assist data transfer during application layer AI/ML operation. It looks at the following possible 5GC extensions:

- Monitoring 5G network resource utilization relevant to the UE.
- Extending 5GC information exposure on the UE/network conditions and performance prediction (e.g. location, QoS, load, congestion, etc.) to the application.
- Enhancements of external parameter provisioning to the 5G Core (e.g. expected UE positioning, expected UE mobility, etc.) to assist Application AI/ML operation.
- Possible QoS, Policy enhancements to support Application AI/ML operational traffic while supporting regular (non Application-AI/ML) 5GS user traffic.
- Assistance from 5G Core to the AF and the UE to coordinate and manage the Federated Learning (FL) operation (i.e. FL members selection, group performance monitoring, adequate network resources allocation and guarantee) between the application clients running on the UEs and the Application Servers.

3GPP TR 23.700-80 (2022-09) identifies the key issues faced and the potential solutions available for AI/ML-based services over the 5G system.



IVAS - TAKING 3GPP VOICE AND AUDIO SERVICES TO A NEW IMMERSIVE LEVEL

By Stefan Bruhn (Dolby Laboratories, Inc.), Markus Multrus (Fraunhofer IIS), Imre Varga (Qualcomm Incorporated, 3GPP SA4 Audio SWG Co-Chair)

It is almost established practice that 3GPP standardizes a new codec for 3GPP voice service every decade. The driver for that is the never-ending demand for enhanced QoE - while maintaining highly competitive service efficiency. Each time, from Adaptive Multi Rate (AMR) over AMR-WB to Enhanced Voice Services (EVS), a quantum leap in service quality offered has been achieved. Current standardization work is taking place against the background of an upswing in immersive media services, such as the spatial or 'surround' audio experience which is already well established for streaming professionally generated content.

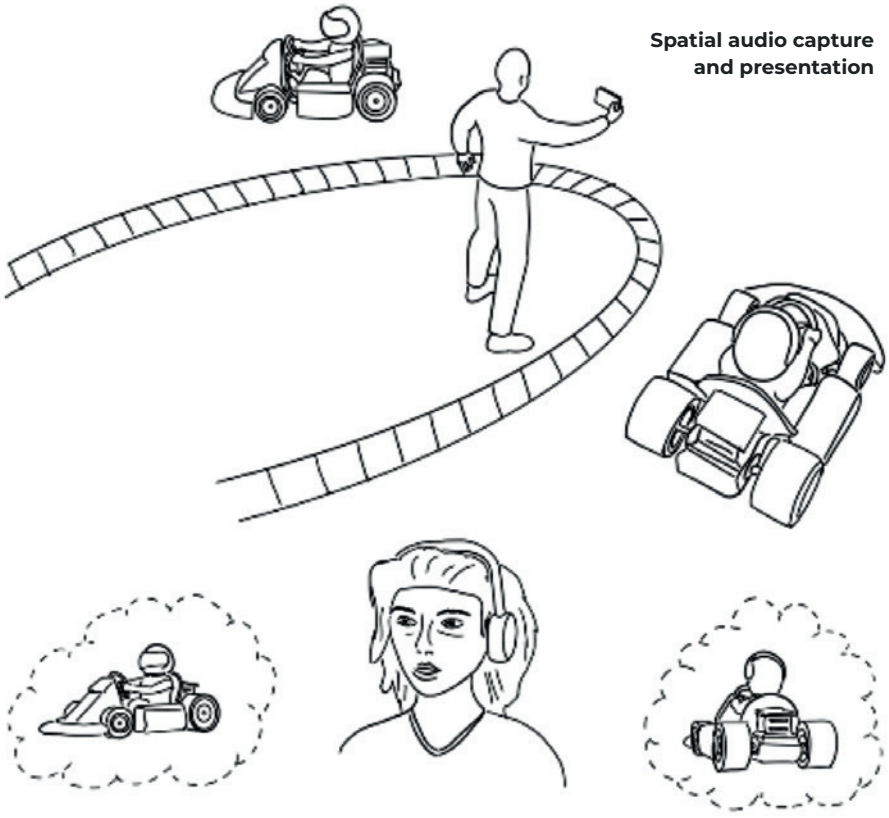
At the same time, advanced visual rendering systems with large and curved TV screens, (head-tracked) VR gears and AR glasses are enabling the immersion of the user into the rendered Audio Visual (AV) scene.

What is currently lacking is a codec enabling the sharing of immersive audio experiences from highly mobile and uncontrolled capture environments and the rendering of those experiences in other virtually unconstrained environments using headsets, earbuds or multi-speaker systems with custom loudspeaker configurations – in environments such as homes, cars or conference rooms.

3GPP SA4 is now closing this gap with the standardization of its codec for Immersive Voice and Audio Services (IVAS).

IVAS will not only introduce immersion into the traditional voice service, it will also address the demand for more general immersive multimedia services. Service applications include, but are not limited to, conversational voice, multi-stream teleconferencing, VR conversational and user generated live and non-live content streaming, AR/MR.

This article is written to draw attention to this important standardization work, to give User Equipment (UE) manufacturers and service providers the possibility to monitor or influence the standardization process and to make sure that the time-to-market of IVAS-enabled new immersive services and products is minimized.



Spatial audio capture and presentation

Features and Use-Cases

The IVAS codec will be built upon and be backwards compatible with the successful EVS codec. Thus, a single universal codec will be provided incorporating the quality and performance attributes of EVS (such as excellent audio quality, low delay, appropriate range of bit rates, high-quality error resiliency, practical implementation complexity) while taking them to the next – immersive – level.

For this, new features will be added: Immersive audio formats, such as channel-based audio (including stereo and common multi-channel configurations from 5.1 up to 7.1+4), binaural audio, scene-based audio (i.e. Ambisonics up to 3rd order) and object-based audio. Also, IVAS will support Metadata-assisted spatial audio (MASA) – a novel, parametric spatial audio format optimized for direct UE pick-up without loss, instead of converting to one of the other immersive formats. In order to enable playout on a multitude of devices, a rendering solution and an interface to an external rendering will be made available, including head-tracked rendering.

In a stereo or immersive telephony use-case, a participant can capture and convey an immersive scene to a remote participant, e.g., to share the full immersive experience of an event. For spatial conferencing applications, the flexibility of the IVAS codec will provide multiple options for:

- Ad-hoc conferencing calls with the transmission of the physical immersive scene picked up by a UE, e.g., placed on a table. Rendering of the immersive scene makes it easier to distinguish the talkers' voice, clearly separated from ambient sounds, leading to more natural and effort-less conferencing.
- More complex scenarios with multiple participants, transmitted as individual streams and spatially rendered on the receiving UE to match the video scene, for example.
- Scenarios where an intermediate call server combines multiple participants into an immersive scene.

Further on, the IVAS codec will support content distribution use-cases including streaming of stereo/immersive content and advanced VR/AR applications.

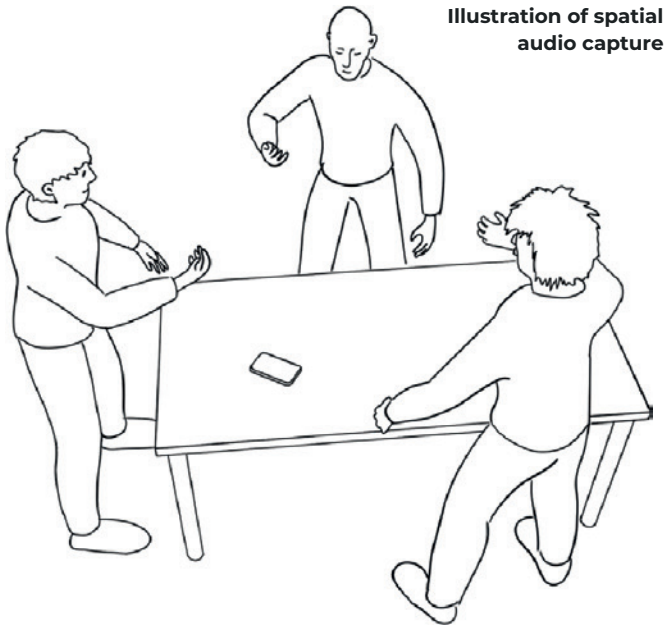


Illustration of spatial audio capture

IVAS codec standardization in SA4 Audio SWG

An IVAS codec candidate is currently being developed. The Terms of Reference of that effort and any essential development project data (code repository, technical documentation, meeting reports) are publicly available on 3GPP Forge.

Once chosen, IVAS codec standardization will follow the traditional rigorous approach based on permanent documents (Pdocs), all agreed in 3GPP. Key Pdocs are design constraints and performance requirements. These ensure the standardized codec can be implemented on relevant UEs and that it is suitable for the intended service applications.

Any new codec undergoes a rigid selection process in which it must meet all 3GPP-agreed requirements. The process includes selection testing in which the quality of the candidate is formally evaluated against the performance requirements. A significant budget – in excess of a million euros – is dedicated to testing the IVAS codec.

A key element of selection testing is the reliance on capable neutral laboratories. Accordingly, SA4 has issued a call for such labs and once SA4 agrees on a lab assignment, the 3GPP Mobile Competence Centre (MCC) is tasked with setting up the necessary contracts.

The actual selection of the codec requires a determination by SA4 that the overall IVAS codec work item goals are fulfilled, based on an assessment of how the performance requirements and design constraints are met. It also involves determining that any other required data and documentation as specified in the selection deliverables have been provided. The deliverables typically include draft IVAS codec specifications and reference C source code. Reference code is expected to become available both as fixed- and floating-point code specifications, enabling efficient and timely implementations on relevant platforms. Subsequently, TSG SA will formally approve codec selection and the provided specifications.

The IVAS codec is scheduled for 3GPP Release 18.

3GPP Working Group SA4 - Multimedia Codecs, Systems and Services is a part of the 3GPP Technical Specification Group Service and System Aspects (TSG SA). See more about SA4 at www.3gpp.org/specifications-groups.

A RELEASE 18 UPDATE

By Puneet Jain, 3GPP Working Group SA2 Chair

Technical Specification Group SA Working Group 2 (SA2) is in charge of developing the overall 3GPP system architecture and services including User Equipment, Access Network, Core Network, and IP Multimedia Subsystem. The group has a system-wide view and defines the main entities of the system architecture, and how these entities are linked to each other, it also defines the main functionality and the information exchange between these entities.

Rel-18 is the first release for 5G-Advanced. SA2 kicked off Rel-18 Stage-2 work in Feb 2022, immediately following the Rel-18 content definition and prioritization at SA#94-e meeting in December 2021. Some Rel-18 study items are based on new requirements, while other study items are a result of unfulfilled Rel-17 requirements that require further work.

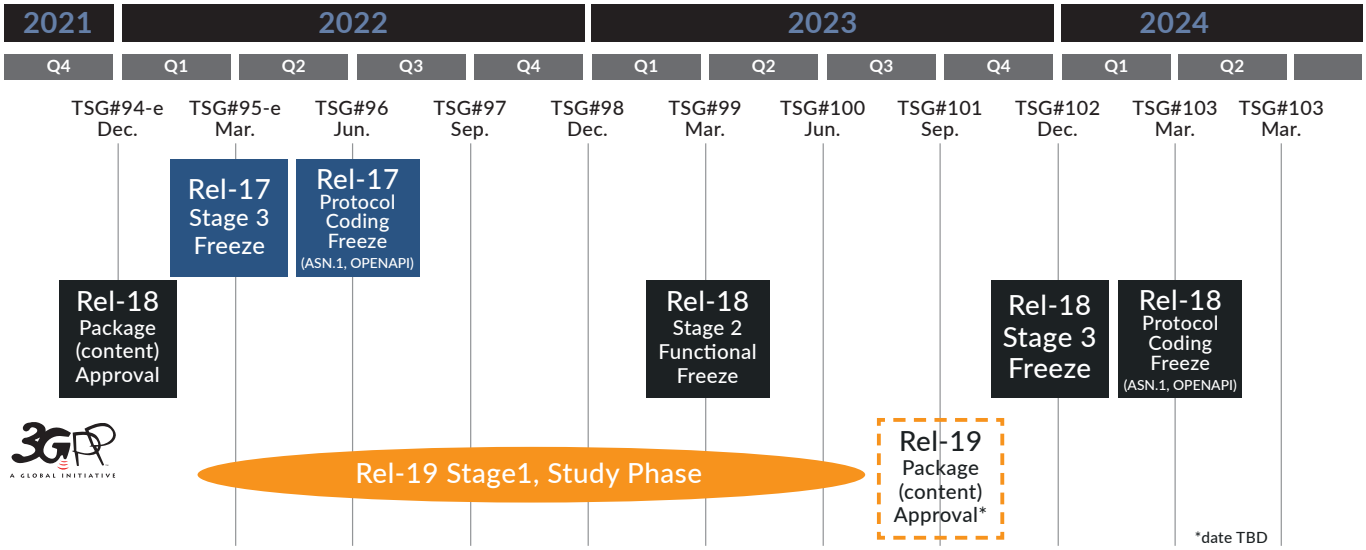
Study items based on new Rel-18 requirements

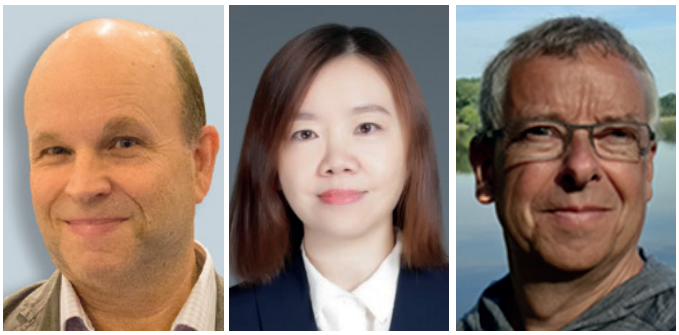
- **Study on 5G System with Satellite Backhaul** (FS_5GSATB, TR 23.700-27): The Rel-18 study aims at further enhancements for 5GS support for satellites, with a specific focus on backhaul with changing delay, as well as support for UPF deployed on GEO satellite with gNB on the ground.
- **Study on Personal IoT Networks** (FS_PINS, TR 23.700-88): study aims to support Personal IoT Network (PIN) with requirements captured in 3GPP TS 22.261 such as PIN Element discovery, PIN Element's capability discovery, PIN element availability and reachability, PIN management, access of PIN via PIN Element with Gateway Capability (PEGC), and communication of PIN Element with other PIN Elements.
- **Study on Ranging based services and sidelink positioning** (FS_Ranging_SL, TR 23.700-86): The study item aims to support Ranging-based services and sidelink positioning for commercial, V2X and public safety use cases for in-coverage, partial coverage, and out-of-coverage of 5G network with a focus on defining procedures for authorization and policy/parameter provisioning, Ranging device discovery and service operation, and Ranging and sidelink positioning service exposure.
- **Study on generic group management, exposure and communication enhancements** (FS_GMEC, TR 23.700-74): This study aims to study enhancements for group attribute management and group status event reporting, enhancements for 5G VN group communication, and support group communication allowing UE to simultaneously send data to different groups, where each group has a different QoS policy.
- **Study on System Support for AI/ML-based Services** (FS_AIMLsys, TR 23.700-80): Rel-17 5GS supports AI/ML training and inference within the 5GC via NWDAF for network automation purposes and there are no 5GS transport solutions to support device-based application AI/ML training or inference services. This study aims to provide intelligent transmission support for application AI/ML-based services to support the use cases for application layer AI/ML operation.
- **Study on XR (Extended Reality) and media services** (FS_XRM, TR 23.700-60): The study item aims at 5GS enhancements to support XR and media services, with a specific focus on QoS/Policy enhancements, exposure enhancements for XR, and support for multi-modality services.
- **Study on system architecture for Next Generation Real-Time Communication services** (FS_NG_RTC, TR 23.700-87): study the system architecture for the next generation real-time communication services based on IMS enhancement requirements from stage 1.
- **Study on UPF enhancement for Exposure And SBA** (FS_UPEAS, TR 23.700-62): The study item aims to support better integration of UPF into the 5GC SBA by enhancing UPF event exposure service(s) including its registration/deregistration, discovery, and consumption by other NFs.
- **Study on 5G Timing Resiliency and TSC & URLLC enhancements** (FS_5TRS_URLLC, TR 23.700-25): This study aims at various TSC and URLLC enhancements, with a specific focus on reporting time synchronization status, interworking with TSN transport networks and scheduler adaptation to support extremely low latencies.
- **Study on Architecture Enhancements for Vehicle Mounted Relays** (FS_VMR, TR 23.700-05): This study aims to support the operation of base station relays possibly mounted on vehicles, using NR for wireless access toward the UE and for wireless self-backhauling toward 5GC.
- **Study on 5G AM Policy** (FS_AMP, TR 23.700-89): The study aims to provide additional enhancement over existing mechanisms for AM (Access and Mobility) policy control when UE moves from/to 5GC to/from EPC.
- **Study on enhancement of 5G UE Policy** (FS_eUEPO, TR 23.700-85): This study aims to support the URSP (UE Route Selection Policy) for home-routed and LBO roaming scenarios, 5GC awareness of URSP enforcement, Provision consistent URSP to UE across 5GS and EPS, Support standardized and operator-specific traffic categories in URSP.
- **Study on System Enabler for Service Function Chaining** (FS_SFC, TR 23.700-18): The study aims to support service function chaining in the 5G Core network (5GC) such as - enhancements to traffic steering policy and northbound APIs for allowing an AF to request network capability exposure functionalities.
- **Study on Extensions to the TSC Framework to support DetNet** (FS_DetNet, TR 23.700-46): Deterministic Networking (DetNet) is standardized by IETF and provides time-sensitive features that guarantee almost zero packet loss rates and bounded latency. This study aims to enable 3GPP support for DetNet such that mapping is provided between the central DetNet controller entity (as defined in IETF) and the 5G system.
- **Study on Seamless UE context recovery** (FS_SUECR, TR23.700-61): This study aims to update NAS procedures to negotiate the feature support and to indicate the unavailability period to 5GC and 5GC actions.

Study items based on continuation of Rel-17 work

- **Study on 5GC enhancement for satellite access Phase 2** (FS_5GSAT_Ph2, TR 23.700-28)
- **Study on Phase 2 of UAS, UAV and UAM** (FS_UAS_Ph2, TR 23.700-58)
- **Study on Enhancement to the 5GC LoCation Services-Phase 3** (FS_eLCS_Ph3, TR 23.700-71)
- **Study on Stage 2 for Proximity based Services Phase 2** (FS_5G_ProSe_Ph2, TR 23.700-33)
- **Study on architectural enhancements for 5G multicast-broadcast services Phase 2** (FS_5MBS_Ph2, TR 23.700-47)
- **Study on Enhancement of Network Slicing Phase 3** (FS_eNS_Ph3, TR 23.700-41)
- **Study on RedCap Phase 2** (FS_REDCAP_Ph2, TR 23.700-68)
- **Study on Access Traffic Steering, Switching and Splitting support in the 5G system architecture; Phase 3** (FS_ATSSS_Ph3, TR 23.700-53)
- **Study on Stage 2 of Edge Computing Phase 2** (FS_EDGE_Ph2, TR 23.700-48)
- **Study on enhancement of support for 5WWC** (FS_5WWC_Ph2, TR 23.700-17)
- **Study on Enablers for Network Automation for 5G - phase 3** (FS_eNA_Ph3, TR 23.700-81)
- **Study on enhanced support of Non-Public Networks phase 2** (FS_eNPN_Ph2, TR 23.700-08)
- **Work Item on Stage 2 of MPS when access to EPC/5GC is WLAN** (MPS_WLAN)

Despite the e-meeting challenges, SA2 continues to make good progress on Rel-18 work, thanks to the meticulous SA2 work planning, technical document budget allocation per Time Unit (TU), and outstanding effort of the meeting participants. At the time of writing, Rel-18 Study items are between 70% - 100% complete. SA2 plans to finish the Stage-2 normative work by Mar 2023. Rel-18 Stage-3 target freeze date is Dec 2023 and ASN.1/Code freeze target is Mar 2024.





SA5 REL-17 ACHIEVEMENTS

By WG SA5 Leadership, Thomas Tovinger, Zou Lan and Gerald Görmer

The Rel-18 work in SA5 is now at full speed, but for this article we will summarize some of our Rel-17 achievements, which provide a foundation and act as an enabler for what is to come in Rel-18, providing enhanced network/service management and charging capabilities to support new 5G network features:

Management capabilities supporting provisioning and data collection of 5G network and network slice

- To support provisioning the network and network slices, the 5G network resource models (NRM) are extended to support management of new features or functionalities of 5GC and NG RAN, e.g. 5GC NRM including NFs Profile, EASDF, NEF selection, NSACF, NWDAF, edge computing and NR NRM to support RAN sharing scenario. The network slice NRM is extended with transport requirement information model to coordinate with transport network and support end to end network slice management (TS 28.541).
- To support data collection, file retrieval and download mechanisms and methods for controlling management data production, collection, coordination, and discovery are introduced. The data includes enhancement of MDT, trace, QoE, performance measurements, KPIs and external management data (TS 28.537/TS 28.622/TS 28.552/TS 28.554/TS 28.405/TS 32.422).

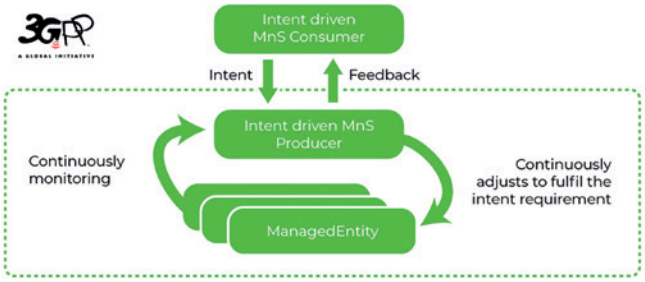
Intelligence and Automation capabilities include autonomous network levels, intent-driven management, closed loop SLS Assurance, plug and connect for network functions, management data analytics

- Autonomous Network (AN) is a telecommunication system with autonomy capabilities which is able to be governed by itself, with minimal to no human intervention. ANL standardizes the level of autonomy capabilities by indicating collaboration between human and telecom system. There are different enabler capabilities supporting different levels of autonomy. Examples of these include Self-Organization Network (SON), management data analytics (MDA), intent driven management (IDM), closed loop SLS assurance (COSLA). A framework approach for evaluating ANL is as follows (TS 28.100).

Autonomous Network Level		Task Categories				
		Execution	Awareness	Analysis	Decision	Intent Handling
L0	Manual Operating Network	Human	Human	Human	Human	Human
L1	Assisted Operating Network	Human & Telecom	Human & Telecom	Human	Human	Human
L2	Preliminary Autonomous Network	Telecom System	Human & Telecom	Human & Telecom	Human	Human
L3	Intermediate Autonomous Network	Telecom System	Telecom System	Human & Telecom	Human & Telecom	Human
L4	Advanced Autonomous Network	Telecom System	Telecom System	Telecom System	Telecom System	Human & Telecom
L5	Full Autonomous Network	Telecom System	Telecom System	Telecom System	Telecom System	Telecom System

Note 1: Human reviewed decision has the highest authority in each level if there is any conflict between human reviewed decision and telecom generated decision.
Note2: The order of above five task categories does not reflect the workflow sequence.

- An intent specifies the expectations including requirements, goals and constraints for a specific service or network management workflow. Intent-driven management is introduced to reduce the complexity of management without getting into the intricate detail of the underlying network resources. Intent-driven management works together with closed-loop automation to continuously satisfy the intent expectation provided by consumer as shown in the diagram right. A closed control loop automatically adjusts and optimizes the services provided over 5G network based on the various performance management, QoE input data, and the state of the 5G network (TS 28.312/TS 28.535/TS 28.536).



- Management data analytics provides processing, analyzing data related to network and service events and status with utilizing AI/ML technologies. Recommendations to enable necessary actions for network and service operations may also be provided (TS 28.104/TS 28.105).

Support of New Services

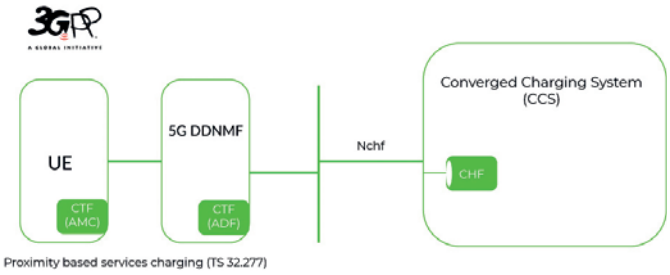
- Energy Efficiency (EE) KPIs are defined at various granularity levels of 5G networks including Virtualized Network Function (VNF), 5G Core network function, 5G Core network, NG-RAN, network slice of various types. 5G NRM has been augmented with attributes capturing customer's expectations in terms of energy efficiency of the network slice being ordered, in relation with GSMA NG.116 attributes (TS 28.310).
- To support vertical requirements on 5G network, Service level agreement requirements are further standardized into requirements of RAN, CN and transport network correspondingly (TS 28.541).
- Management of non-public network provides the flexible capabilities to manage SNPN and PNI-NPN according to the different deployment needs from vertical customers. (TS 28.557)

Monetization capabilities introduced for Release 17

Proximity based services charging (TS 32.277)

Proximity based services support by 5GS introduced in Rel-17, is enhanced by support of the Converged Charging framework, allowing monetization by Operators when used by 5G ProSe-enabled UEs being in proximity to each other using NR. 5G ProSe Direct Discovery charging relies on the 5G Direct Discovery Name Management Function (5G DDNMF) embedded Charging Trigger Function (CTF) using CHF Nchf API during UE 5G ProSe Direct Discovery procedures.

5G ProSe Direct Communication over NR (broadcast mode, groupcast mode, and unicast mode), used for commercial services, can be monetized based on QoS amongst other criteria. The split CTF, between UE CTF-(AMC Accounting Metrics Collection) and 5G DDNMF CTF-(ADF Accounting Data Forwarding) enables usage reporting from UE to CHF categorized per QoS Flow.



Proximity based services charging (TS 32.277)

ProSe Direct Discovery over PC5 reference point and ProSe UE-to-Network Direct Communication are also covered.

Edge Computing Charging (TS 32.257)

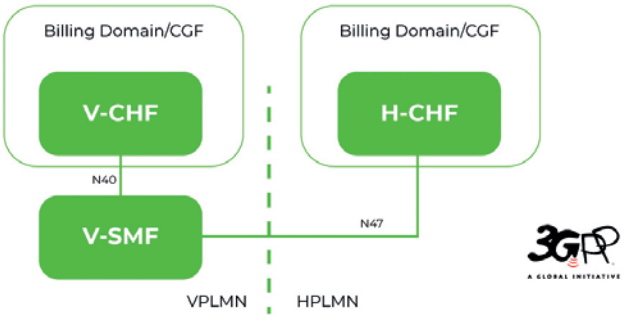
While end user charging for accessing edge applications is already covered from earlier releases under the existing 5G data connectivity charging (by using dedicated identifications), new areas of Edge Computing (EC) are extended with Charging capabilities in Rel-17 for:

- Edge enabling services exposed by Edge Computing Service Providers (ECSP) to Application Service Providers (ASP) and ECSP edge enabling infrastructure resources usage by ASP
- Edge Application Server (EAS) deployment (instantiation, upgrade, termination) by an ECSP for an ASP.

Other Enhancements as Partial Conclusion of Ongoing Studies

Charging for roamers with 5G data connectivity is covered since Rel-15, however only in home routed scenario. Rel-17 introduces a charging solution for roamers in local breakout covering both wholesale between MNOs and UEs retail charging. A new N47 reference point enables per UE quota management from the Home MNO. More solutions are being studied in Rel-18.

As the result of Network Slice (NS) study partial conclusion, a simplified option for NS usage charging based on individual UEs 5G data connectivity charging is enhanced for Rel-17 in a TS 32.255 Annex D. In this option, the Converged Charging System (CCS) serves individual UEs as well as NS Tenants based on internal specific implementation, for the purpose of monetization by Communication Service Providers (CSP) of NS usage by Tenants.



A GLOBAL INITIATIVE

The 5G

Since the completion of 3GPP Release 15 – the first phase of 5G to deliver on the full promise of the Internet of Everything.


Self-driving Cars


Smart Cities


Work & Play in the Cloud


Industry Automation


Smart Homes


Augmented Reality

Release 18

SA2 led - System Architecture & Services

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

SA3 led - Security & Privacy

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

SA4 led - Multimedia Codecs, Systems and Services

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

SA5 led - Management, Orchestration & Charging

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

https://bit.ly/3GPP-Work-Plan

Early Release 19 Studies

SA1 - Services

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

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

Specification Groups

TSG CT Core Network and Terminals

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

TSG RAN Radio Access Network

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

TSG SA Service and System Aspects

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

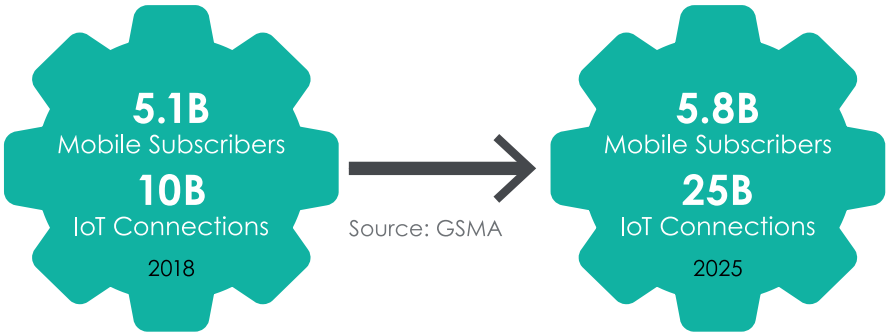
standard

5G ADVANCED

specifications - the cellular industry is expanding the capability of the network
Release 18 will deliver 5G-Advanced, as the mid-point of 5G standardization.

3D Video, UHD Screens

Gigabytes per second



SA6 led - Application Enablement & Critical Communication Applications

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

RAN1 led - Radio Layer 1 (Physical layer)

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

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

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

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

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

RAN4 led - Radio Performance & Protocol Aspects*

Further RF requirements enh. for NR Frequency Range 1 (FR1)
NR RF requirements enh. for Frequency Range 2 (FR2), Phase 3
Req. for NR Frequency Range 2 (FR2) multi-Rx chain DL reception RRM enh. for NR and MR-DC
Enh.on NR and MR-DC Measurement Gaps and Measurements without Gaps
NR demodulation performance evolution
Study on simplification of band combination specification
Study on enh. for 700/800/900MHz band combinations
NR BS RF requirement evolution
Study on NR Frequency Range 2 (FR2) Over-the-Air (OTA) testing enh.
Support of intra-band non-collocated EN-DC/NR-CA deployment
Enh. NR support for high-speed train scenario in frequency range 2 (FR2)
BS/UE EMC enh.
Air-to-ground network for NR
NR support for dedicated spectrum less than 5MHz for FR1

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

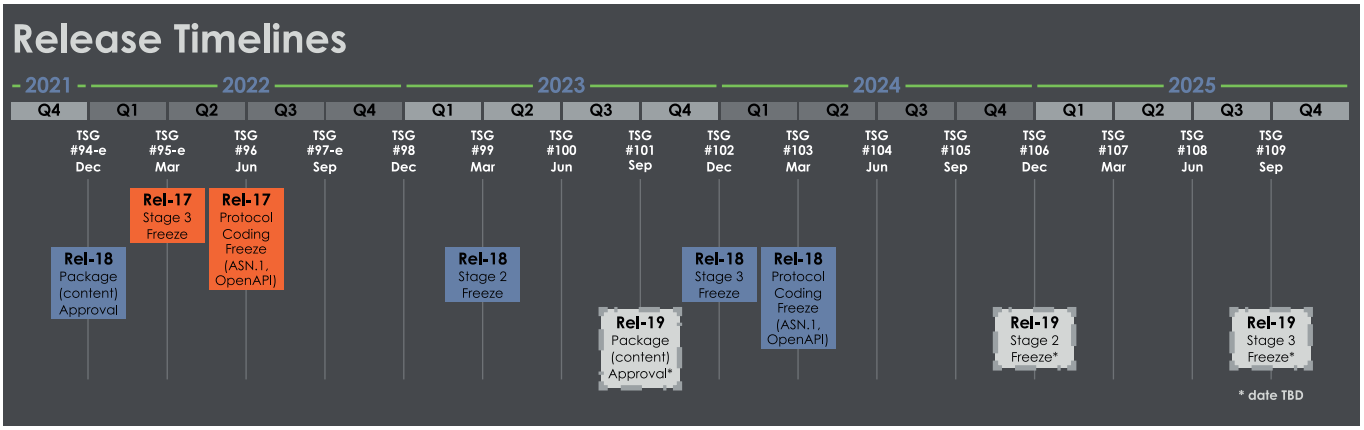
TSG CT Stage 3 work

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

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

Completion of stage 3 work is targeted for **TSG#103** March 2024.

Release Timelines



UE DATA COLLECTION REPORTING AND EXPOSURE

By Richard Bradbury,
BBC Research & Development

In Release 17, 3GPP has defined a new reference architecture for collecting UE data and exposing it to downstream consumers. As well as supporting generic UE data, such as service experience, the abstract building blocks are intended to be reusable in any number of different data domains, the first of which is 5G Media Streaming.

In TS 23.501 and TS 23.288, SA2 has defined a **Network Data Analytics Function** (NWDAF) which analyses data collected from Network Functions and UEs in the 5G System, and publishes the results to subscribing **data analytics consumers**. Network Functions supporting the data analytics architecture implement an **event exposure** service-based API. The NWDAF subscribes to uniquely identified **events** published by Network Functions in order to acquire the data that it then goes on to analyse and expose to its subscribers. These may, in turn, use the analysed data to modify the operation and/or configuration of the 5G System, potentially in real time. In this way, a closed loop can be formed to continuously optimise a 5G System.

Reference architecture for UE data collection, reporting and exposure

To support the collection of data from UEs, SA2's architecture envisages an Application Function that receives data reports from a **Data Collection Client** via conventional data plane PDU Sessions and exposes events to the NWDAF using the Naf_EventExposure service-based interface defined by SA2 and specified by CT3 in TS 29.517. Recognising its domain expertise in media-related metrics, SA2 turned to SA4 for help in defining the **Data Collection AF** and the related architecture for UE data collection, reporting and exposure.

This is documented by SA4 in TS 26.531 and is summarised in the figure below. Detailed procedures for provisioning the Data Collection AF and reporting UE data to it, as well as definitions of the corresponding service-based interfaces, are specified by SA4 in the companion TS 26.532.

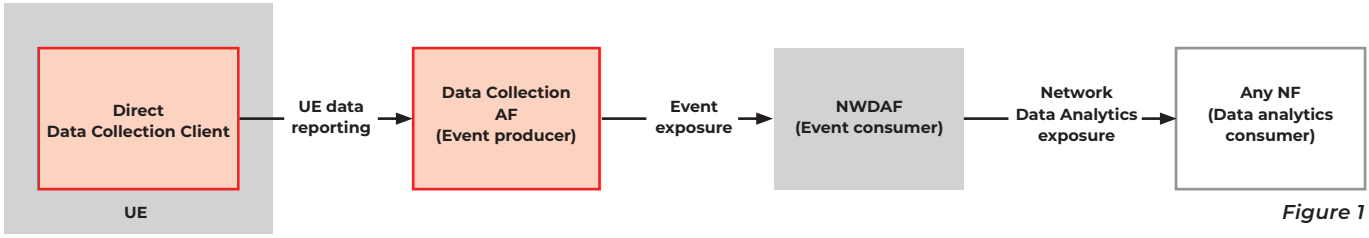


Figure 1

As well as supporting the (currently small) repertoire of generic UE-related events defined by SA2, SA4 decided to expand the scope of the UE data collection, reporting and exposure system in two different directions, as highlighted by the second figure:

1. It was recognised that **Application Server** (AS) instances can be an additional source of UE data. Application logs contain valuable data about UE activity that can be analysed to extract patterns and trends.

2. It was recognised that third party **Application Service Providers** (ASPs) are valid consumers of UE events from the Data Collection AF in addition to the NWDAF. An ASP's Event Consumer AF may wish to perform its own analysis of UE data in order to optimise its applications.

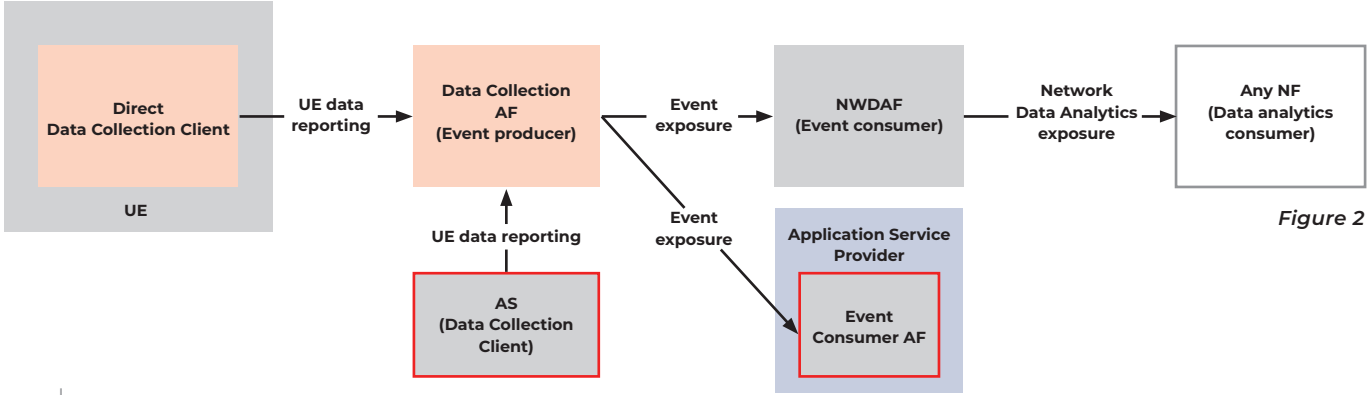


Figure 2

In order to support this extended architecture, additional data protection mechanisms were deemed necessary by SA4. When the collection of UE data is provisioned by an ASP at the Data Collection AF, a number of **data processing instructions** can be specified to limit the UE data exposed to event consumers. These instructions are expressed in the form of **Data Access Profiles** as follows:

- For a particular event type, the exact parameters to be collected can be limited by each Data Access Profile. This permits compliance with one of the key principles of data protection legislation that only data necessary for specific purposes should be collected.
- In addition, each metric of collected UE data can be summarised along the axes of time, user and/or location using an **aggregation function**. For example, rather than exposing events detailing the service experienced by individual UEs, a particular Data Access Profile may expose only maximum, minimum and mean average values aggregated over five-minute intervals.
- Multiple Data Access Profiles can be provisioned for a given event type to vary the data restrictions imposed on different event consumers. When more than one Data Access Profile is provisioned, the Data Collection AF selects one based on local policy when it receives a new subscription request from an event consumer.
- As part of the authorisation procedure for event consumers, the Data Collection AF may also collaborate with an external Authorization AS, following a similar message exchange pattern to OAuth.

Instantiation of the reference architecture

The reference architecture for UE data collection, reporting and exposure defined in TS 26.531 is abstract in the sense that it is intended to be instantiated inside the architecture of other data domains. One such instantiation has been defined by SA4 in Release 17 for the 5G Media Streaming (5GMS) data domain. Summarised in the figure below, the detailed definition can be found in TS 26.501.

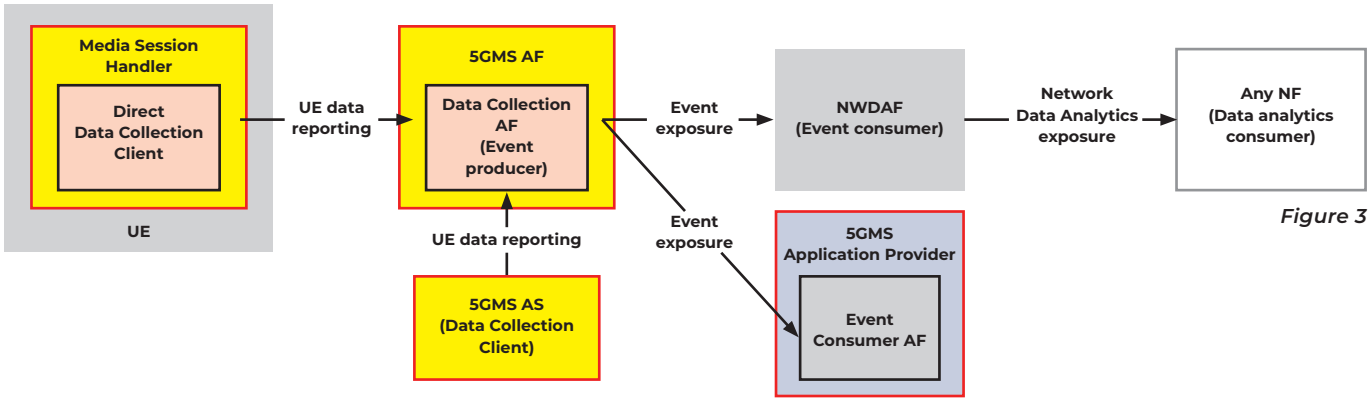


Figure 3

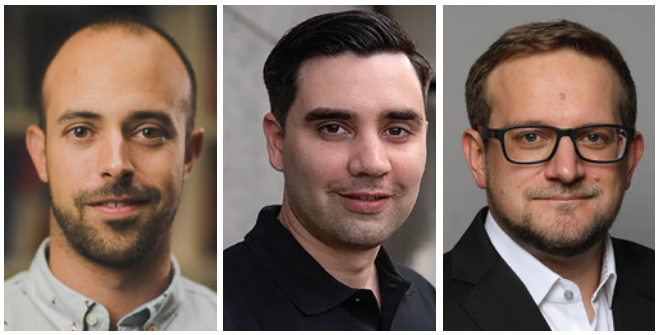
Here, the Data Collection Client is realised by the existing UE-side **Media Session Handler** component. This uses existing consumption reporting and QoE metrics reporting mechanisms to report collected UE data to a Data Collection AF realised by the existing **5GMS Application Function**. Thus, consumption and QoE metrics can be exposed as events to downstream event exposure subscribers such as a **5GMS Application Provider**'s Event Consumer AF.

Similarly, invocations of standard media streaming features such as dynamic QoS policies and network assistance that are already logged by the 5GMS AF can also be exposed as events. Finally, the media streaming application logs collected by the **5GMS Application Server** can be passed on to the Data Collection AF for exposure as events. In all, five new event types are defined in TS 26.532 for these 5GMS features, and the corresponding data types for exposing them to event consumers have been added to TS 29.517 by CT3.

Future work

SA4 expects to instantiate the UE data collection, reporting and exposure architecture in other data domains in subsequent 3GPP releases. Hence, there may be more than one concrete instantiation of the Data Collection AF in a given 5G System deployment, one for each data domain. And there may be multiple logical Data Collection Clients running on a UE.

Meanwhile, in Release 18, SA2 is studying the feasibility of exposing the data analytics output of the NWDAF back to UEs in order to drive feedback loops for Artificial Intelligence and Machine Learning applications.



5G-MAG REFERENCE TOOLS DEVELOPING OPEN SOFTWARE TOOLS FOR 5G MEDIA

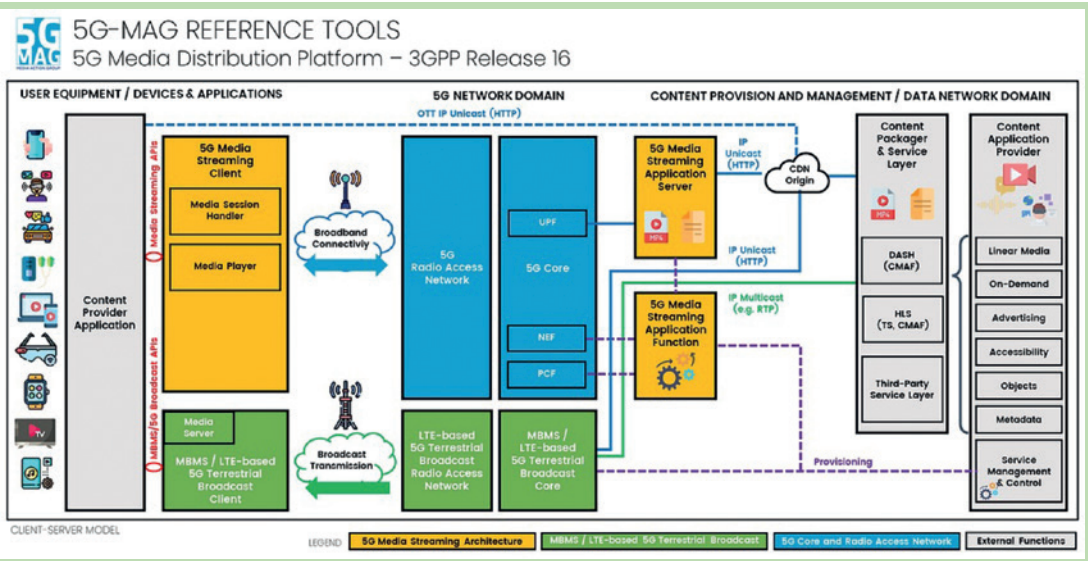
By Jordi J. Gimenez - 5G-MAG, Daniel Silhavy – Fraunhofer FOKUS, Johann Mika – ORS Group

5G-MAG has undertaken the duty to bring the 5G Media platform closer to service providers, network operators, developers and users. The 5G-MAG Reference Tools development programme, started in September 2021, has established an open community with the objective of providing common open software reference tools to support the implementation and interoperability of 5G Media technologies.

Developers are already implementing core parts of the Release 16 specifications and other related tools. Actually, a toolbox for 5G Broadcast (as defined in the 3GPP standards in Release 16 as LTE-based 5G Terrestrial Broadcast) is already available including an open-source transmitter, receiver and client components, openly available to the community.

With 3GPP Release 17, 5G Media specifications are expanded into the domains of 5G Media Streaming with dynamic QoS policies, event exposure, Multicast Broadcast Services, Edge applications, among others, with an eye on the future developments towards XR and The Metaverse.

Multiple software components are being made publicly available on Github: **www.github.com/5G-MAG**. An IPR-friendly license model enables the use of the tools in academic, testing, and demo environments while encouraging contributions from relevant industry players. The initial steps of the project are focused on the implementation of media players as part of a 5G client; service layers and the testing of applications developed by other media-related organizations; hybrid broadcast/ broadband scenarios and integration of third-party functions in the network. The initial Release 16 architecture is depicted in the following figure and available at **www.5g-mag.com/blueprints**.



More recently, the 5G-MAG community has been provided with an overview of media-centric 5G technologies and features in 3GPP Rel-16 & Rel-17 by 3GPP experts under the Target 2023 (www.5g-mag.com/target2023) activities. The community has collected market-oriented use cases and applications that may benefit from 5G media functionalities and from a common reference implementation. The proposed use cases are focused on a variety of subjects such as enhancements for media streaming, hybrid broadcast and streaming services or immersive media and extended reality (XR).

These may trigger implementation of Release 17 5G Media specifications such as 5G Media Streaming, Dynamic network QoS policies, 5G Media Streaming over eMBMS, Edge Applications for Streaming, 5G Multicast Broadcast Services, Event exposure framework or first insights into XR and the Metaverse.

Based on the use cases, technology descriptions and implementation efforts these are the use cases prioritized for 2023:

- Reliable Video On-Demand over Mobile Networks using 5G Media Streaming
- Reliable Personalized Live Radio over Mobile Networks using 5MBS
- 5G Broadcast On-Demand with 5G Media Streaming
- Premium and Targeted Content Insertion
- DVB-I over 5G Media Streaming
- DVB-I Hybrid Service over 5G Broadcast and 5G Media Streaming
- Emergency Alerts and Media Services through 5G Broadcast

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NON-IAB BASED MOBILE BASE STATION RELAYS

By Rashmi Kamran Bhatia, IIT Bombay

Mobile Base Station Relay (MBSR) is a lucrative option to extend network coverage and support enhanced capacity. A prime use case of MBSR is Vehicle Mounted Relay (VMR) to provide connectivity to users inside or nearby outside the vehicle.

The requirements for MBSRs are provided in 3GPP TS 22.261 (stage 1), focusing on efficient mobility and service continuity for connected users in different scenarios. While the stage 1 requirements allow for both IAB and non-IAB based architectures, the stage 2 development in 3GPP Release 18 has considered IAB-based architecture only.

TSDSI has undertaken a study on MBSR wherein the evolved solution places a gNB-DU at MBSR, and the corresponding gNB-CU, called MBSR-gNB-CU, in the edge cloud. MBSR comprises the gNB-DU functionality along with an additional UE (Mobile Termination (MT)) stack to enable IP connectivity with MBSR-gNB-CU. A unique feature of the TSDSI solution is that it utilizes the 5G system's PDU connectivity service to connect the MBSR (gNB-DU) to the corresponding MBSR-gNB-CU as shown in Figure 1. The F1 interface between the gNB-DU and gNB-CU is carried in the PDU session established between MBSR (MT) and MBSR-gNB-CU via the 5G system.

TSDSI has undertaken a study on MBSR wherein the evolved solution places a gNB-DU at MBSR, and the corresponding gNB-CU, called MBSR-gNB-CU, in the edge cloud.

Figure 1 shows the working of this solution for the VMR use case. Initially, the MT of the MBSR is connected to gNB1 over the radio (Uu) interface, and its PDU session(s) to the MBSR-gNB-CU are established via gNB1 and UPF1. Multiple UEs within the vehicle are connected to gNB-DU of the MBSR (VMR) through NR interface. For all UEs connected to gNB-DU of MBSR, the MBSR-gNB-CU acts as gNB-CU.

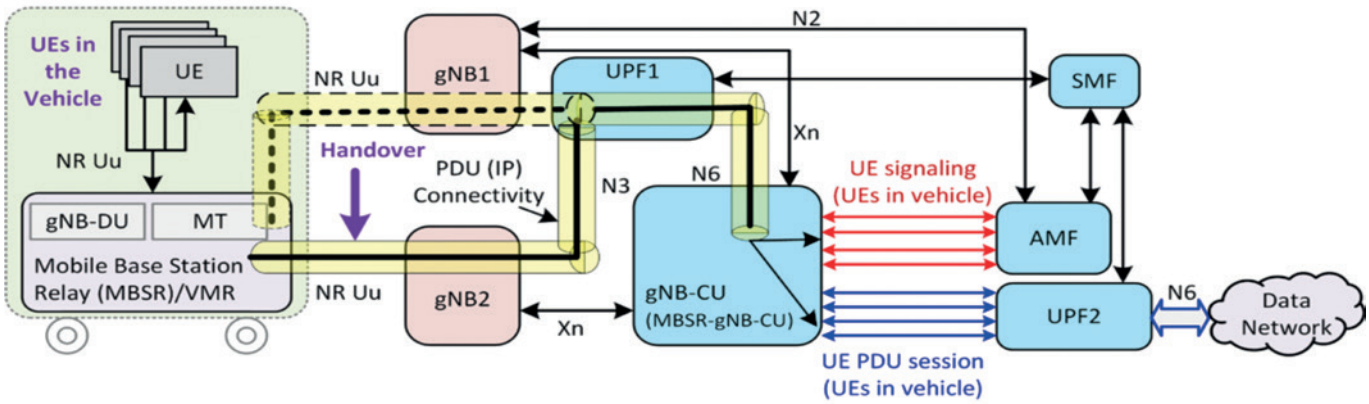


Figure 1: Working of the solution for the VMR handover scenario

When the MBSR moves and gets closer to gNB2, a conventional UE handover is triggered between gNB1 and gNB2 for the MBSR (MT function). However, the PDU session(s) between the MBSR and MBSR-gNB-CU do not get impacted due to the handover, hence there is no disruption in the IP and F1 connectivity between the two entities. Since the UEs within the MBSR (VMR) move along with the VMR, it essentially is a no mobility scenario for the UEs as they remain connected to the same gNB-DU (MBSR) and the same gNB-CU (MBSR-gNB-CU) despite the mobility of the MBSR. Therefore, there is no handover signaling for the connected UEs. This simplicity and no impact on service continuity for UEs make it a viable option for non-IAB based MBSR solution for future 3GPP releases also.

I would like to acknowledge Prof. Abhay Karandikar, Prof. Prasanna Chaporkar, Mr. Pranav Jha, Mr. Shashi Ranjan and Ms. Shwetha Kiran for their contribution.

PARTNER FOCUS

CRITICAL COMMS - MAKING A CONTROLLED LEAP TO THE NEXT LEVEL

Tero Pesonen is chair of TCCA's Critical Communications Broadband Group (CCBG) and is vice-chair of TCCA's Board, representing Finnish operator Erillisverkot. This year Tero marks 25 years in the critical communications industry. In this article he considers the impact 3GPP has had on the sector and looks to the future.

The critical communications operational model is moving steadily towards information-centric operations, via its commitment to 3GPP based global standards as the avenue to introduce video and other high speed data services. 4G LTE is the initial step on a long journey of continuous improvements.

It is the first technology that can be used in large scale in a shared fashion with our user community. It also provides the best territorial coverage for the current decade and beyond – An important factor as in critical communications keeping connected is often a lifeline.

New Radio – NR – and the entire 5G and 5G Advanced promise more connectivity. Examples include via Non-Terrestrial-Networks (i.e. satellite), capabilities for positioning and perhaps a solution for the device-to-device communications challenge with Proximity Services over Sidelink.

The challenge of 'one size fits all'

3GPP has historically been perceived as an organisation driving commercial mobile operator interests to enable ever increasing revenue streams from the consumers. However, since TCCA, together with other critical communications stakeholders, particularly public safety – joined 3GPP, there has been tremendous willingness to co-operate and jointly seek solutions that can accommodate the needs of critical users.

A big part of this drive was the founding of 3GPP's SA6 working group to address Mission Critical and other application-related requirements.

Now, further verticals are seeking 3GPP support for their sectors' needs. To enable all stakeholders to be concurrently successful, we need to examine new use cases and explore the possibilities to develop services that stretch over many verticals, including critical communications. Only in this way can sufficient economics of scale be reached to justify investment both in the standardisation as well as subsequently into products.

That said, it is difficult to overstate the importance of getting public safety's move to 5G right, coming from a variety of migration paths – With many regions still in early planning the move from narrowband such as TETRA or P25 networks to 3GPP broadband services.
In parallel, the early public safety adopters such as the USA, UK, South Korea, France and Finland are rapidly gaining practical experience on the transition highlighting in the short term the need for Mission Critical Services (MCX) standards conformance towards interoperability certification . This will provide benefit for all critical communications sectors including railways, utilities, mining and alike.

In the medium timeframe, feedback from the field is channelled back to standardisation. For the long term, the critical communications sector looks forward to being involved in 6G development from the early stages. Only by participating in the advances in technology can innovations be brought to life to serve the safety of the societies.

Time to reflect

I recently turned fifty, so I have spent half of my life working in the field of critical communications. It has an integral role in my life. Working in a segment where, at least indirectly, we are contributing to saving lives and keeping societies safe makes me very proud. The technical challenges of the past twenty-five years have taken place in a demanding environment. In my early career it was about digitalising communications and introducing features such as narrowband messaging services, whilst building a global multi-vendor interoperable ecosystem. Now, it is about making a controlled leap to the next level of operations with broadband enabled AI and XR. This has to be done without losing the benefits of open standards and the amazing spirit of cooperation that exists in the critical communications community.

I look forward to meeting 3GPP and partner colleagues at the TCCA's Critical Communications World event in Helsinki in May 2023.

TCCA https://tcca.info/

THE ROAD TO 6G : BUILDING ECOSYSTEM ADVOCACY

By Joe Barrett, President, Global mobile Suppliers' Association

The GSA is one of the largest mobile industry spectrum groups, a global advocacy and technical team of over 185 spectrum experts from GSA membership - focused into regional and work-group teams.

For 5G, GSA is supporting the harmonisation and assignment of spectrum in a range of frequency bands, namely, high-bands, mid-bands and low-bands. The group's work spans other areas also, including providing input to the next World Radiocommunications Conferences; WRC-23 and WRC-27.

The emphasis on the three spectrum ranges is important. Operator access to all bands will enable outdoor and indoor coverage needs to be fully met and the complete set of mass-market 5G services to be provided – ideally through a sustainable business model that delivers the best socio-economic value.

GSA involvement in the allocation and assignment of new spectrum, as well as safeguarding existing spectrum, encompasses many fronts including the ITU and the WRCs where all the world's regulators come together to agree on updating a binding international treaty on radiocommunications, including those relevant to spectrum for IMT (International Mobile Telecommunications).

But this process actually starts a lot earlier. Getting new spectrum into the market could require around ten years of work at the industry and regulatory level. For example, next year the ITU will see the WRC-23 start discussions on what potential spectrum ranges to be studied for what we call 6G.

Future spectrum opportunities for IMT could be named at WRC-23, but it is not until the next conference later in 2027 (WRC-27) after four years of deliberations that the frequency bands will be finally decided. Our aim is to provide contributions to the ITU's programme as well as the regional and national arenas with regards to suitable bands to be studied. We've been working on this for some time already; by the time of the launch of 6G from around the year 2030 onwards the process will have taken some ten years.

Of course, in addition to the ITU activities, regional and national regulators can assign spectrum for use by 5G/6G/IMT in other frequency bands. However, as a global framework for harmonisation, ITU and WRC decisions carry a lot of weight. The GSA knows this process well. At WRC-19, global spectrum regulators identified several millimetre wave frequency bands for 5G IMT. GSA was a part of the difficult but ultimately successful negotiations that took place in the run up to identifying several millimetric wave frequency bands for 5G IMT – notably 26 & 40 GHz – and agreement to study additional spectrum opportunities in the mid-band frequencies between 3.3 and 10.5 GHz, as well as spectrum below 1 GHz towards WRC-23.

But identifying spectrum is only part of the story. Will it be made available? In mid bands, most administrations have cleared that spectrum. Spectrum, the GSA believes, should be made available in the most effective and harmonised manner globally, in terms of spectrum assignment and technical conditions. There should be no undue restriction on the provision of mobile services in locations where those services are required. Harmonisation in this context refers to spectrum assignment as well as technical conditions. GSA advocates technology and service-neutral licensing of a sufficient amount of contiguous spectrum for 5G per network, with suitable regulatory conditions, to support the mass-market delivery of high bandwidth applications and services.

GSA's advocacy takes place through partnership with local associations and operators (or operator groups) wherever possible and working effectively alongside global or regional organisations like the GSMA, COAI, and of course standards bodies such as 3GPP.

The approval of 3GPP New Radio (NR) as an IMT-2020 global specification was another landmark for GSA. As part of its preparation for 6G, GSA is bringing together its members to begin the process of gathering and building consensus across the mobile ecosystem – including helping support the 3GPP standardisation process.

6G right now is still in pre-standardization phase so the main 6G activity of the GSA will focus on feeding into the ITU process on IMT-2030. This work will help support the 3GPP 6G standardisation time frame. Through participation of GSA members in collaborative research projects in different regions around the world we ensure that GSA's work is informed by the different geo-political contexts as we prepare for 6G.

GSA members are all strongly committed in continuing the standardisation for both the evolution of 5G and 6G, enabling the continuation of the successful global mobile ecosystem in 3GPP. GSA also undertakes discussion in support of the 3GPP standardization process as well as well enabling the smooth global standardisation process between ITU-R and 3GPP.

Identifying spectrum and standardising new technologies is a very long process that starts well before auctions are held and networks are deployed. While 5G is still being licensed and deployed, 6G may be the distant future for some people. But as far as GSA is concerned, that path to the future has already started.

GSA

www.gsacom.com

AN INTERVIEW WITH ADRIAN SCRASE

ETSI CTO & Head of the 3GPP MCC

Highlights: Tell us about your role in the start-up phase of 3GPP and the creation of the MCC?

Adrian Scrase: The discussions that led to the creation of 3GPP took place during 1998 at which time I was Secretary of the ETSI Board. In that capacity, I took part in all of the discussions with the Partners which led to the eventual creation of the project in December of that year. During those discussions it was evident that, for 3GPP to operate efficiently, a dedicated support team would be required and so the Mobile Competence Centre (MCC) was formed.

Highlights: 3GPP is an International project, with a growing level of participation. How has that changed the way 3GPP operates?

> At the outset, there were around 400 members in 3GPP, mainly drawn from large equipment manufacturers and network operators most of whom were household names. Today, there are more than 800 members in the project.

At the outset, there were around 400 members in 3GPP, mainly drawn from large equipment manufacturers and network operators most of whom were household names. Today, there are more than 800 members in the project.

But it is not today's membership number that is important, it is the diversity of that membership, which now includes many smaller companies, research bodies, universities and government agencies.

With the advent of 5G we also see membership being drawn from industry sectors that aspire to use our standards for the basis of their mission critical operations, including agriculture, automotive, aviation, healthcare, factory automation, mining and exploration, public safety and rail to name but a few.

More recently we have seen interest growing in the use of 5G for military operations which has even led to NATO joining 3GPP.

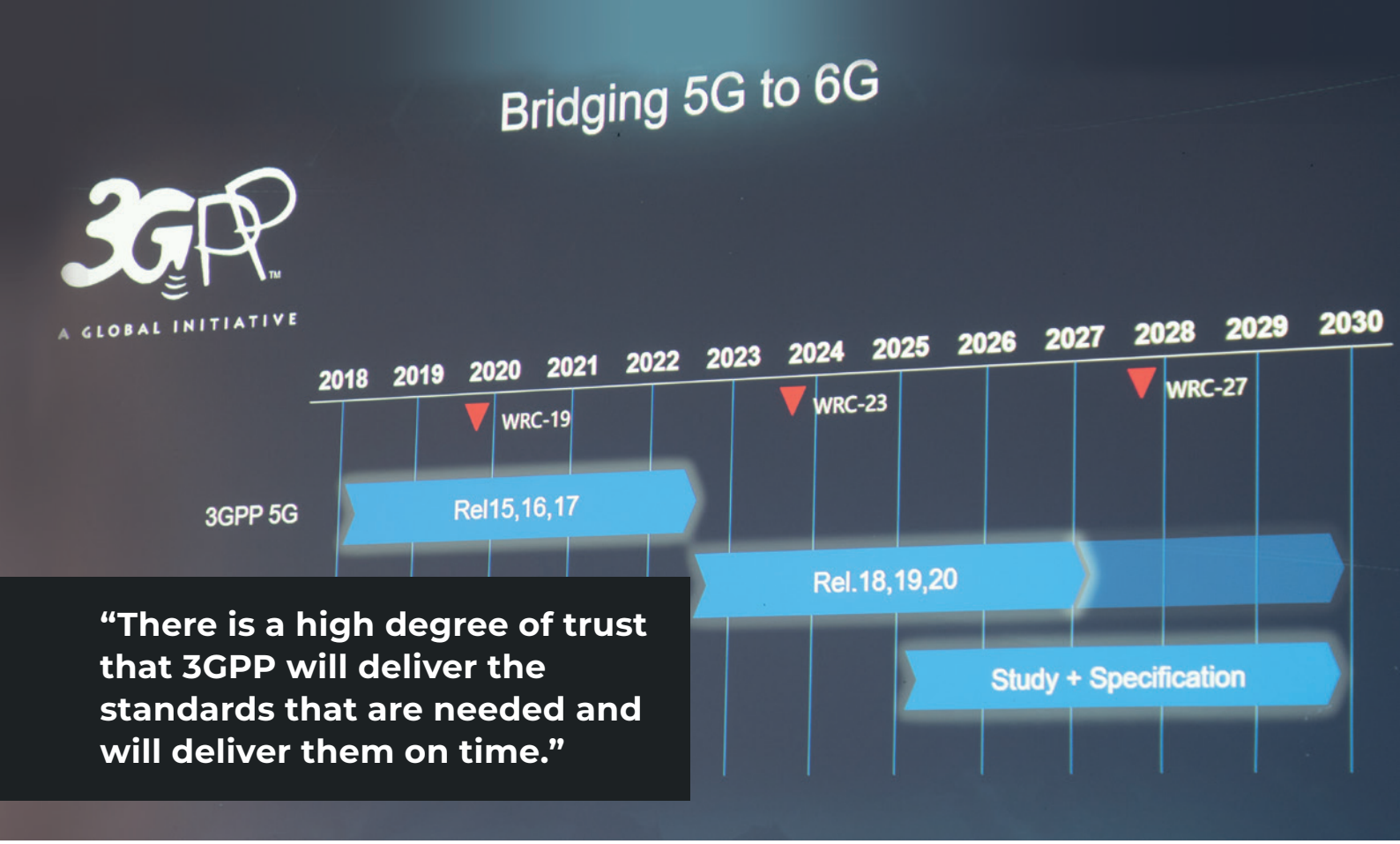
In summary then, 3GPP's membership has grown in every dimension and I expect this growth to continue for the years to come.

Highlights: As the user communities evolve, how do you gather and meet their diverse requirements? Do the newcomers arrive with their solutions, ready to go?

The new industry sectors coming to 3GPP have a very thorough understanding of their business operations. They know precisely what they need to achieve, but they very often express those needs in a different language to the one that we are familiar with.

The translation of their business needs into 3GPP-speak can be a complex task but it is essential if we are to meet their expectations. Product life cycles can also vary widely and these too need to be understood.

I think the public safety experience makes a very good case study. 4G standards had only just been completed when



"There is a high degree of trust that 3GPP will deliver the standards that are needed and will deliver them on time."

the Public Safety community approached 3GPP around 2012 requesting significant changes to be made to the standard. The public safety community organised themselves, engaged fully and dedicated considerable time and effort for their needs to be included in 3GPP standards. This resulted in mission critical features now being an inherent part of the 3GPP portfolio and the basis on which first responder services are being modernised globally.

Some of the later use cases – including V2X, Railways, factory automation and Industry 4.0 – have benefitted from the lessons learnt on all sides when bringing mission critical into the groups.

Highlights: How do you see future networks evolving to deal with new, more demanding, use cases?

There are two major developments which I believe will play a role in shaping our future. Until recently, it was widely assumed that telecommunications services would be delivered by public mobile operators. 5G specifications however describe how such services may be delivered using a private network arrangement. When considering how demanding industrial user needs can be satisfied there is now the choice of public network operators providing a guaranteed level of service through a network "slice" or by developing a dedicated private network to deliver that service.

The other gamechanger I see is the increasing interest in using non-terrestrial networks to satisfy user needs. Non-terrestrial networks are not new to 3GPP, but the intention of integrating non-terrestrial components within our 5G architectural design will pave the way for seamless connectivity and offer significant benefits both in terms of coverage and capacity.

Highlights: How will 3GPP be able to manage where 5G ends and future 6G work begins?

No decisions have yet been made about when 6G work will start and this is a prudent position to take if we are to avoid the risk of raising expectations which will be hard to meet.

That said, there is significant 6G work being done within the research community and early standardization studies commencing. Indeed, ETSI has already created two Industry Specification Groups, one focusing on Reconfigurable Intelligent Surfaces and the other on TeraHertz communications, both of which are expected to become 6G building blocks.

Highlights: Are there any potential road blocks that could delay or change plans for 6G?

We learned from 5G that market conditions can change rather quickly. We saw an early first phase of 5G specifications - which placed stress on our committees and on the quality of the resulting specifications.

We are also going through a time of considerable change. In this post pandemic environment our meetings are still largely being conducted as virtual meetings and it is not clear when face-to-face meetings will again become the norm. Indeed, with rising travel costs and our members having carbon neutral targets that they must meet we may never return to a full calendar of face-to-face meetings. We need to adapt to these changing conditions and this may mean adjusting our expectations accordingly.

Highlights: But you are optimistic about the future of the project?

Absolutely, yes. 3GPP is a very impressive talent pool with members providing their very best staff to participate in standards writing. There is a high degree of trust that 3GPP will deliver the standards that are needed and will deliver them on time. The evolving membership has broadened our capability to meet the demands from diverse user communities and we are now compelled to succeed.

PLANNING THE GREAT COMEBACK

By Lionel Morand, TSG CT Chair, Wanshi Chen, TSG RAN Chair, Georg Mayer, TSG SA Chair

Standardization work in 3GPP relies on the effort and dedication contributed by thousands of delegates around the globe, through regularly scheduled meetings.

From the outbreak of COVID-19 in early 2020 until June 2022 all face-to-face (F2F) meetings in 3GPP have been replaced by e-meetings, to ensure that the work can carry on.

As the pandemic's menace has receded, we were able to host the first F2F Technical Specification Group (TSG) plenary meetings in June 2022. These were followed by a RAN1 Working Group F2F meeting in August 2022. Both meetings were successful and have paved the way for us to plan a gradual resumption of physical meetings.

F2F vs. Electronic Meetings

F2F meetings are critical to 3GPP's success. They are typically held from Monday to Friday in a meeting week, where each day is fully scheduled. Hundreds or even thousands of delegates from the same or multiple groups can meet in a same meeting venue.

Sessions are usually chaired by the elected leadership and during such sessions official agreements are made. Because the 3GPP work is built upon consensus, which also implies forging compromises, giving enough time for discussion outside the official sessions has proved to be a successful means for reaching consensus.

'Offline' discussions can be officially organized or held informally, taking place in parallel, before or after the official meeting schedule and involving any number of delegates. These discussions help to increase mutual understanding among delegates, helping to resolve diverging views and to address open issues.

Some may even argue that offline discussions are one of the main reasons for going back to F2F, as they allow delegates to come to agreements more informally. Moreover, F2F meetings provide great opportunities for socializing and friendship, which is also an important aspect when it is about working together in a community spirit.

From early 2020, 3GPP has mostly met virtually, making use of emails and conference calls as the two primary means for e-meetings. Considering the participation from multiple continents and the need to avoid midnight sessions for delegates as much as possible, conference calls have been carefully chosen and kept to a typical duration of less than three hours. Email discussions are more time zone neutral,

but exchanges are then slow and less efficient than the conference call, especially for technical discussions when equations or plots are involved.

This has led to the e-meetings in the working groups running beyond a single week, in order to alleviate the impact of efficiency losses.

Consequently, the workload for delegates in e-meetings has greatly increased due to the extra meeting days and other factors. In addition, the lack of ad-hoc offline sessions or socializing opportunities can easily magnify the differences even for minor 'issues'.

3GPP continues to attract new companies and delegates. Many new delegates who joined 3GPP during the e-meeting era have never had the chance to get in touch with other delegates outside the e-mail and conference call settings. As a truly global organization, 3GPP relies on the good exchange among delegates, to not only resolve momentary controversies, but also to allow continuing the overall evolution of mobile technologies. It is therefore, crucial for 3GPP to gradually resume F2F meetings in light of the improved COVID-19 situation.

Meeting Decision Group

Resuming F2F meetings in 3GPP is much more complicated than it may appear.

There are still differing post COVID-19 related strategies in different 3GPP Organizational Partners (OPs) regions. Some are facing meeting hosting restrictions, quarantine requirements, vaccination requirements, COVID-19 test requirements, visa application complexity and restrictions on flight availability. Other regions are more easily accessible.

To monitor the COVID-19 related developments and to decide efficiently whether 3GPP meetings can be held as F2F meetings, an ad-hoc meeting decision group was formed by 3GPP's PCG/OP and moderated by Balazs Bertenyi, a very experienced 3GPP veteran. Regular meetings are scheduled with all OPs, the meeting organizers, 3GPP TSG Chairs and 3GPP WG Chairs.

Meeting Planning: 2022, 2023 and Beyond

Discussion in the ad-hoc group facilitated the first F2F meetings in June and August, with both witnessing happy reunions and celebrations. These F2F meetings also provided precious learning for the subsequent F2F meetings planned in 2022.

The first WG F2F meeting, in Toulouse during August, featured two-way remote attendance and three parallel sessions chaired by the RAN1 leadership and two parallel offline sessions. The RAN1 meeting provided a demanding setting, with some glitches experienced at the beginning of the meeting, but all considered the meeting was very successful.

All eyes are now on the November 2022 meetings of all 3GPP WGs, which will also be held in Toulouse. For quite a number of delegates, it will even be the first ever 3GPP meeting they are able to attend in person.

Meeting planning for the rest of 2022 and 2023 can be summarized as follows:

If travel related conditions allow, some electronic meetings may be converted to F2F meetings.

November 2022	WG meetings	F2F, Toulouse
December 2022	TSG meetings	Electronic
February 2023	WG meetings	F2F, EU
March 2023	TSG meetings	F2F, Rotterdam
April 2023	WG meetings	Electronic
May 2023	WG meetings	F2F, Korea for RAN and to be determined (TBD) for SA/CT WGs
June 2023	TSG meetings	Electronic
August 2023	WG meetings	F2F, EU
September 2023	TSG meetings	F2F, TBD
October 2023	WG meetings	Electronic
November 2023	WG meetings	F2F, North America
December 2023	TSG meetings	TBD (F2F or electronic)

Two-Way Remote Attendance

Due to the continuing travel restrictions in some countries and regions, it is not yet practical to fully resume F2F meetings. This is evident from the meeting experiences from the summer, where many delegates were not able to attend. Therefore, a temporary solution has been implemented, to ensure F2F meetings allow fair participation for those not traveling.

To that end, we have jointly drafted a set of detailed guidelines for remote participation, which was endorsed by the meeting decision group. Remote participants shall be able to listen and talk (two-way participation). The leadership and the group have agreed to handle and consider remote participant interventions in the same way as intervention from F2F participants. However, it is noted that voting rights may not be accrued through remote participation, and remote participants cannot formally object to decisions taken in the meeting.

Remote participation in meetings is a temporary emergency measure, used to maximize 3GPP progress during a time of extreme travel 'hardship' suffered by some 3GPP partner's regions. 3GPP TSGs and WGs are committed to return to regular F2F meetings without any remote participation facilities as soon as reasonably possible.

Concluding Remarks

Since the start of the COVID-19 pandemic, 3GPP was able to transform all its meetings, discussions and decision-making into a fully electronic and remote framework. This allowed 3GPP to continue progressing standard evolutions for over 2.5 years, without having any F2F meetings. In particular, Release 17 was the first release entirely worked out using only e-meetings. Whilst this handling of the crisis is nothing less than a great success and proves the flexibility of 3GPP as an organization, the shortcomings of a pure e-meeting setting become more and more obvious over time. But even today, organizing F2F meetings proves to be a complicated task.

Despite the extreme challenges and immerse complexities, 3GPP managed to deliver a thoughtful future meeting plan which enables a viable path to return to F2F meetings and includes a temporary remote participation solution. This demonstrates that through careful discussion and sincere cooperation, progress can be made not only in the technical domain, but also in the non-technical domain. Such planning and cooperation will continue driving more successes for 3GPP.

"Many new delegates who joined 3GPP during the e-meeting era have never had the chance to get in touch with other delegates outside the e-mail and conference call settings."

MEMBERSHIPS IN 2022

A full list of the companies in 3GPP is available online at:
https://www.3gpp.org/about-us/membership.

New Members

3GPP has welcomed the following organisations* into the project during 2022 so far. We currently have over 800 participating companies and organizations in 3GPP.

New 3GPP IM 2022	OP
Apple	CCSA ETSI
BeammWave A	ETSI
Broadpeak	ETSI
BSI	ETSI
Bytedance Technology	CCSA
C-DAC	TSDSI
Chinatelecom Cloud	CCSA
Chongqing Angying	CCSA
Chosun University	TTA
Cobham Satcom	ETSI
Comba	CCSA
CTSI	CCSA
Cygnusemi	CCSA
DBL	CCSA
Deloitte Tohmatsu Cyber LLC	TTC
Denso Automotive	ETSI
Dolby	ETSI
Effort	ETSI
Erik Sunell Consulting	ETSI
E-surfing Digital	CCSA
Esurfing IoT	CCSA
Eurofins KCTL	ETSI
Facebook Japan K.K.	ARIB

*NB. The list above may represent an evolution of an existing membership, or a change of company name, in addition to being a list of new members.

New 3GPP IM 2022	OP
Greenerwave	ETSI
Group 2000	ETSI
Haier W. W.	CCSA
Hangzhou Douku	CCSA
Hangzhou Mengyuxiang	CCSA
HFCL	TSDSI
IIT JODHPUR	TSDSI
IIT Roorkee	TSDSI
IMDA	ETSI
Intel Romania	ETSI
INVAS Technologies Pvt Ltd	TSDSI
iQoo	CCSA
JSI	ETSI
Kumu Networks	ATIS
Nanjing Weibo	CCSA
National Radio Research Agency	TTA
NCI Agency	CCSA ETSI
Neustar, Inc.	ATIS
NIIR	ETSI
NTPU	ETSI
NTT Advanced Technology Corporation	TTC
NVIDIA US	ATIS
OPPO (Chongqing) Intelligence	CCSA
ORS	ETSI
Rakuten Symphony	ATIS
SAICT	CCSA
SDI Squared LLC	ETSI
SEU - Southeast University	CCSA
SKY Perfect JSAT Corporation	ARIB
Skylo Technologies	ATIS
TCS	TSDSI
Texas A&M University	ETSI
Trimble	ATIS
Ubinexus	CCSA
Unisoc	CCSA
US Cellular Corporation	ATIS
Valid8.com, Inc.	ETSI
ViaSat Satellite Holdings Ltd	ETSI
vivo Japan KK	ARIB
Wiliot Ltd.	ETSI
Xiaomi EV Technology	CCSA

Source: 3gppmembership@etsi.org

Retiring RAN1 expert rewarded

A 3GPP Working Group RAN1 veteran with over 20 years in the group has been presented with a Lifetime Achievement Award, during the RAN1#110 meeting this summer.

Robert Love has made significant contributions to RAN1 standardization notably as the editor of the LTE technical specification TS36.213 - Physical layer procedures, ensuring the production of high-quality versions from 3GPP Release 8 onwards.

Bob's work has exemplified what an outstanding 3GPP delegate should be. In 2013 he received the 3GPP Excellence Award – given to only four experts in the year, over the whole project.

Mega-Meeting in the Pink City

1000+ delegates are expected for the November 14-18, with the CT, RAN and SA Working Groups meeting at the MEETT congress center Toulouse. The week will see the 100th meeting of the SA1 Working Group and a party is planned for SA1 Services experts, old and new.

On the meetings theme - This Issue of Highlights has more on our return to face-to-face meetings. See our article (page 24) 'Planning the great comeback', which considers our meeting prospects for the year ahead.

3GPP's MRPs:

Thanks to the 3GPP Market Representation Partners in 3GPP, for their continued support and generous inputs to each edition of 3GPP Highlights.

3GPP
A GLOBAL INITIATIVE

www.3gpp.org/about-3gpp/partners