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D3.3 REPORT ON STANDARDIZATION AND VERTICALS

| | |
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Executive Summary

An important part of the remit of Global5G.org is to “... ensure broad outreach to vertical stakeholders and help build consensus on priority actions through ‘5G vertical market’ events to facilitate understanding on use case requirements and foster contributions to standardization.” Numerous activities have been undertaken by Global5G.org to further this mission.

On top of this and thanks to the 3GPP MRP Task Force, Global5G.org has created an updated Tracker on the 3GPP Work Plan (June 2019), which it is using to track items related to verticals and help position Europe in the global landscape.

Vertical stakeholders often have significant problems in orienting themselves within the standardisation landscape. An introductory guide to the standards groups, destined in particular to accompany the online standardisation tracker, has been prepared and will go online as part of the Global5G.org mission to assist verticals in representing their interests within the standardisation groups.

Together with the 5G Infrastructure Association, Global5G.org leading activities in a new Task Force set up with the Market Representation Partners of 3GPP acting as a catalyst for boosting vertical industry participation in 5G standardisation. The standards tracker is online to assist verticals in orienting themselves in 3GPP standardisation. The Task Force works together to organise a workshop series aimed at lowering entry barriers for verticals. We are now on the organisation of the 2nd Workshop.

A further goal was to provide an in-depth analysis of the 5G standardisation landscape with a focus on relevance to verticals and a mapping of 5G PPP contributions working in synergy with the Pre-Standardization WG. Over 295 standards contributions have been gathered from 5G PPP Phase 2 projects that directly or indirectly influence 5G standardisation and architectural developments. The standards contributions come in many formats including technical or specification documents, presentations, white papers, proof of concepts, interoperability tests, source code and so on. Both graphical analyses and full tabulations of contributions are provided.

By far the most important standardisation body relevant to 5G verticals is the 3rd Generation Partnership Project, 3GPP. Actions have been undertaken to organise high-quality vertical stakeholder events with the 3GPP, with the specific mission of familiarizing both 3GPP actors and vertical actors with the needs and offerings of each other. These community-building activities resulted in a landmark workshop held in Brussels in February 2019. The success of the first 3GPP vertical user workshop in February galvanized interest of both the 3GPP and the verticals communities in hosting another workshop, with even more emphasis on pressing technical issues.

1 Introduction

1.1 Purpose and Scope

The purpose of *D3.3 – Report on Standardization and Verticals* is to:

- Give an in-depth analysis of the 5G standardisation landscape with a focus on verticals and a mapping of inputs from 5G PPP projects and EU-led/-based vertical industry associations, primarily but not exclusively to the 3rd Generation Partnership Project (3GPP) as the main standards body for 5G and vertical industries.
- Show how Global5G.org is working closely with the Pre-Standardization Working Group and its members to collect inputs, analyse the debriefings of 3GPP plenaries based on EU priorities for phase 2 and carry out a gap analysis for phase 3 and the Smart Connectivity work programme.
- Report on concrete interactions with standards bodies like 3GPP and ETSI around vertical industries and standardisation activities. A good case in point is the new workshop series “5G Vertical Users” co-hosted with several EU Market Representation Partners of 3GPP. Other examples include on-going inputs from phase 2 to ETSI Open Source Management and Network Orchestration (ETSI OSM), as well as ETSI Experimental Networked Intelligence Industry Specification Group (ETSI ENI ISG).
- Develop and update a Standards Tracker: offering practical guidelines on 5G standardisation across verticals, showing the benefits of participation in this process with access to outstanding levels of expertise, pointing to on-going study and work items, pinpointing common or complementary requirements, and highlighting EU contributions in the global landscape. Its focus is mostly on 3GPP as the leading standards body for 5G but is extendible to other standards organisations. The blueprint for the tracker draws on data collected through the 5G-IA Pre-Standardization WG, both from phase 2 projects and 3GPP tracking documents.
- Convey the value of collaboration across diverse stakeholder groups. The starting point for this is the Verticals Task Force with Global5G.org from May 2018, and the creation of the new Task Force from April 2019 with the 5G Infrastructure Association and several other associations that are also 3GPP Market Representation Partners supporting vertical industries in 5G standardisation
- Share outcomes of cross-WG collaborations and their outcomes, such as the recent work with the 5G PPP Architecture Working Group and contributions to its white paper published in mid-June 2019, with a workshop presenting the main findings at EuCNC 2019. In short, the Global5G.org analysis zooms in on a subset of phase 2 inputs related to 5G architectures.

1.2 Relationship to other project outcomes

Within the context of Global5G.org, D3.3 falls within the scope of *WP3 – Global 5G ecosystem: standards and support to consensus building*, and specifically Task 3.1 – Standardisation Analysis and Support for Verticals. The main goal of the Task is to support 5G standardisation, network densification and 5G commercial service potential across member states by easing multi-stakeholder engagement and fostering best practices.

Specifically, D3.3 has close links to the following Global5G.org deliverables:

- *D2.1 - Identify use cases from verticals (March 2018)*, describing a set of potential 5G use cases across four selected verticals (automotive, energy/utilities, healthcare and manufacturing), with a first analysis of relevant standards organisations.
- *D2.3 - Vertical industries and rollout to markets 1st Report (May 2019)*, drawing on some of the key findings of the two Global5G.org webinars on automotive and energy alongside selected IDC and external market analyses.
- *D2.2 and D2.4 – Verticals Cartography, First Report (June 2019) and Final Report (December 2019)* in terms of how use-case experiments relate to 5G standardisation: which applications and services need standardising and why.

At the Work Programme level, Task 3.1 contributes to tracking progress towards EU 5G standardisation priorities in the global landscape, as well as supporting gap analyses for future activities, including 5G PPP phase 3 and Smart Connectivity under Horizon Europe.

1.3 List of Acronyms & Abbreviations

| Acronym | Description |
|-----------|---|
| 3GPP | Third Generation Partnership Project |
| 3GPP MRP | 3GPP Market Representation Partner |
| 3GPP OP | 3GPP Organisational Partners |
| 3GPP-CT1 | 3GPP TSG-CT WG1 MM/CC/SM (Iu) |
| 3GPP-CT3 | 3GPP TSG-CT WG3 Interworking with external networks |
| 3GPP-CT4 | 3GPP TSG-CT WG4 MAP/GTP / BCH/SS |
| 3GPP-RAN1 | 3GPP TSG-RAN WG1 Radio Layer 1 |
| 3GPP-RAN2 | 3GPP TSG-RAN WG2 Radio Layer 2 and Radio Layer 3 RR |
| 3GPP-RAN3 | 3GPP TSG-RAN WG3 Iu, Iub, Iur, S1, X2 and UTRAN/E-UTRAN |
| 3GPP-SA1 | 3GPP TSG-SA WG1 Services |
| 3GPP-SA2 | 3GPP TSG-SA WG2 Architecture |
| 3GPP-SA3 | 3GPP TSG-SA WG3 Security |
| 3GPP-SA4 | 3GPP TSG-SA WG4 Codec |
| 3GPP-SA5 | 3GPP TSG-SA WG5 Telecom Management |
| 3GPP-SA6 | 3GPP TSG-SA WG6 Mission-critical applications |
| 5GAA | 5G Automotive Association, a 3GPP MRP |
| 5G-ACIA | 5G Industrial Internet of Things |
| 5G-IA | 5G Infrastructure Association |
| 5G PPP | 5G Infrastructure Public Private Partnership |
| BoF | Birds of a Feather (IETF) |

| | |
|--------------------|---|
| eMBB | Enhanced Mobile Broadband |
| ESOA | EMEA Satellite Operators Association, a 3GPP MRP |
| ETSI | European Telecommunications Standards Institute |
| GCF | Global Certification Forum, a 3GPP MRP |
| GSA | Global Suppliers Association, a 3GPP MRP |
| GSMA | GSM Alliance, a 3GPP MRP |
| IETF | Internet Engineering Task Force |
| ISG | Industry Standards Group (ETSI) |
| ITU | International Telecommunication Union |
| ITU-D | ITU Development sector |
| ITU-R | International Telecommunication Union Radiocommunication Sector |
| ITU-T | International Telecommunication Union Telecommunication Standardisation Sector |
| MCPTT | Mission Critical Push to Talk |
| MEF | Metro Ethernet Forum |
| MulteFire Alliance | No long term. An alliance working to enable new wireless networks by operating cellular-based technology in unlicensed or shared spectrum |
| NFV | Networks Functions Virtualisation (ETSI) |
| NGMN Alliance | Next Generation Mobile Network Alliance, a 3GPP MRP |
| MTC | Machine-type Communication |
| NTN | Nonterrestrial networks |
| ONF | Open Network Foundation |
| OSI | Open Systems Interconnection |
| Open Source MANO | Open Source Management and Network Orchestration (ETSI) |
| PSCE | Public Safety Communications Alliance, a 3GPP MRP |
| RFC | Request for Comment |
| SCF | Small Cell Forum, a 3GPP MRP |
| SDO | Standards Developing Organisation |
| SES | Satellite Earth Stations and Systems |
| SG | Study Group (ITU) |
| SI | Study Item Description |
| TC | Technical Committee (ETSI) |
| TCCA | The Critical Communications Association, a 3GPP MRP |
| TR | Technical Report (3GPP, ETSI) |
| TS | Technical Specification (3GPP, ETSI) |
| TSG | Technical Specification Group (3GPP) |
| TSG-CT | TSG Core Network and Terminals |
| TSG-RAN | TSG Radio Access Networks |
| TSG-SA | TSG Service and System Aspects |
| URLLC | Ultra-reliable low latency communication |
| WG | Work Group |
| WID | Work Item Description |
| ZSM | Zero Touch Network and Service Management (ETSI) |

Table 1: Essential Glossary for 5G standardisation

1.4 Structure of the document

The rest of this document is structured as follows:

Section 2: describes the focus on 5G standardisation within the 5G PPP, summarising the main groups and task forces where Global5G.org contributes and how they help boost engagement and impacts. It also outlines the 5G Vertical User Workshop series as an essential mechanism to achieve the impacts. It also reports on the main activities taking place in the 5G-IA Pre-Standardization WG, which Global5G.org has helped to extend and animate.

Section 3: zooms in 3GPP, its organisations, processes and groups. it then moves on to cover other targeted standards organisations in 5G PPP.

Section 4: covers the impacts from the Global5G.org analyses, using dedicated trackers within the Pre-Standardization WG and through cross-WG collaborations.

Section 5: focuses on the prospective guide on standardisation for verticals, which is leveraging the collaborative work with 3GPP and its Market Representation Partners, and the workshop series now in place.

Section 6: presents the main conclusions and next steps.

Section 7: lists the main references.

Sections 8-9: present the agendas for the 5G Vertical User workshop series (1st and 2nd events).

Section 10: lists the phase 2 projects contributing to the joint impact analysis with the 5G PPP Architecture WG.

2 The 5G Standardisation Global Landscape

Here we look at the focus on standardisation within the 5G PPP and the most relevant standards organisations for 5G in relation to both verticals and 5G PPP phase 2 projects.

2.1 Standardisation in 5G PPP

The 5G Public Private Partnership has a very pro-active relationship with standards development, and provides many mechanisms to help vertical stakeholders participate in various ways in the process. Global5G.org is also very active in the standardisation processes, both historically and today. We participate in key Working Groups of the 5G PPP and develop tools to help verticals navigate the world of 5G standards. Together, the 5G PPP and Global5G.org are able to help verticals get involved.

Perhaps in no other WG do European and industrial policy makers work so closely together. This is where European policymakers, industrial players (large companies and SMEs) and specialised researchers work together to create a roadmap of relevant standardisation and regulatory topics for 5G, to ensure that European interests are considered. This includes identification of Research and Development topics that could be important candidates for standardisation, influencing the timing of R&D Work Programmes. This is where vertical participants can potentially make their voice heard even prior to entering the standards development processes of specific standards organisations.

2.1.1 Pre-Standardisation Working Group

The WG has evolved in view of progress in 5G PPP and the on-going on-boarding of phase 3 projects. The mission statement below reflects this evolution:

- Collect and monitor inputs from 5G PPP projects across the three funding phases to relevant standards bodies, e.g. 3GPP, ETSI, IETF, ITU, IEEE, and several industry associations.
- Influence pre-standardisation on 5G and related R&D: Potentially propose where topics should be standardised.
- Influence timing on R&D work programs (e.g. EC WPs).
- Foster the development of globally harmonised standards.
- Track progress towards EU priority topics as defined by the EC (Unit E1).
- Identify gaps to be targeted in future funding programmes.
- Develop a roadmap of relevant standards.
- Inputs from projects are tracked in a regularly updated file. Collaborate with other WGs and Task Forces as required, e.g. forthcoming white paper of the Architecture WG - chapter 7 on relevant standards (EuCNC 2019 workshop 8), as well as the Verticals TF (Chair: 5G-IA, TIM) and the recently formed TF with selected market representation partners of 3GPP (e.g. the 5G Vertical User Workshop series).

Governance model: The Terms of Reference are available on BSCW. You should be able to access them with your user name and password. The Pre-Standardization WG is under the 5G Infrastructure Association and therefore chaired by a member organisation (in this case Ericsson, Olav Queseth). Global5G.org acts as replacement chair in the event of absences (e.g. February-March 2019).

Number of members and projects: 101 members, including the EC (Bernard Berani), and 3GPP specialists (e.g. Toon Norp, TNO; Hans van der Wees (NEC Europe Labs), Thomas Walter (DOCOMO Labs Europe). Members already on-boarded from Phase 3 projects include: 5G-EVE, 5GENESIS and 5G-VINNI; 5G MOBIX, 5G CARMEN; 5G SOLUTIONS and 5G TOURS.

SDOs that the group is focusing on: The WG focuses on 3GPP as the main standards body for 5G, including vertical industries. Active members of 3GPP provide inputs to the WG, including debriefs from 3GPP plenaries, EU priority topics and gap analysis. The WG has developed a tracker to monitor progress of 3GPP standardisation work. Other targeted bodies include:

- 3GPP as the main standards body producing technical specifications for 5G and verticals. It is the most targeted standards organisation in 5G PPP.
- ETSI Open Source MANO (Management and Network Orchestration): 10 phase 2 projects are contributing. Some of these projects also contribute to the ETSI MEC ISG (multi-access cloud).
- ETSI ENI ISG (artificial intelligence and 5G networks): 1 phase 2 project is contributing
- IETF and ITU: small number of contributing projects
- Industry associations like NGMN Alliance, e.g. white papers / studies.

Core activities include:

- Tracking progress towards EU priorities towards 5G standardisation.
 - EU Priorities: NR-V2X; industrial IoT; Reliability of URLLC; NTN; SI-WI shifts for Rel-16; security progress. Preliminary views of Rel-17 items.
- Tracking input contributions from 5G PPP phase 2 projects through the Blueprint and measuring impacts.
 - Based on the inputs, Global5G.org also liaises with the contributing projects, and also, the chairs of the respective groups, e.g. ETSI OSM and ETSI ENI ISG.
- Keeping members informed of updates and opportunities to contribute to 5G standardisation.
- Monitoring verticals in the 3GPP work plan as a priority action, with plans to track study and work items across major categories aimed at identifying EU leadership and intensity of contributions in the global landscape. The Blueprint also includes the current 3GPP Work Plan (June 2019) for this very purpose.
 - WG Member Hans van der Wees (NEC Europe Labs) reports on 3GPP Plenaries with a debriefing on the main items related to EU priorities. This is also supported by Toon Norp (NTO), former 3GPP SA1 Chair.
 - Relevant 3GPP announcements and LinkedIn posts are shared periodically with the WG.
- Analysing gaps in the current 3GPP work plan with a view to Release 18.
 - Drawing on the gaps to help shape future EC programmes communicated to the Vision WG (Toon Norp and Global5G.org).
- Contributing to the Annual Progress Monitoring Reports in terms of standards impacts.
- Producing the bi-monthly activity reports for the Steering and Technology Boards via To-Euro 5G. Global5G.org has taken on this task since April 2018, and now presents the main activities and impacts during the SB phone calls.
- Working within the 5G-IA Verticals Task Force and 3GPP MRP Task Force to help drive standardisation across verticals. This mostly revolves around the co-organisation of Vertical User Workshops, with the first taking place in February 2019 and the second one in July 2019. These workshops are co-organised with the 3GPP TSG Chairmen and Chairmen of the most relevant groups, e.g. the 2nd Workshop is co-located with the SA6 Meeting to help find common requirements and complementarities.

- Working with relevant EU projects on standardisation, e.g. STANDICT.eu (Coordinator: Silvana Muscella, CEO of Trust-IT), sharing insights on EU priorities and the gap analysis, as well as relevant specifications, work and study items for the Standards Watch¹.

Through the Pre-Standardization WG, Global5G.org has so far track 295 inputs from 5G PPP phase 2 projects. Each item covers the following data points:

- Category, e.g. architecture core and transport.
- Standards Organisation and Group, e.g. 3GPP-SA2.
- Project name.
- Title of Input.
- Partners involved.

| Cat. (desirable) | SDO + Group | PROJECT | title of input contribution | Partners involved |
|------------------------|-------------|----------------|--|----------------------------|
| core & transport Arch. | ITU-T SG15 | 5G-PICTURE | The Requirements of Mobile-optimized OTN(M-OTN) | Huawei, TIM |
| core & transport Arch. | ITU-T SG15 | 5G-PICTURE | FEC for FlexO-LR interfaces rates of 200 Gbit/s and 400 Gbit/s | TIM |
| core & transport Arch. | ITU-T SG15 | 5G-PICTURE | OTU4 long-reach interface. ITU-T Rec. G.709.2 | TIM |
| core & transport Arch. | IETF | 5G TANGO | YANG models for ACTN TE Performance Monitoring Telemetry and Network | Autonomics |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Clarification on key issue: Network slicing for eV2X | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Updated SID: Study on Enhancement of network slicing | Nokia |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Discussion paper on V2X slicing KI | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Updates to Impacts and Evaluation of Solution 12 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Updates to Solution 1 for Network Data Analytics Feedback | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Solution for KI#2 on Analytics Exposure to AF | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Solution to NWDAF assisting traffic routing using MEC information | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Updates to Solution 19 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Overall Conclusion for Key Issue 4 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Updates to Solution 12 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Updates to Solution 24 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | TS 23.288 skeleton for 5G analytics framework | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | CR for TS 23.501 based on conclusion of eNA TR 23.791 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Adding Selected Solutions #12 from eNA to TS 23.288 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Adding Selected Solutions #24 from eNA to TS 23.288 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | P-CR TS 23.288: Setup of Network Map for Data Collection | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | LS from FS-eNA to SAS/RAN3 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Adding reference to new TS 23.288 in TS 23.502 | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | TS 23.288: Update to Data Collection from OAM | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Update to NF Load Analytics Procedures | Huawei |
| core & transport Arch. | 3GPP-SA2 | 5G MoNArch | Update to Network Performance Analytics Procedures | Huawei |
| core & transport Arch. | IETF CCAMP | 5G-TRANSFORMER | A YANG Data Model for Microwave Radio | UC3M, NEC, Ericsson, Nokia |

Figure 1: Tracker for Phase 2 Projects

The Blueprint also tracks documents in the 3GPP Work Plan (June 2019) for Releases 16 and 17 (1072 items and related documentation). This on-going standardisation activity is tracked by category, including items and related documentation for verticals. These include:

- Release 17 verticals, e.g. asset tracking, cyber physical control applications, railways mobile communication systems (See figure below).
- Release 16: satellite access in 5G.
- Release 16: mission-critical, public warning, railways and maritime.
- Release 16: Streaming & TV.
- Release 16: UAV.

¹ <https://www.standict.eu/>.

- Release 16: LTE-based 5G terrestrial broadcast.

| title | % don | Release | Start date | End date | SI/WI | Group | Rapporteur organisation |
|--|-------|---------|------------|----------|-----------|-------|-------------------------|
| Study on Asset Tracking Use Cases | 50% | Rel-17 | 06/09/18 | 14/06/19 | SP-180922 | S1 | NOVAMINT |
| Study on Communication Services for Critical Medical Applications | 60% | Rel-17 | 06/09/18 | 12/12/19 | SP-180783 | S1 | B->COM |
| Study on CMED | 90% | Rel-17 | 06/09/18 | 13/09/19 | SP-180783 | S1 | B->COM |
| Stage 1 on CMED | 0% | Rel-17 | 06/06/19 | 12/12/19 | SP-190306 | S1 | B->COM |
| Enhancements for cyber-physical control applications in vertical domains | 35% | Rel-17 | 07/03/19 | 12/12/19 | SP-190310 | S1 | Siemens AG |
| Study on eCAV | 60% | Rel-17 | 07/03/19 | 05/09/19 | SP-190092 | S1 | Siemens AG |
| Stage 1 eCAV | 10% | Rel-17 | 06/06/19 | 12/12/19 | SP-190310 | S1 | Siemens AG |
| Study on application layer support for Factories of the Future in 5G network | 15% | Rel-17 | 07/03/19 | 12/03/20 | SP-181139 | S6 | ZTE Corporation |
| Study on enhancement of support for 5G LAN-type service | 0% | Rel-17 | 06/06/19 | 12/03/20 | SP-190454 | S2 | Huawei |
| Study on supporting Unmanned Aerial Systems Connectivity, Identification, and Tracking | 0% | Rel-17 | 06/12/18 | 12/03/20 | SP-181114 | S2 | Qualcomm Corporation |
| Study on application layer support for Unmanned Aerial System (UAS) | 10% | Rel-17 | 06/12/18 | 13/12/19 | SP-181140 | S6 | Huawei |
| 5G Enhancement for UAVs | 64% | Rel-17 | 06/09/18 | 13/12/19 | SP-190308 | S1 | China Unicom |
| Study on EAV | 90% | Rel-17 | 06/09/18 | 13/12/19 | SP-180909 | S1 | China Unicom |
| Stage 1 of EAV | 0% | Rel-17 | 06/06/19 | 12/12/19 | SP-190308 | S1 | China Unicom |
| Complete Gap Analysis for Railways Mobile Communication System | 20% | Rel-17 | 06/06/19 | 12/12/19 | SP-190312 | S1 | UIC |
| Enhancements to Application Architecture for the Mobile Communication System for | 0% | Rel-17 | 06/06/19 | 10/12/19 | SP-190565 | S6 | Nokia |
| Study on Future Railway Mobile Communication System3 | 40% | Rel-17 | 06/06/19 | 12/12/19 | SP-190321 | S1 | UIC |
| Audio-Visual Service Production | 63% | Rel-17 | 06/06/18 | 12/12/19 | SP-190304 | S1 | BBC |
| Study on AVPROD | 95% | Rel-17 | 06/06/18 | 12/06/19 | SP-181015 | S1 | EBU |
| Stage 1 of AVPROD | 0% | Rel-17 | 06/06/19 | 12/12/19 | SP-190304 | S1 | BBC |

Figure 2: Tracker for 3GPP Work Plan June 2019

The image below shows a sample of a 3GPP Plenary Debriefing open for discussion during the WG monthly calls and recorded in the minutes by the WG Chair.

Rel-16 Planning (aka 5G Phase 2) (changed)

Stage 1: frozen December 2018 without exceptions.

Stage 2: frozen June 2019 with 9 SA2 (eLCS, Vertical LAN, URLLC, eV2X, 5WWC, ATSSS, CloT, RACS, eSBA) and 2 SA6 (eMCCI, eMCDData) exceptions

Stage 3: freezing target March 2020. (ASN.1 freeze planned for June 2020 (tentative)).

Rel-16 Power Saving (Revised WID: RP-191607)

Based on four offline sessions, the power saving objectives were completely rewritten. The objectives (details see WID):

- Specify power saving techniques with PDCCH-based power saving signal/channel triggering UE adaptation in RRC_CONNECTED mode [RAN1, RAN2, RAN4]
- Specify power saving techniques of UE adaptation to maximum number of MIMO layers [RAN1, RAN2, RAN4]
- Specify mechanism for UE to indicate its preference of transitioning out of RRC_CONNECTED state. [RAN2]
- Specify, if agreed, mechanism to provide UE assistance information [RAN2, RAN1]:
- Specify network-configured mechanism to relax intra and inter-frequency RRM measurement for neighbour cells for RRC_IDLE/INACTIVE with minimal mobility performance impacts [RAN2, RAN4]

Rel-16 NR-U (Prioritization: RP-191581; Revised WID: RP-191575)

The result of a prioritization exercise for NR-U work was (1) for WGs to focus on completion of essential items; (2) 10MHz is supported in NR-U via NR-U/NR-U CA or NR/NR-U CA without air-interface optimizations specific to 10MHz. 10MHz Pcell or SpCell is not supported in NR-U.

Figure 3: Sample of a 3GPP Plenary Debriefing

As WG Chair, Ericsson has led the discussions on the standardisation gap analysis. The figure below shows examples for 5G New radio for verticals and the overall vision.



Figure 4: Pre-Standardization WG Gap Analysis

2.1.2 5G-IA Vertical Task Force

Global5G.org has been a member of the Vertical Task Force since May 2018, working very closely with its Chair, Raffaele De Peppe, TIM, to help shape the activities and reinforce engagement across vertical industries.

Regular one-to-one exchanges take place to determine priority actions and direct liaison with industry associations, e.g. at events, where synergies and Memorandum of Understandings (MoUs) can be discussed. One example of this is the MoU signed with Public Safety Communications Europe (PSCE), a market representation partner of 3GPP and co-host of the 5G Vertical User Workshops (announcement in 5G PPP newsflash, April 2019).

Regular exchanges also take place within the group to coordinate activities between the VTF, To-Euro 5G and Global5G.org.

The VTF Chair is also a member of the 3GPP MRP Task Force, helping to reinforce relations with vertical industries and other relevant associations.

2.1.3 5G-IA International Cooperation Stream

Global5G.org has been a member of the International Cooperation Stream since May 2018. It contributes to the activities tracking collaborative work related to the 5G PPP, e.g. following the progress of the international projects like 5G DRIVE, 5G-CORAL, CLEAR5G etc. It also liaises on the Global 5G events and other events taking place outside Europe. More recently, it has increased its focus on impacts achieved through the international cooperation projects, including contributions to globally harmonised standards.

2.1.4 5G PPP Architecture WG

Through its membership of the Architecture WG (AALTO), Global5G.org has recently embarked on a cross-WG synergy with the Pre-Standardisation WG. The synergy relates to the production of a new white paper from the Architecture WG, specifically on standards impacts.

To this end, Global5G.org (AALTO and Trust-IT) worked together to collect inputs from the phase 2 projects in the Architecture WG and updated the Pre-Standardization Blueprint tracker. AALTO conducted an analysis on the impacts, while Trust-IT created a graphical version of the statistics. Moreover, AALTO wrote summaries of the targeted standards organisations with support from Trust-IT and also created annexes detailing the inputs per project and category.

The four categories analysed were: overall architecture, radio and edge, core and transport, management and network orchestration.

The resulting white paper is published on the 5G PPP website² and is now open for public consultation. Results were presented in a dedicated workshop at EuCNC2019, with a joint AALTO-Trust-IT presentation and panel discussion with AALTO and other WG representatives.

2.2 Synergies with 3GPP and its Market Representation Partners

2.2.1 3GPP MRP Task Force

As a member of the 3GPP MRP, the 5G-IA and its Pre-Standardization WG have worked with 3GPP and its PCG to:

- Share mutual benefits on being part of the partnership, including statistics on the inputs from the 5G PPP over its two first phases (September - October 2018), with the support of Global5G.org to the then Secretariat General of 5G-IA.
- Upon PCG recommendation, a core team was set up to organise a 1st 5G Vertical User Workshop (December 2018), bringing together 5G-ACIA, 5GAA, 5G-IA and PSCE with Technical Specification Group Chairs for Radio Access Networks (TSG RAN) and Core Networks and Terminals (TSG CT), along with Adrian Scrase, ETSI CTO and Secretary of PCG. Global5G.org was also part of the core team.
- The 1st 5G Vertical User Workshop took place on 10-11 February 2019 in Brussels, hosted by 5GAA to chart a course towards vertical standardisation activities through the leadership of EU-led/-based industry associations. An Executive Summary and Report of the Workshop was duly prepared and published on www.5g-ppp.eu.
- Upon PCG recommendation, a new Task Force was set up in April 2019, comprising 5G-IA (Chair and Chair of the Verticals Task Force), 5G-ACIA, 5GAA and PSCE, flanked by ETSI Board Member Christian Toche; ETSI CTO Adrian Scrase; 3GPP TSG chairs for RAN, CT and Services and Systems Aspects (SA): Balazs Bertenyi, Lionel Morand (new TSG CT Chairman) and Georg Mayer (new TSG SA Chairman). Global5G.org (Trust-IT) is a member of the Task Force.
- The Task Force is now working on the organisation of the 2nd 5G Vertical User Workshop on 9-10 July in Rome, co-located with the 3GPP SA6 WG (mission critical applications) to boost technical inputs and define common requirements and complementarities moving forward. Four post-event reports will be prepared: an “Outputs Document” for the PCG and XXXX; an executive summary and report for public distribution, and a summary report for other standards organisations for future collaboration on 5G vertical standardisation. The workshop is being led by Global5G.org on behalf of the 5G-IA.

The role of the 5G PPP’s very own 5G-IA within 3GPP MRPs is clear evidence of the pro-active attitude of the 5G PPP toward standardisation, complementing its chairman of the 5G PPP’s Pre-Standardization

² <https://5g-ppp.eu/5g-ppp-architecture-public-consultation/>.

WG. An Executive Summary and Post-event Report were produced with the main take-aways shared in the 5G PPP April 2019 News Flash.

2.2.2 5G Vertical User Workshop Series with 3GPP

The overriding goal of this workshop series is to boost the participation of vertical industries in the 5G standardisation process, primarily through 3GPP and its MRP TF. This includes newcomers to 3GPP, where the Global5G.org will come in handy in pointing vertical industry representatives to practical guides, tips from 3GPP high-profile representatives and a walkthrough on-going standardisation so anyone from any vertical industry ripe for 5G can get help.

1st 5G Vertical User Workshop

The organisation of the 1st workshop started in December 2018, with weekly phone calls to define the objectives and agenda, as well as organise the logistics and selection of participants, whereby each MRP involved in the TF suggested member names. The workshop took place in Brussels on 12-13 February 2019, with two half-day formats.

The Workshop was organised as a collaborative event for strategic dialogue between industries and 3GPP by exchanging on future needs and upcoming cellular standards developments. The Agenda is included in Annex 1 (Section 8).

- The Workshop demonstrated the clear value in having constructive discussions outside of 3GPP on how to improve the engage of MRPs and other 5G Vertical Industry representatives. Following the workshop, this entire report will be presented to 3GPP PCG as a contribution for informational purposes to share all relevant insights.
- There are clear shared goals from across the various 5G vertical industries/sectors, with a great appetite from industry and Standards Development Organisation to receive the input of their respective vertical representatives. There is a need to pool resources, share experience and lessons learnt whilst becoming more familiar with 3GPP as a whole, and also to create a more 'vertical friendly' standardization environment to support such efforts.
- This first 5G Verticals workshop provided a much-needed and unique opportunity for this particular group of stakeholders to come together, however, feedback during the final concluding session demonstrated that clearly driving action by verticals within 3GPP would require additional, more focused workshops or meetings between the verticals to turn valuable dialogue into valuable action.
- The core organisational group of verticals have therefore since agreed that regular face-to-face meeting will take place amongst all verticals in line with dates of 3GPP PCG meetings, supplemented by ad-hoc conference calls, also considering the 3GPP meetings schedule. The first iteration of such a meeting will take place ahead of the June 2019 TSG #84 already mentioned.
- Future meetings will involve a more focused audience of verticals, with aims to involve a wider array of said verticals. The aim will be to specifically identify gaps, mergers and possible cooperation on study items with mutual benefits across multiple verticals.

- The decision to organise under this initiative more focused vertical workshop meetings, does not exclude the possibility of other larger mixed and even international events elsewhere to complement; however, based on feedback received during and since the event, such an expanded scope was not seen as the most effective means to drive concrete action by involved in parties within 3GPP in comparison to the focused ‘Working Group’ style approach to be adopted.
- It was also advised by 3GPP representatives that the 5G Vertical group focus on the three major themes to be covered in current and future releases, namely: Industrial IoT and Time-Sensitive; Sidelink Requirements; and Ultra-Reliable Low Latency Communication (URLLC).

Another key takeaway of the workshop was the need to make future workshops more technically oriented and to increase vertical industry coverage, as well as produce an inputs document. These points have both been taken on board for the 2nd Workshop.

2nd 5G Vertical User Workshop

The 2nd 5G Vertical User Workshop is taking place 9-10 July in Rome. To boost technical inputs and networking, the workshop is co-located with the SA6 meeting in the same venue.

Key features include:

- An extended number of vertical industries targeted:
 - Maritime.
 - Rail.
 - Automotive and transportation (Continental, as a 3GPP newcomer).
 - Aviation/drones.
 - Farming.
 - Healthcare.
- A dedicated session to help verticals maximise impacts from standardisation inputs with the resources available to them, reviewing current processes and looking for ways to lower entry barriers.
- Dedicated sessions with SA6 to understand work on mission-critical applications, pinpointing horizontal issues been tackled that are relevant across diverse verticals.
 - A dedicated slot on common requirements and complementary with each topic presented by a selected “champion”, namely the leaders of co-hosting MRPs and EU standards specialists.
- Four reports:
 - Outcomes & Report to PCG & TSG.
 - Agreed action points moving forward.
 - Report for 5G IA Board & other SDOs, comprising a full report and Executive Summary.

All aspects of the workshop will be put in the public domain.

The latest version of the agenda is in Annex -2, Section 9.

3 3GPP

3.1.1 Organisational Overview and Partnerships

The 3rd Generation Partnership Project (3GPP) is the primary body for developing technology specifications for cellular networks. It started with 3G (hence its name), and has evolved toward 5G in its 20-year history. 3GPP brings together seven telecommunications standard development organisations: ARIB: Association of Radio Industry and Business³ (Japan); ATIS: Alliance for Telecommunications Industry Solutions⁴ (US); CCSA: China Communications Standards Association (China); ETSI: European Standards Organisation⁵; TSDSI: Telecommunications Standards Development Society (India)⁶; TTA: Telecommunications Technology Association (South Korea)⁷; TTC: Telecommunications Technology Committee (Japan)⁸. These are known as organisational partners and with ATIS, ARIB, CCSA and ETSI officiating the Project Coordination Group (PCG), which is the highest decision-making body in 3GPP.

3GPP also coordinates a group of Market Representation Partners (MRPs), comprising 5G-ACIA⁹; 5G Automotive Association¹⁰ (5GAA); 5G Americas¹¹; 5G Infrastructure Association¹²; Broadband India Forum¹³; Cellular Operators Association of India¹⁴ (COAI); CTIA¹⁵; EMEA Satellite Operators Association (ESOA)¹⁶; GCF¹⁷; GSA¹⁸; GSMA¹⁹; IPV6 Forum²⁰; NGMN Alliance²¹; Public Safety Communication Europe (PSCE) Forum²²; Small Cell Forum²³; TCCA²⁴; TD Industry Alliance²⁵; Wireless Broadband Alliance²⁶.

³ https://www.arib.or.jp/english/std_tr/index.html.

⁴ <https://www.atis.org/>.

⁵ <https://www.etsi.org/>.

⁶ <https://tsdsi.in/>.

⁷ https://www.tta.or.kr/eng/new/standardization/eng_ttastd_main.jsp.

⁸ <https://www.ttc.or.jp/e>.

⁹ <https://www.5g-acia.org/>.

¹⁰ <http://5gaa.org/>.

¹¹ <http://www.5gamericas.org/en/>.

¹² <https://5g-ppp.eu/5g-infrastructure-association/>.

¹³ <https://www.broadbandindiaforum.com/>.

¹⁴ <https://www.coai.com/>.

¹⁵ <http://ctia.org/>.

¹⁶ <https://www.esoa.net/>.

¹⁷ www.globalcertificationforum.org/.

¹⁸ www.gsacom.com.

¹⁹ www.gsmworld.com.

²⁰ www.ipv6forum.com.

²¹ www.ngmn.org.

²² <http://www.psc-europe.eu/>.

²³ www.smallcellforum.org.

²⁴ <https://tcca.info/>.

²⁵ <http://www.tdia.cn/>.

²⁶ <http://www.wballiance.com/>.



Figure 5: 3GPP Market Representation Partners

3.1.2 3GPP Processes: A Guide for Verticals

Although 3GPP is commonly thought of as a standards development organisation, in fact it is not: it “only” develops technical specifications. That is part of the key to the streamlined, agile process for standardising 5G: since 3GPP “only” develops technical specifications, they are not constrained by the often-slower processes of standards development until the technical specifications are considered complete and satisfactory, that is, commercially viable for implementation.

Only then, are they fed into the various regional (e.g. Europe, North America, etc.) standards bodies that make up the partnership. For example, in the case of Europe, this is ETSI (aka The European Telecommunications Standards Institute).

The technical specifications are developed within groups dedicated to specific topics of interest and are all member-driven. The first vertical association to join the MRP was TCCA (The Critical Communications Association), a global organisation that has driven standardisation activities in 3GPP, such as mission critical push to talk. As such, TCCA has paved the way for other vertical associations to join the MRP and help define requirements and work together on common interests. As the MRP has grown in recent times, 3GPP has opened its doors to many other associations (as testified above) to help shape 5G standardisation, by moving along the standardisation trajectory through multi-stage study and work items, which ultimately find their way into 3GPP Releases. As a member-driven organisation, consensus building plays a key role in taking forward the various study and work items across the 3-stage process.

According to former TSG SA chairman, Eric Guttman, “**consolidation and cooperation between verticals is important for success in standards but also to make them commercially viable. Working with 3GPP vendors and operators allows vertical stakeholders to benefit from knowledge and competence and find common interests**” (1st 5G Vertical User Workshop, February 2019). Achieving economies of scale is key, such as reusing functionalities whenever there is a common benefit, is advantageous across diverse verticals (a goal of the 2nd 5G Vertical User Workshop, July 2019). TCCA is a very good case in point, as this association has been active in 3GPP since Release 13 contributing to mission critical push to talk (MCPTT), working towards a more solid architectural foundation over the years to now be a high-respected member of 3GPP.

We will get to the Working Groups in a minute, but first let's look at the process they follow. In many ways, it is indeed like the agile processes we know from software development. For example, the working groups are **self-organising**. There is no top-down leader. They rely on individual members to propose new features or services to work on. This makes it easy to see how and why participation can be important: every vertical player has an equal opportunity to make his voice heard.

Once a new feature or service is proposed, it is voted on at a quarterly plenary meeting, and if it passes, it results in a so-called **Study Item**, which is basically about working out feasibility and architectural options. A report is produced and approved, after which a so-called **Work Item** generally begins to concretise the actual implementation details like interfaces, resulting in a true 3GPP Technical Specification.

So, we have three so-called Stages: **Stage 1** (requirements, where new services are proposed); **Stage 2** (architecture, where the overall concepts and alternatives are worked out); and **Stage 3** (interface specifications / protocols, where the details are nailed down). These stages are often overlapping.

One important thing to note is that the three stages (requirements, architecture, protocols) vary across the TSGs. Let's take the example of TSG-SA, the Systems Aspects set of Working Groups that is often the one that is most relevant to a vertical stakeholder interested in joining:

- Stage 1 (Requirements): SA1 for services; SA5 for Operation, Administration, and Management; SA4 for Media.
- Stage 2 (Architecture): architecture is treated in SA2,2, and 6; and in SA4 and SA5 as above.
- Stage 3 (Protocols): these are treated in SA4 and SA5 as above.

Special aspects of 5G are often treated in separate working groups. For example, the management and network orchestration aspects fall to SA WG5 – Network Management, which specifies the requirements, architecture and solutions for provisioning and management of the network and its services.

Also, similar to an agile process is the fact that technological decisions are not made by some kind of “chief architect”, but rather through the concept of “**collective ownership**” that you see, for example, in Extreme Programming: anybody can reject a contribution or make modifications. Once again, you should hopefully see that there are no insuperable hurdles to participation as an interested vertical.

A final key aspect of the overall 3GPP technical specification process is that it is organised in terms of **releases**, which are iterative, incremental, and generally live in parallel with each other. In practice, this means that 5G evolves quickly, keeping pace with technological progress, but at the same time maintaining the continuity that is so important for orderly commercial evolution.

There are a lot of contributions (so-called Technical Documents or just “TDocs”) out there, but that is part of what the Blueprint created within the 5G-IA Pre-Standardization WG, where Global5G.org keeps a track on progress with the support of 3GPP delegates within the group, and the group's chair. Other parts of the Blueprint include a tracker of inputs from 5G PPP projects, an activity that started in phase 1, and which Global5G.org now supports directly.

3.1.3 Tip Boxes on 3GPP Groups and How to get started

Here are some tips from 3GPP, shared during the 1st 5G Vertical User Workshop.

Getting Started - Tips for Verticals from TSG SA Chairman, Georg Mayer

- 1) **Play an active role:** send long-standing delegates to 3GPP meetings.
Follow your work through all stages and WGs. Don't stop at Stage 2.
- 2) **Get organised:** get your interest group together and agree on what you need, then go to 3GPP.
Talk with other verticals, vendors and operators to support each other on common goals.
Understand the processes.
- 3) **Support others in their activities:** Even if it is not your main focus, contribute to work that is driven by others.
- 4) **Plan ahead:** Split your big ideas into work items that be handled in a release.

Most importantly of all – Don't get frustrated.

Tip Box 1: Tips for Verticals from 3GPP

As we'll see later, the 3GPP MRP-hosted 5G vertical user workshops are designed to help verticals navigate the 3GPP standardisation process and lower entry barriers to input contributions.

We start with three tip boxes with some essential information before moving on to a more technical look at each working group.

A quick zoom in on 3GPP-RAN

TSG RAN is responsible for Stage 2 specification of the Radio Access Network. Radio and edge architecture falls under three RAN WGs: RAN WG1 – Radio Layer 1; RAN WG2 – Radio Layer 2 and Radio Layer 3 RR; RAN WG3, responsible for the overall UTRAN/E-UTRAN architecture and protocol specifications. RAN WG1 focuses on the physical layer of the radio interface, while RAN WG2 is in charge of the Radio Interface architecture and protocols.

Tip Box 2: Quick Look at 3GPP RAN

A quick zoom in on 3GPP-SA2 and SA4

The 3GPP SA WG2 – Architecture covers aspects related to Architecture with a system-wide view, deciding on how new functions integrate with existing network entities. Its main responsibility is developing Stage 2 of the 3GPP network. It picks up on work within SA WG1 – Service Requirements, identifying the main functions and entities of the network, how these entities are linked to each other and the information they exchange. SA WG2 outputs are used as inputs for groups in charge of defining the precise format of messages in Stage 3 (for the protocols).

SA WG4 (Codec) also contributes to the overall architecture. Part of its mandate includes quality evaluation, end-to-end performance, and interoperability aspects with existing mobile and fixed networks, from a Codec perspective.

Tip Box 3: Quick Look at 3GPP SA

A quick zoom in on 3GPP-CT1 and 4

Core and transport architecture falls under SA WG2 and CT WG1. CT1 is responsible for specifications that define the User Equipment (UE), as well as CT4, dealing with the Bearer Independent Architecture, among other aspects.

Tip Box 4: Quick Look at 3GPP CT

3.1.4 3GPP Working Groups: A technical Overview

Now that we have seen an overview of the basic 3GPP specification development process, let's take a closer look at the Working Groups, to see what's there. This is where we get a bit more technical but technical knowledge within verticals is a key aspect to be able to contribute.

3GPP Working Groups are structured around three Technical Specification Groups, each with its own Working Groups. We start with a few formalities and then zoom in on some key points about the main WGs already supporting or relevant to verticals.

- **Radio communications** (officially "TSG-RAN" as in "Radio Access Network"): responsible for defining functions, requirements and interfaces. RAN conceptually resides between a device (e.g. mobile phone, computer, any remotely controlled machine) and provides connection with its core network.
 - **3GPP-RAN1**: Radio Layer 1, dealing with specifications of the physical layer of the radio interface, e.g. user equipment (UE).
 - **3GPP-RAN2**: Radio Layer 2 and Radio Layer 3 RR, in charge of the Radio Interface architecture and protocols.
 - **3GPP-RAN3**, responsible for UTRAN/E-UTRAN architecture and specifications of protocols. UTRAN stands for "UMTS Terrestrial Radio Access Network" while E-UTRAN is "Evolved Universal Terrestrial Radio Access". In 3GPP it refers to work items on Long Term Evolution (LTE) in early LTE specifications.
- **Systems and services** (officially "TSG-SA" as in "System Aspects"): responsible for overall architecture and service capabilities of systems based on 3GPP specifications.
 - **3GPP-SA1**: Services, in charge of service and feature requirements applicable to mobile and fixed communications²⁷.

²⁷ <https://www.3gpp.org/specifications-groups/sa-plenary/sa1-services/home>.

- **3GPP-SA2:** Architecture, responsible for developing stage 2 of the 3GPP network based on service requirements from SA 1 and 2, identifying main functions and entities and how they link together²⁸.
- **3GPP-SA3:** Security, creating security and privacy features for LTE so they can be evolved and expanded for 5G²⁹.
- **3GPP-SA4:** Codec (a device or program that compresses data to enable faster transmission and decompresses received data). Responsible for specifications for speech, audio, radio, video, and multimedia codec, as well as quality evaluation, end-to-end performance and interoperability aspects with existing mobile and fixed networks (from codec perspective)³⁰.
- **3GPP-SA5:** Telecom Management, specifying the requirements, architecture and solutions for provisioning and managing the network, e.g. RAN, CN³¹.
- **3GPP-SA6:** Mission-critical Applications, having a dual role. SA6 defines, evolves and maintains stage 2 technical specifications for application layer functional elements and interfaces supporting critical communications and other applications based on stage 1 service requirements from SA1, as well as other application layer aspects³².
- **The core network** (officially “TSG-CT” as in “Core network and Terminals”), responsible for specifying terminal interfaces (logical and physical), terminal capabilities (e.g. execution environments) and the core network part of 3GPP systems. The core network is the part that offers services to customers interconnected by the access network³³.
 - **3GPP-CT1:** MM/CC/SM, responsible for the 3GPP specifications that define the User Equipment - Core network L3 radio protocols and Core network side of the lu reference point³⁴.
 - **3GPP-CT3:** Interworking with external networks, specifying bearer capabilities for circuit and packet switched data services, and necessary interworking functions; end-to-end QoS for UMTS core network³⁵.

²⁸ <https://www.3gpp.org/specifications-groups/sa-plenary/sa2-architecture/home>.

²⁹ <https://www.3gpp.org/specifications-groups/sa-plenary/sa3-security/home>. See also, https://www.3gpp.org/news-events/1975-sec_5g.

³⁰ <https://www.3gpp.org/specifications-groups/sa-plenary/sa3-security/home>.

³¹ <https://www.3gpp.org/specifications-groups/sa-plenary/sa5-telecom-management/home>.

³² <https://www.3gpp.org/specifications-groups/sa-plenary/sa6-mission-critical-applications/home>.

³³ <https://www.3gpp.org/specifications-groups/ct/plenary/home>.

³⁴ <https://www.3gpp.org/specifications-groups/ct/ct1-mm-cc-sm-lu/home>.

³⁵ <https://www.3gpp.org/specifications-groups/ct/ct3-interworking-with-external-networks/home>.

- 3GPP-CT4: MAP/CAMEL/GTP/BCH/SS, standardising stage 2 and 3 aspects within the core network (e.g. supplementary services, basic call processing, mobility management within the core, a.o.³⁶
- 3GPP-CT6: Smart card application aspects, responsible for developing and maintaining specifications and associated test specifications and the interface with the mobile terminal³⁷.

There is plenty inside each of these so-called Technical Specification Groups (TSGs), but you can see the general outlines of the separation of interest: the radio interface, the core network and its management, and various aspects of the systems and applications running over the network ranging from service requirements to specific applications like multimedia. Even at this highest level, any vertical new to 3GPP needs to be able to navigate its way into the right group in which to participate and promote its requirements and interests.

3.1.5 Special role of 3GPP-SA6

But the most relevant and important Working Group for aspiring vertical participants is SA6, which is dedicated to a topic that is especially dear to Global5G.org: mission-critical services, which can cut across many kinds of vertical applications and which have received much attention in Global5G.org activities and deliverables.

Recently (Spring 2019), the SA6 Working Group has expanded its own cross-cutting vertical mission even more explicitly. With a view toward expanding the reach of 5G across many industries, the WG has decided to help to harmonize many aspects of 5G across sectors. The figure illustrates the four major initiatives undertaken by SA6 and how they fit together in an overall concept.

³⁶ <https://www.3gpp.org/specifications-groups/ct/ct4-map-camel-gtp-bch-ss-trfo-ims-gup-wlan/home>.

³⁷ <https://www.3gpp.org/specifications-groups/ct/wg6>.

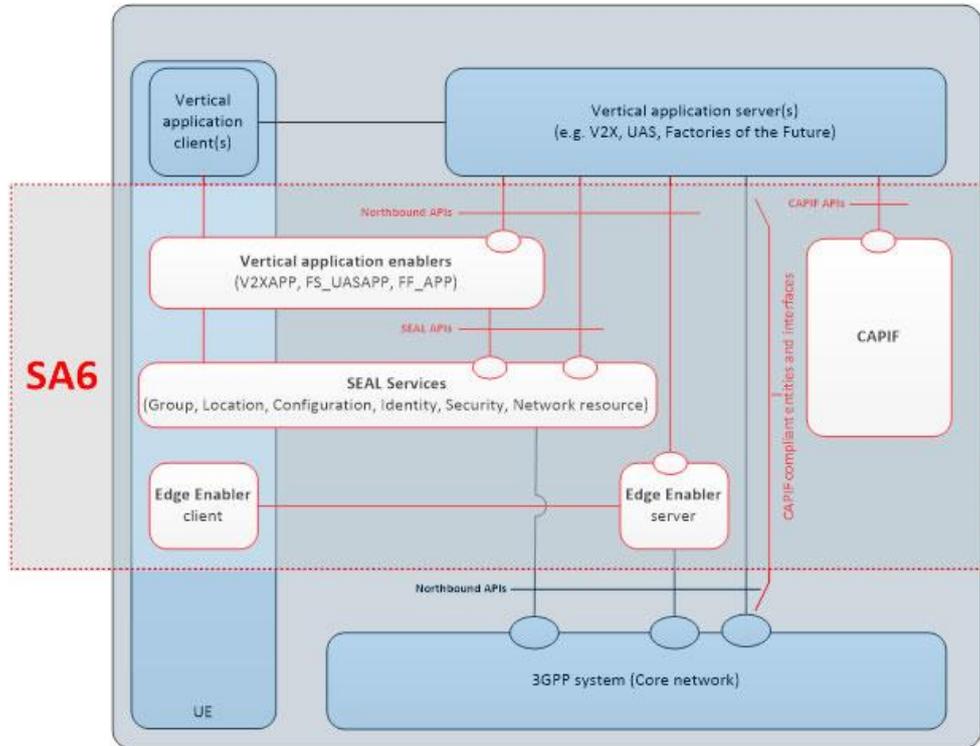


Figure 6: Positioning of SA6 in 3GPP (Source: 3GPP)

First of all, SA6 has launched an initiative to ensure that vertical applications across diverse sectors share a single-entry point for API-related aspects that they have in common, such as discovery, authentication, and authorization. The initiative, called the Common API Framework (CAPIF), has been integrated with (Northbound) APIs defined by other working groups and is available to ensure a harmonized approach to APIs for verticals.

Similarly, a second initiative called the Service Enabler Architecture Layer for Verticals (SEAL) also strives to make available reusable, common services needed by applications regardless of the vertical, such as group management, configuration management, location management, identity/key management, and network resource management.

Positioned on top of the SEAL layer is a growing set of sector-specific “enabling” services, which are at a higher level than SEAL services, but serve the same purpose of providing common, reusable capabilities for applications within their specific sector. For example, the application layer support for V2X services, called V2XAPP, provides key capabilities such as V2X message distribution, service continuity, application resource management, dynamic group management and VAE server APIs over the Evolved packet system (EPS) capabilities. The same kind of application layer support is now being developed in SA6 for other sectors, including drones and manufacturing.

Finally, acknowledging that edge computing will be essential to many vertical applications, the SA6 has launched an initiative to define an architecture for enabling edge applications, called FS_EDGEAPP – once again, ensuring a harmonized approach to the creation of edge-enabled vertical applications.

As you can see, then, SA6 is rapidly becoming an important “go-to” place for vertical stakeholders looking to participate in and benefit from 3GPP standardisation. Although it is certainly not the only working group dealing with verticals, it has made the availability of harmonised capabilities across multiple vertical sectors an explicit goal of its work.

3.2 ETSI

ETSI has standardisation activities that specify requirements and potential enablers or building blocks for an overall 5G system. This includes key aspects such as, virtualisation, multi-access edge computing, management and network orchestration. Several ETSI Industry Specification Groups (ISGs), Technical Committees (TCs) and projects work collaboratively with 3GPP, and, in some case, give direct input to 3GPP.

The most relevant ones in the context of this report are:

- **Experiential Network Intelligence** (ENI ISG – Industry Specification Group) is defining a Cognitive Network Management architecture using closed-loop AI mechanisms that leverage context-aware and metadata-driven policies to improve the operator experience³⁸.
- **Networks Functions Virtualisation** (NFV ISG) defines requirements and architecture for the virtualisation of network functions while also dealing with the technical challenges of network virtualisation. Outputs of this group include also pre-standardisation studies, detailed specifications, and Proof of Concepts³⁹.
- **Open Source MANO** is an ETSI-hosted project developing an Open Source NFV Management and Orchestration (MANO) software stack aligned with ETSI NVF⁴⁰.
- **Multi-access Edge Computing** (MEC ISG) aims for a standardised, open environment that will enable the efficient and seamless integration of applications from vendors, service providers, and third-parties across multi-vendor MEC platforms⁴¹.
- **TC on Satellite Earth Stations and Systems** (SES) focuses on all aspects related to satellite earth stations and systems. This includes satellite communication systems, services and applications; as well as, satellite navigation systems and services; all types of earth stations and earth station equipment⁴².
- **Zero Touch network and Service Management** (ZSM ISG) specifies horizontal (i.e., cross-domains, cross-technology) and vertical (i.e., cross layers) end-to-end network and service management reference architecture to enable agile, efficient and qualitative management and full automation of emerging and future networks and service. Full automation in this

³⁸ <https://www.etsi.org/technologies/experiential-networked-intelligence>.

³⁹ <https://www.etsi.org/technologies/nfv>.

⁴⁰ <https://osm.etsi.org/>.

⁴¹ <https://www.etsi.org/technologies/multi-access-edge-computing>.

⁴² <https://www.etsi.org/committee/1412-ses>.

context includes automation of delivery, deployment, configuration, assurance and optimisation of networks and services⁴³.

Additionally, ETSI organises Plugtests to ensure interoperability of products and services, as well as provide feedback to different standardisation groups (both within and outside ETSI). For instance, the ETSI Mission Critical Push to Talk (MCPTT) Plugtests events⁴⁴ have provided a platform to demonstrate the interoperability of a wide range of implementations utilising different scenarios and test cases based on 3GPP Mission Critical Services

3.3 ITU

The International Telecommunication Union (ITU) coordinates the development of global telecommunications standards in addition to fostering the growth and sustained development of the sector and ensuring universal access. The activities of ITU activities are focused on three core sectors, namely: Standardization (ITU-T) which standardizes global telecommunications; (2) Radiocommunications (ITU-R) sector, which manages the international RF spectrum and satellite orbit resources, and Development (ITU-D) that supports the ITU mission to ensure equitable, sustainable and affordable access to ICT. The ITU sectors include Study Groups (SGs), which assemble global experts for the development of international standards commonly referred to as ITU-x Recommendations where x stands for T, D or R depending on the ITU sector concerned. In terms of the scope of this report, SGs of interest include:

- ITU-T SG13 - Future networks, which focuses on IMT-2020 (that defined the requirements for 5G networks and services), cloud computing and trusted network infrastructure⁴⁵.
- ITU-T SG15 - Networks, Technologies and Infrastructures for Transport, Access and Home [10]. This SG gives special consideration to the changing telecommunication environment towards future networks, including networks that supporting the evolving needs of mobile communications (IMT-2020)⁴⁶.

3.4 IETF

The Internet Engineering Task Force (IETF) is an open SDO for Internet-related technologies⁴⁷. In the context of 5G, primarily to understand how 5G affects Internet Technologies. To this end, it also collaborates with 3GPP. Key areas that IETF is focusing on includes network slicing, MEC, machine learning at network level, and Low Power IoT Networking (LPWA). The technical work in IETF is performed in Working Groups (WGs), which are organised based on topic into several technical areas. The IETF standards produced are then published as Internet Drafts which may evolve into accepted

⁴³ <https://www.etsi.org/technologies/zero-touch-network-service-management>.

⁴⁴ The Plugtest event name has been changed from MCPTT to MCX (Mission Critical Services) to increase the event scope as vendors are moving beyond voice.

⁴⁵ <https://www.itu.int/en/ITU-T/studygroups/2017-2020/13/Pages/default.aspx>.

⁴⁶ <https://www.itu.int/en/ITU-T/studygroups/2013-2016/15/Pages/default.aspx>.

⁴⁷ <https://www.ietf.org/>.

Request for Comment (RFC) documents.

The Common Control and Measurement Plane (CCAMP) WG is standardising a common control plane and a separate common measurement plane for non-packet technologies (e.g. optical cross-connects, microwave links, TDM switches etc.) found in the Internet and in the telecom service provider networks⁴⁸.

Within the IETF framework there is a possibility to organise pre-WG technical discussions in the form of Birds of a Feather (BoF) sessions at IETF meetings. While some of the BoF may eventually evolve into fully-fledged WGs, others simply provide a discussion forum on topics of possible interest within the IETF community. Common Operations and Management on network Slices (coms) is one example of a BoF that appears later among the standards contributions of this report.

3.5 Other standards Organisations

Several other standards organisations and associations are relevant to 5G standardisation, including phase 2 projects tracked through the 5G-IA Pre-Standardization WG and cross-WG collaborations (e.g. 5G PPP Architecture WG). These include:

- **DVB** (Digital Video Broadcasting): an industry-led consortium of the world's leading digital TV and technology companies that develops open technical specifications for the delivery of digital TV and other broadcast services⁴⁹. These DVB specifications are ultimately translated into international standards by major standards organisations like ETSI. The specification work is carried out in DVG WGs, such as, DVB TM-IPI, responsible for the development of technical specifications for the delivery and discovery of DVB services over IP networks.
- The **Open Networking Foundation** (ONF) is a user-driven non-profit organisation focused on promoting the adoption of SDN through open standards development⁵⁰.
- **MulteFire Alliance** specifies an LTE-based technology for operating in unlicensed & shared spectrum⁵¹.
- **MEF** (formerly known as the Metro Ethernet Forum) is an industry alliance specifying agile, assured, and orchestrated communications services across a global ecosystem of automated networks⁵².

⁴⁸ <https://datatracker.ietf.org/wg/ccamp/about/>.

⁴⁹ <https://www.dvb.org/>.

⁵⁰ <https://www.opennetworking.org/>.

⁵¹ <https://www.multefire.org/>.

⁵² <https://www.mef.net/>.

- The **Open ROADM Multi-Source Agreement (MSA)** defines interoperability specifications for Reconfigurable Optical Add/Drop Multiplexers (ROADM). The specifications consist of both Optical interoperability as well as YANG data models⁵³.
- The **NGMN Alliance** is an industry alliance that complements and supports standards bodies like 3GPP, where it serves as an MRP⁵⁴. The Alliance provides a coherent view of requirements of mobile operators for next generation networks with regards to 5G. Specification work takes place through a number of projects. For instance, the NGMN Network Management and Orchestration (NWMO) project has been specifying the requirements for 5G Network and Service Management including Orchestration.

4 Standards impacts

4.1 5G PPP Phase 2 Overall Impacts

One of the primary goals of the task that formed the context of this deliverable was to provide an in-depth analysis of the 5G standardisation landscape with a focus on relevance to verticals and a mapping of 5G PPP contributions working in synergy with the Pre-Standardization WG.

There is little doubt that the most targeted standards organisation is 3GPP, as testified by the figure below, as well as by the main findings for the Architecture WG.

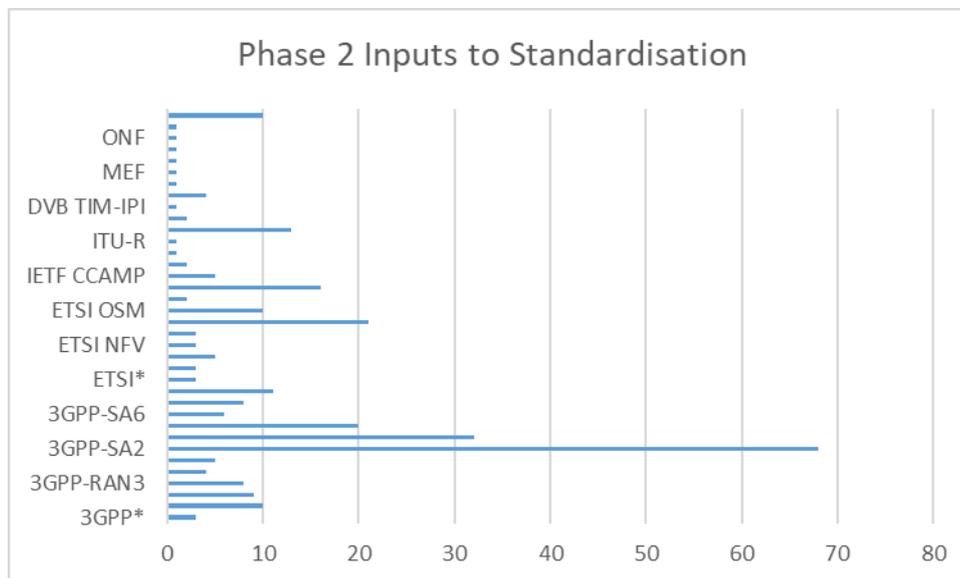


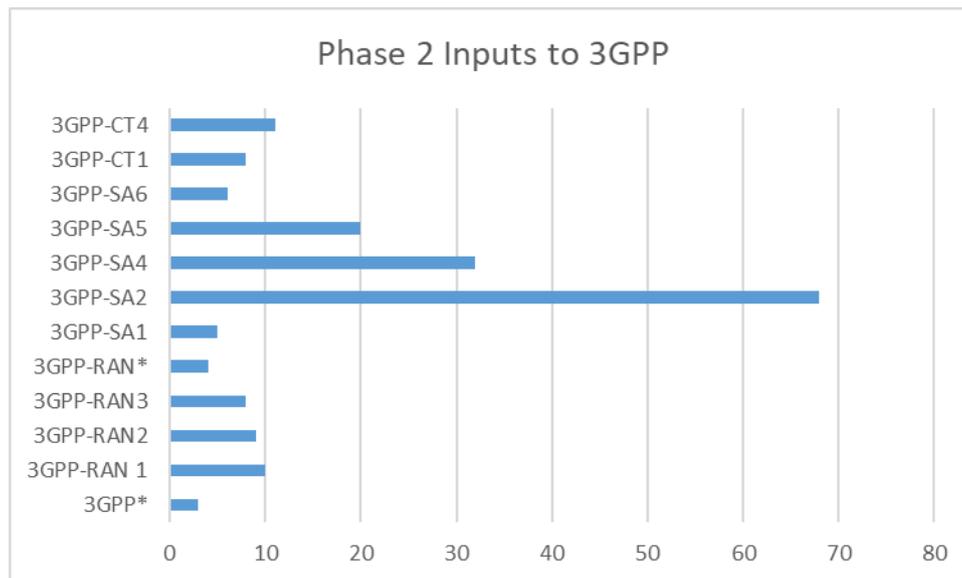
Figure 7: 5G PPP Phase 2 Standardisation Inputs

⁵³ <http://openroadm.org/home.html>.

⁵⁴ <https://www.ngmn.org/home.html>. See also its agreement with ESOA, at the same link.

Out of a total of 295 inputs, 184 are to 3GPP (62%). The 2nd most target organisation id ETSI, with 50 inputs, followed by IETF (50 inputs) and ITU (14 inputs).

Zooming in on 3GPP, we see that the most targeted WG is SA2, with 68 inputs. This is followed by SA4 with 32 inputs and SA5 with 20 inputs. CT4 is on 11 inputs and RAN1 on 10. Compared with phase 1, we can spot a key shift from RAN (142/317 tracked inputs) towards SA WGs. It should also be noted that in phase 2 not a single input has been contributed to SA3 – security, which in phase 13 received 13 inputs. Likewise, ETSI TC CYBER has also fallen off the radar, with 3 inputs in phase 1 vs. 0 in phase 2.



4.1.1 Standards Impacts for 5G Architectures

A sub-set of data from phase 2 was collected and analysed via the 5G PPP Architecture WG, counting a total of 219 contributions, thereby confirming that 5G architectures has been a big focus in this phase of the 5G PPP.

Here, we summarise the main findings that have fed into the new white paper of the Architecture WG: Section 7 on standards impacts.

The standards contributions reported come in many formats including technical or specification documents, presentations, white papers, proof of concepts, interoperability tests, source code and so on. For each contribution, details are provided of the contributing project, standards organisation targeted, title or short description of the contributions and status of the contribution at the time of writing. The table below shows the complete listing over the four categories analysed.

| Number of contributions per architectural area | |
|--|------------|
| Overall architecture | 70 |
| Radio and edge architecture | 41 |
| Core and transport architecture | 58 |
| Management and orchestration architecture | 50 |
| Total | 219 |

Table 2: Number of contributions reported by 5G PPP Phase 2 project per architectural area

The table clearly shows that the most targeted category is the overall architecture, with similar numbers of inputs for the other three categories.

The bullet points below show the breakdown for 3GPP SA Working groups, with a high concentration to SA2, followed by SA4, in relation to the overall architecture.

- 3GPP SA2 – Architecture: 40 contributions.
- 3GPP SA4 – Codec: 25 contributions.
- 3GPP SA6 – Mission-critical applications: 3 contributions
- 3GPP SA1 – Services: 1 contribution
- 3GPP SA5 – Telecom Management: 1 contribution.

The 5G PPP Phase 2 project contributions related to radio and edge architectures were mostly to WGs of the 3GPP TSG RAN, many focusing on 5G NR enhancements for V2X and multimedia broadcast. Additional standards contribution for the multimedia broadcast are also targeted towards the DVB industry alliance. In the case of edge architectures, ETSI (MEC and NFV ISGs) have been for main venues for MEC-related contributions primarily on 5G architectural enablers for MEC applications.

The bullet points below show the breakdown for 3GPP RAN:

- 3GPP RAN 1: 10 contributions.
- 3GPP RAN 2: 8 contributions.
- 3GPP RAN 3: 6 contributions.
- 3G RAN (WG not specified): 4.

Contributions for 5G core network architectures have mostly been targeted towards WGs of 3GPP TSGs SA and CT. As for contributions related to transport architectures, those for microwave/millimetre wave transport have been towards IETF, whereas, those contributions for optical-based transport have targeted mostly ITU-T and IETF.

The bullet points below show the inputs for 3GPP:

- 3GPP CT1: 8 contributions.
- 3GPP CT4 – 11 contributions.
- 3GPP SA 2 – 21 contributions.

Contributions targeting MANO have been mostly to ETSI via the ZSM ISG, but also to the NFV ISG and OSM project. Outside of ETSI, there have been contributions to 3GPP mostly targeting the SA WG5 (Telecom Management), which specifies architecture and solutions for provisioning, charging and management of mobile networks (including RAN and core) and their services.

The bubble graphs below show the inputs across the four categories, giving a consolidated analysis of the raw inputs gathered from the Phase 2 projects. The analyses are complemented by the complete table of contributions provided in Section 8, compiled by Global5G.org. As already reported to the Pre-

Standardization WG, the cross-WG collaboration has been a very positive experience, ensuring visibility for both Global5G.org and the 5G PPP, with new data to share with 3GPP and ETSI, among other standards organisations. This will remain a source of ongoing updated information throughout the duration of Global5G.org and afterward through participation in Full5G.

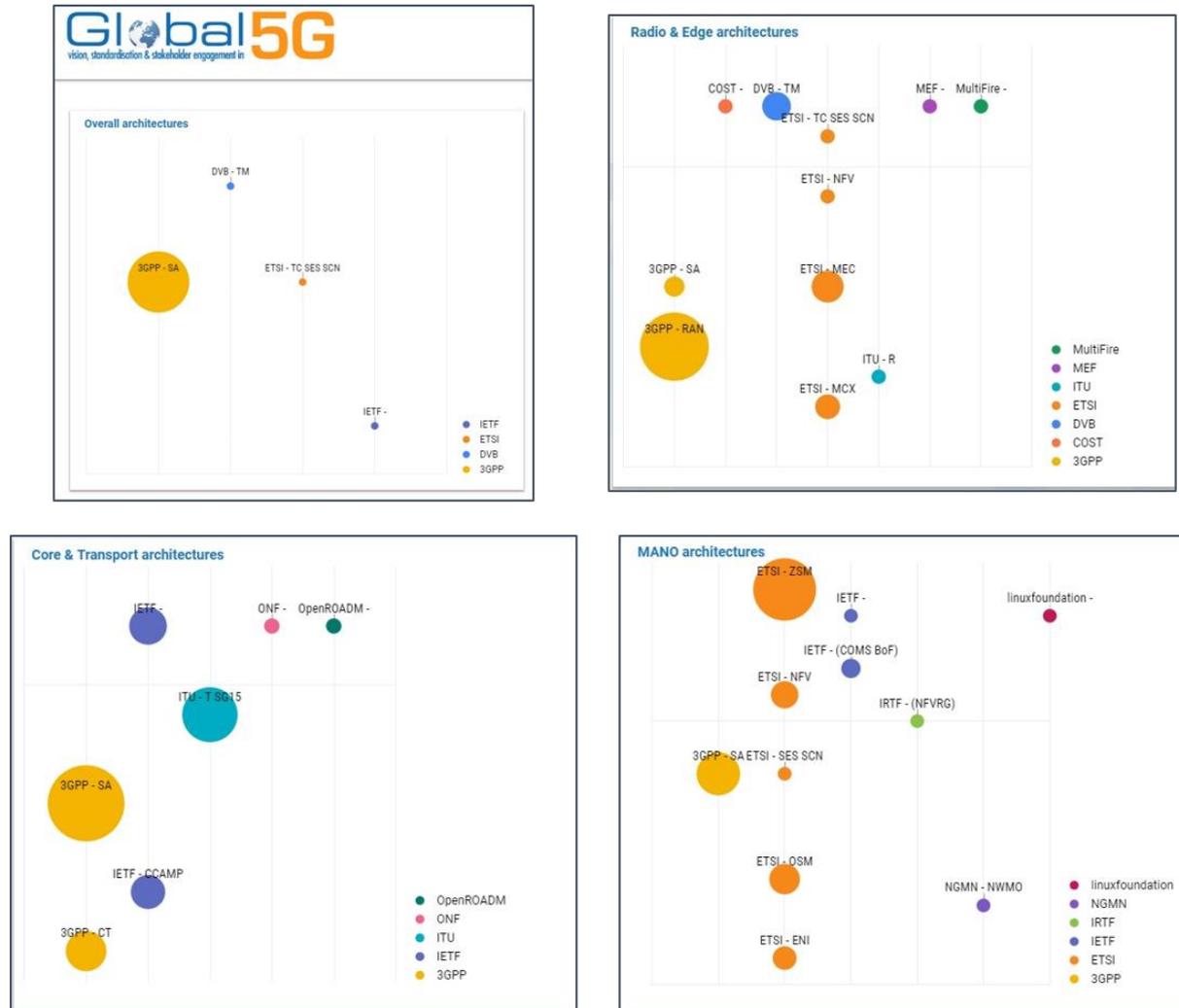


Figure 8: 5G PPP phase 2 inputs to architecture standardisation

4.1.2 3GPP Verticals in Releases 16 and 17

The figure below shows the breakdown for verticals in Rel-16 and -17. Out of the 83 items tracked 34 come from EU-based companies, with the top 3 being: Nokia (10); Thales Alenia Space (6) and Ericsson (5).

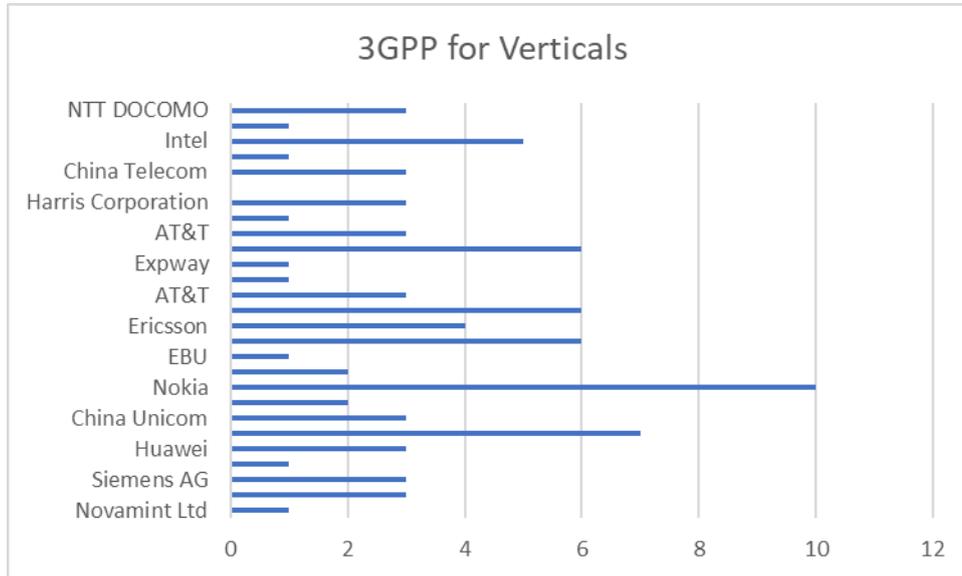


Figure 9: 3GPP Work Plan 06.2019 - Verticals

5 Prospective Guide to Standardisation for Verticals

In the reviewer report after the Year 1 review of Global5G.org, the reviewers noted the significant problems that vertical stakeholders often have in orienting themselves within the standardisation landscape. The discussion resulted in a recommendation to prepare a kind of introductory guide to the standards groups, as part of the Global5G.org online Standards Tracker.

The development of the Standards Tracker is taking place side-by-side with the 3GPP MRP Task Force. We are using the insights and practical tips in the 3GPP MRP, Global 5G.org is now extending and enhancing the first draft of its online Standards Tracker. The 2nd workshop will be a “guinea pig” for pointing participants to dedicated items and to collect feedbacks for further improvements and new entries.

Standard

[Home](#) » [Standard](#)

Global5G.org facilitates the scale-up of research results and **vertical industries** requirement transfer to the standardisation process, working with the **5G PPP Pre-standardization Working Group** to identify and map relevant research results and leverage on consolidated links with all **relevant SDOs** to encourage vertical industries to contribute to the standardisation process, including cross-vertical issues, such as security and privacy.

Critical Medical Applications

3GPP Item, Feasibility Study on Communication Services for Critical Medical Applications: targeting radiologists and surgeons for more reliable, efficient and flexible critical medical applications.

3GPP 5G-Health Organization: 3GPP WG SA1

[Learn more](#)

Practical Guide on 3GPP and its work

guide to go here

3GPP Guide Organization: 3GPP

Figure 10: Global5G.org Online Standards Tracker

5.1 Standardisation Guide for Verticals

Any form of telecommunications needs standards. Two parties can only communicate if they speak the same language. So, nobody using telecommunications in their business can escape a relationship with standards.

The standards development ecosystem can be confusing and intimidating for a vertical stakeholder. This is all especially true in the context of 5G, where technological innovation is evolving so rapidly that the standards development process has to be particularly streamlined and agile in order to keep pace. The temptation is just to stay away from standards development, and just use whatever there is as it becomes available.

But 5G vertical stakeholders need to participate in the standards development process. Standards are also about much more than mere interoperability. They can affect the architecture, performance characteristics, and capabilities – in short, nearly every aspect – of your products and services. Furthermore, inadequate or missing standards can hamper your ability to build and sell your most innovative products and services. They can also weaken the entire 5G ecosystem, hampering its growth and thus indirectly damaging not only your prospects but those of the entire 5G community.

Each vertical brings its own special set of needs to 5G, and standards developing organisations are incapable of second-guessing the requirements of such a vast and diverse group. They need the direct participation of the vertical stakeholders, collaborating with their peers to ensure that the capabilities, interfaces, and performance characteristics they need are accounted for.

In addition, be sure to utilize the Global5G.org Standardisation Tracking tools to assist you in finding the best way to follow and contribute to standards and protect your own interests within the growing 5G ecosystem.

6 Conclusions and Next Steps

6.1 Main Conclusions

The following set of major conclusions may be drawn from the discussion in the body of this report:

- 5G standardisation for vertical industries is well underway. However, more can be done to increase vertical industry participation in the processes.
- To this end, the new task Force with the 3GPP MRPs can help drive participation, leveraging the experiences and guidance of the MRPs and high-profile representatives in 3GPP. In practice, this collaborative work translates into a new event series aimed at easing the way, with guidance and mentoring alongside joint activities with SA6.
- Based on the on-going discussions and interactions with the MRP, Global5G.org is re-shaping its online Standards Tracker, bringing in tips from the 3GPP and MRP via the Task Force.

- Relevant entries will be added to the Tracker from future interactions and workshops, including any feedback received during the 2nd 5G Vertical User Workshop, which will be used as a “guinea pig” for the 1st release.
- 5G PPP projects are actively contributing to 5G standardisation, especially architectures, as demonstrated by the analysis for the Pre-Standardization WG and work with the Architecture WG. This was a fruitful collaboration that can be repeated in the future, while also recommending similar approaches across the 5G PPP.
- Efforts within the Pre-Standardization WG to on-board new members and animate the group has helped create a vibrant community, now working ever more closely together to share insights and bring in new knowledge.
- These impacts are communicated to the EC also via the annual PMRs, where Global5G.org will the 5G-IA (Chairman and Head Office).

6.2 Further Work

Global5G.org personnel are participating in a number of 5G PPP Working Groups that are actively pursuing several of the topics that were discussed in this report, and will provide valuable inputs for updates and extensions to the relevant sections of the document.

7 References

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8 Agenda for the 1st 5G Vertical User Workshop

8.1 5G Vertical User Workshop

8.2 Initiative of 3GPP Market Representatives Partners (MRP):



Open to other 5G Verticals

12th February 2019, 12:00 to 13 February 2019, 14:00

Marriott Brussels GP
Brussels, Belgium

5G networks are intended to bring a new disrupting ecosystem, where actors such as the Vertical industries (automotive, industry 4.0, health, media, security & public safety, energy) will be involved alongside the telecom operators, manufacturers, SMEs and

Research Institutes. Therefore, there is an increasing need to involve this wider spectrum of industries to optimally capture end-user requirements and contribute to the 3GPP standardization process. 3GPP’s working groups operate bottom-up based on partners contributions, and 3GPP would notably benefit from further developing the role and usefulness of 5G vertical industries as Market Representatives.

This 5G Vertical Users Workshop, as an initiative of a subset of European 3GPP Market Representatives (MRP), aims to establish a collaborative event for strategic dialogue between industries and 3GPP by exchanging on future needs and upcoming standard developments. The workshop as a result, aims to produce a report shared directly to 3GPP Project Coordination Group (PCG) as a mean to stimulate and facilitate greater involvement of the 5G Vertical Users in the 3GPP process.

The agenda for this 5G Vertical Users Workshop therefore focuses on: 5G Vertical profiles, needs and expectations; Current 5G activities including 5G Projects and Standardisation activity; 5G Rel.16&17 3GPP Standardisation, and a Draft Report based on the workshop finding to be communicated to 3GPP PCG.

This workshop will be organised on invitation only. Each of the 5G Vertical associations are asked to nominate their representatives. Results of the workshop will be made public through the 5G Vertical association websites.

Registrations is available at https://www.surveymonkey.co.uk/r/5G_WS_Brussels



| 5G Vertical User Workshop Agenda | |
|--|---|
| Day 1 | |
| Moderated by Balazs Bertenyi, TSG RAN Chairman, 3GPP | |
| 12:00 | Registration & Welcome Lunch |
| 13:00 | 5G Vertical Tour de Table: Profile, Needs and Expectations <ul style="list-style-type: none"> • David Lund, Public Safety Communication Europe (PSCE) • Maxime Flament, CTO, 5G Automotive Association (5GAA) • Andreas Müller (Robert Bosch GmbH), Chairman, 5G Alliance for Connected Industries and Automation (5G-ACIA) |

| | |
|-------|---|
| | <ul style="list-style-type: none"> • <i>Speaker to be confirmed, EMEA Satellite Operators Association (ESOA)</i> • <i>Pierre-Yves Le Lann, 5G Business at Orange Labs</i> • <i>Antonio Arcidiacono, CTO and CIO, European Broadcasting Union (EBU)</i> <p>Q&A and Discussions are encouraged throughout this session.</p> |
| 15:30 | Coffee Break |
| 15:50 | <p>5G Vertical Activity Tracking followed by Q&A Session</p> <ul style="list-style-type: none"> • <i>PSCE Activity Tracking, David Lund</i> • <i>5G-PPP Verticals and Standards Tracker Tool – 5G-IA / Global5G.org</i> • <i>Pan-European Trials Roadmap, 5G-IA</i> • <i>5G-PPP Phase 2 Projects focusing on standardisation, 5G-IA Pre-standardization WG</i> |
| 17:00 | <p>Roundtable Discussion: 5G Projects</p> <ul style="list-style-type: none"> • <i>Current 5G project contributions to 3GPP standardisation process?</i> • <i>How to boost contributions of EU 5G Vertical Projects to 3GPP Standardisation process?</i> |
| 18:00 | Close of day 1 |
| 19:00 | Networking Dinner, Location tbc |

| | |
|---|---|
| Day 2 | |
| Co-moderated by 5G-IA, 5GAA, 5G-ACIA and PSCE | |
| 08:45 | Morning Coffee |
| 09:00 | <p>5G Rel.16 (and further) 3GPP standardization process</p> <ul style="list-style-type: none"> • <i>Rel-16 identify commonalities for verticals –</i> • <i>Rel-17 will be an incremental release. 5G vertical platform may have more chance to actively contribute.</i> • <i>Tour de rapporteurs of 5G Rel.16 3GPP study items: V2X, IIOT, Unlicensed NR, Positioning and URLLC enhancement</i> |
| 10:45 | Coffee Break |
| 11:00 | <p>Interactive Session on Next Steps and Agreements on Report to 3GPP PCG</p> <ul style="list-style-type: none"> • <i>How to accelerate the creation of 5G vertical platform and consolidate the 5G vertical requirements</i> • <i>Relation between MRP – 5G Verticals? Should 5G verticals become active as MRPs?</i> • <i>How to engage 5G verticals and projects in 3GPP standards process?</i> • <i>How to reach consensus on key enabling technologies? Which ones?</i> |
| 13:00 | Lunch |
| 14:00 | End of meeting |

9 Annex 2 – Agenda for the 2nd 5G Vertical User Workshop

9.1 2nd 5G Vertical User Workshop

9.2 Initiative of 3GPP Market Representation Partners (MRPs):



Open to other 5G Verticals

9 July 2019, 10:00 to 10 July 2019, 16:00

Eurostars Roma Aeterna Hotel

Rome, Italy

5G networks are intended to bring a new disrupting ecosystem, where actors such as the Vertical Industries (automotive, Industry 4.0, health, media, security & public safety, energy) will be involved alongside the telecom operators, manufacturers, SMEs and research institutes. Therefore, there is an increasing need to involve this wider range of industries to optimally capture end-user requirements and contribute to the 3GPP standardization process. 3GPP's working groups operate bottom-up based on partners contributions, and 3GPP would notably benefit from further developing the role and usefulness of 5G vertical industries as Market Representation Partners.

This 5G Vertical Users Workshop, as an initiative of a subset of European 3GPP Market Representation Partners (MRPs), is designed to help vertical industries become part of the standardisation process, create new synergies and obtain guidance from 3GPP by exchanging on future needs and upcoming standards developments.

A key outcome of the workshop will be boosting contributions to 5G standardisation across verticals and 5G projects, with the current focus in 3GPP on Release 17. The agenda for this 5G Vertical Users Workshop therefore focuses on: 5G vertical requirements, technical priorities, and common interests. The workshop as a result, aims to produce a report ("Input Document") shared directly with the 3GPP Project Coordination Group (PCG) detailing concrete action points around greater involvement of the 5G Vertical Users in the 3GPP process.

This workshop will be organised on invitation only. Each of the 5G Vertical associations are asked to nominate their representatives. Results of the workshop can be made public through the 5G Vertical association websites.



| 2nd 5G Vertical User Workshop Agenda | |
|---|--|
| Day 1 | |
| 09:30 | Registration & Welcome Coffee |
| 10:00 | <p>A look through 3GPP Study Items relevant for vertical industries 3GPP representative, moderated by Georg Mayer, TSG SA Chairman</p> <ul style="list-style-type: none"> • <i>How to boost contributions of 5G Vertical Industries to 3GPP Standardisation process</i> |
| 11:00 | Coffee Break |
| 11:15 | <p>5G Vertical Tour de Table: MRP Priorities – a technical view point, e.g.</p> <ul style="list-style-type: none"> • <i>Automotive: Maxime Flament, CTO, 5GAA</i> • <i>Automotive: Andreas Andrae, Wireless Communication Research, Continental</i> • <i>Industrial Internet of Thing: Andreas Mueller, Chairman 5G-ACIA</i> • <i>Public Safety: David Lund, President PSCE</i> • <i>Utilities: Julian Stafford, Technical Director, EUTC</i> • <i>Transportation - Rail: Ingo Wendler, UIC and Amine Didioui, SNCF</i> • <i>Maritime: Omar Frits Eriksson, Deputy Secretary-General, International Association of Lighthouse Authorities (IALA)</i> • <i>Non-terrestrial networks: ESOA</i> • <i>Media and Broadcasting: Antonio Arcidiacono, EBU</i> • <i>Farming: Christophe Gossard, John Deere</i> • <i>Healthcare: Brian O'Connor, Chair of the European Connected Health Alliance and/or Connecta Health Alliance</i> • <i>Aviation/drones</i> <p>Q&A and Discussions are encouraged throughout this session.</p> |
| 13:00 | Buffet Lunch |
| 14:00 | Interactive Session on 3GPP processes – lowering entry barriers for verticals, maximising impacts with resources available |

| | |
|-------|--|
| 15:30 | Coffee Break |
| 16:00 | Creating Interest Groups amongst verticals Interactive session <ul style="list-style-type: none"> • How to accelerate the creation of 5G vertical platform and consolidate the 5G vertical requirements • How to reach consensus on key enabling technologies? Which ones? |
| 18:00 | Close of Day 1 |
| 19:30 | Buffet/Informal Dinner with SA6 Guests |
| | Venue tbc |

| | |
|---|--|
| Day 2 | |
| Moderated by Balazs Bertenyi, TSG RAN Chairman | |
| 08:45 | Morning Coffee |
| 09:00 | Interactive session with 3GPP SA6 – multiple vertical perspectives Overview of on-going work in SA6 + interactive discussions on architecture/stage 2 |
| 10:45 | Coffee Break |
| 11:00 | Interactive mapping common requirements and complementarities 3GPP moderator + vertical champion on each subject <ul style="list-style-type: none"> • Sidelink & C-V2X <ul style="list-style-type: none"> ○ Predictive QoS, Maxime Flament, CTO 5GAA ○ SA6 representative • URLLC & time-sensitive networking • Positioning • Non-public networks (non-spectrum-related) • Nonterrestrial Networks • MBMS |
| 13:00 | Buffet Lunch |
| 14:00 | Interactive Session: Agreements, Action Items and Next Steps <ul style="list-style-type: none"> • Outcomes & Report to PCG & TSG • Agreed action points moving forward • Report for 5G IA Board & other SDOs |
| 16:00 | End of Workshop |

10 Annex 3 - List of 5G-PPP Phase 2 Contributions to Standards

The following table of contributions of Phase 2 projects was compiled by Global5G.org partner Aalto through interaction with the projects during the Winter and Spring of 2019 and are current up to that time frame.

| Project Name | Targeted SDO | Title or short description of contribution related to overall architecture | Status |
|--------------|--------------|---|-----------------------|
| 5G CAR | 3GPP-SA6 | New key issue on interaction between V2X application and 3GPP system for V2X application and QoS adaptation | S6-180782 |
| 5G CAR | 3GPP-SA6 | Solution proposal for key issue #13 communicating application requirements from the V2X application server | S6-181048 |
| 5G CAR | 3GPP-SA6 | Procedures for service negotiation | S6-181352 |
| 5G MoNArch | 3GPP-SA2 | New Key Issue: Network slicing for eV2X | S2-180147 |
| 5G MoNArch | 3GPP-SA2 | 23.726: FS_ETSun (Enhancing Topology of SMF and UPF)/23.726 Scope | S2-181046 |
| 5G MoNArch | 3GPP-SA2 | NWDA-assisting E2E QoS Assurance | S2-183634 |
| 5G MoNArch | 3GPP-SA2 | Solution for AF Data Exposure to/from NWDAF | S2-183637 |
| 5G MoNArch | 3GPP-SA2 | Use case on UE-driven analytics sharing | S2-185816 (S2-185290) |
| 5G MoNArch | 3GPP-SA2 | Key issue for NWDA-assisted determination of areas with oscillation of network conditions | S2-185277 |
| 5G MoNArch | 3GPP-SA2 | Solution for Key Issue 4: interactions with OAM for network data collection | S2-185279 |
| 5G MoNArch | 3GPP-SA2 | Updates on text of Key Issue 1 and general architectural assumptions with exposure to OAM | S2-185276 |
| 5G MoNArch | 3GPP-SA2 | Solution for updated key issue 1: exposure of analytics to OAM | S2-185278 |
| 5G MoNArch | 3GPP-SA2 | Discussion paper and pCR on V2X slicing | S2-185475 |
| 5G MoNArch | 3GPP-SA2 | Solution for key issue 3: interactions with 5GS NFs/AFs for data collection | S2-185280 |
| 5G MoNArch | 3GPP-SA2 | Update to the general framework for 5G network automation (TR 23.791) | S2-186271 |
| 5G MoNArch | 3GPP-SA2 | TR 23.742: Solution for NF reliability | S2-186151 |
| 5G MoNArch | 3GPP-SA2 | New SID on enhanced support of vertical and LAN services | S2-186182 |
| 5G MoNArch | 3GPP-SA2 | Key Issue: UE-driven analytics sharing mechanisms to 5GC | S2-187264 (S2-186919) |
| 5G MoNArch | 3GPP-SA2 | UC and KI for KI4 Interactions with OAM for Analytics Exposure | S2-186668 |
| 5G MoNArch | 3GPP-SA2 | New Solution to Key Issue #3: Data Collection by subscription to NFs/AFs | S2-186346 |
| 5G MoNArch | 3GPP-SA2 | Solution: UE-driven analytics sharing | S2-188512 (S2-187903) |
| 5G MoNArch | 3GPP-SA2 | Solution for Data Collection from OAM using Existing SA5 Services | S2-188263 |
| 5G MoNArch | 3GPP-SA2 | Integration of the 5G System in the TSN network | S2-188459 |

| Project Name | Targeted SDO | Title or short description of contribution related to overall architecture | Status |
|----------------|--------------|---|-----------------------|
| 5G MoNArch | 3GPP-SA2 | Update to SID: Study of enablers for network automation for 5G | S2-189047 |
| 5G MoNArch | 3GPP-SA2 | TS 23.501 CR0987: CR for TS 23.501 Clarifications NWDaf Discovery and Selection | S2-1902521 |
| 5G MoNArch | 3GPP-SA2 | TS 23.288: Remove the FFS for AF registration during Data Collection procedure | S2-1902398 |
| 5G MoNArch | 3GPP-SA2 | TS 23.288: Analytics exposure to AF via NEF | S2-1902395 |
| 5G MoNArch | 3GPP-SA2 | TS 23.502 CR1060: NEF service for NWDaf analytics | S2-1902524 |
| 5G MoNArch | 3GPP-SA2 | TS 23.501 CR0964: NEF service for NWDaf analytics | S2-1902397 |
| 5G MoNArch | 3GPP-SA2 | 23.501 CR1258: Clarifications NWDaf Discovery and Selection | S2-1903964 |
| 5G MoNArch | 3GPP-SA2 | 23.502 CR1298: Extensions to NRF Services | S2-1903965 |
| 5G MoNArch | 3GPP-SA2 | P-CR TS 23.288: Clarification of FFS on Analytics Exposure to AFs via NEF | S2-1903966 |
| 5G MoNArch | 3GPP-SA2 | P-CR TS 23.288: Clarifying Flexible AF Registration | S2-1904011 |
| 5G MoNArch | 3GPP-SA2 | TS 23.501 CR1299: Extending Exposure Capability to support Analytics Framework | S2-1903968 |
| 5G MoNArch | 3GPP-SA2 | TS 23.502 CR1300: Updating NEF and NRF Services to Support AF Available Data Registration | S2-1903999 |
| 5G TRANSFORMER | 3GPP-SA2 | New Key Issue: Identify scenarios when Network Slices cannot coexist within a single PLMN | S2-183925 / S2-183923 |
| 5G XCAST | 3GPP-SA4 | Study on V2X Media Handling and Interaction | S4-170715 |
| 5G XCAST | 3GPP-SA4 | SAND for MBMS | S4-170719 |
| 5G XCAST | 3GPP-SA4 | New WID on Usage of CAPIF for xMB API | S4-180283 |
| 5G XCAST | 3GPP-SA4 | New WID on FEC and ROHC activation for GCSE over MBMS (FRASE) | S4-180285 |
| 5G XCAST | 3GPP-SA4 | FS_MBMS_IoT_Timeplan | S4-170579 |
| 5G XCAST | 3GPP-SA4 | Skeleton for TR 26.850 MBMS for IoT v. 0.0.1 | S4-170582 |
| 5G XCAST | 3GPP-SA4 | Pseudo-CR-MBMS IoT | S4-170634 |
| 5G XCAST | 3GPP-SA4 | Pseudo-CR on use case for FS_MBMS_IoT | S4-AH1746 |
| 5G XCAST | 3GPP-SA4 | Pseudo-CR on device analysis for FS_MBMS_IoT | S4-AH1747 |
| 5G XCAST | 3GPP-SA4 | Pseudo-CR on overview of LwM2M for FS_MBMS_IoT | S4-AH1748 |
| 5G XCAST | 3GPP-SA4 | Pseudo-CR on MBMS profiles for FS_MBMS_IoT | S4-171006 |
| 5G XCAST | 3GPP-SA4 | Pseudo-Update CoAP overview with block-wise transfer | S4-171205 |
| 5G XCAST | 3GPP-SA4 | Pseudo-Solutions for File Repair procedure using CoAP | S4-171206 |
| 5G XCAST | 3GPP-SA4 | Pseudo-Binary FDT for FS_MBMS_IoT | S4-171207 |
| 5G XCAST | 3GPP-SA4 | pCR 26.881: Performance evaluation of AL-FEC and MCS dimensioning | S4-180128 |
| 5G XCAST | 3GPP-SA4 | pCR 26.850: Binary data formats for MBMS IoT | S4-180180 |
| 5G XCAST | 3GPP-SA4 | pCR 26.850: Solution for announcement during wake-up periods | S4-180075 |
| 5G XCAST | 3GPP-SA4 | pCR 26.850: Solution for announcement of critical data delivery | S4-180181 |
| 5G XCAST | 3GPP-SA4 | pseudo CR to TR26.850 - ASN.1 binary format for reception report message | S4-180534 |
| 5G XCAST | 3GPP-SA4 | ASN.1 binary FDT instance format | S4-180455 |

| Project Name | Targeted SDO | Title or short description of contribution related to overall architecture | Status |
|--------------|-----------------|--|---------------------------------|
| 5G XCAST | 3GPP-SA4 | PseudoCR - Solution for service announcement procedures | S4-180537 |
| 5G XCAST | 3GPP-SA4 | pCR Evaluation of file repair solutions | S4-AHI799 |
| 5G XCAST | 3GPP-SA4 | Discussion on the low-end profile for MBMS IoT | S4-AHI800 |
| 5G XCAST | 3GPP-SA4 | pCRs to TR 26.850 | S4-AHI801 |
| 5G XCAST | 3GPP-SA4 | Information document on "Trials, Tests and Projects Relating to 5G Broadcast" | SP-180296 |
| 5G XCAST | DVB TM-IPI | Adaptive Media Streaming Over IP Multicast | A176 |
| 5G XCAST | IETF | Hypertext Transfer Protocol (HTTP) over multicast QUIC | draft-pardue-quic-http-mcast-02 |
| 5G XCAST | 3GPP | pCR 26.501 consumption report function to UE Media Functions | S4-190471 |
| 5G XCAST | 3GPP | pCR 26.501 Corrections on consumption report function to UE Media Functions | S4h190830 |
| 5G XCAST | 3GPP | MCDATA File Distribution support over xMB | S4-180879 |
| SAT5G | 3GPP-SA1 | Study on using Satellite Access in 5G (TR 22.822) | In-progress |
| SAT5G | 3GPP-SA2 | WI "FS_5GSAT_ARCH": Seamless integration of satellite and/or HAPS (High Altitude Platform Station) systems into 5G system; TR 23.737 | In-progress |
| SAT5G | 3GPP-SA5 | Study on Access Traffic Steering, Switch and Splitting support in the 5G system architecture | In-progress |
| SAT5G | ETSI TC-SES SCN | WI DTR/SES-00405; Seamless integration of satellite and/or HAPS (High Altitude Platform Station) systems into 5G system; TR 103 611 | In-progress |

| Project Name | Targeted SDO | Title or short description of contribution related to radio and edge architecture | Status |
|--------------|--------------|---|-------------------------------|
| 5G CAR | 3GPP-RAN2 | Mobility challenges for NR V2X platooning | R2-1900606 |
| 5G CAR | 3GPP-RAN2 | Validity area for NR Sidelink resource allocation in V2X communications | R2-1900604 |
| 5G CAR | 3GPP-RAN2 | Discussion on Connection-based versus Connectionless NR Sidelink | R2-1817681 |
| 5G CAR | 3GPP-RAN2 | NR Sidelink resource allocation for V2X communications | R2-1817680 |
| 5G CAR | 3GPP-RAN2 | Various approaches to SL QoS support in NR V2X | R2-1814465 |
| 5G ESSENCE | ETSI NFV | Participation in ETSI NFV Plugtests | June 2018 and June 2019 |
| 5G ESSENCE | MulteFire | Deployment models | In progress |
| 5G ESSENCE | ETSI ISG MEC | Contribution to ETSI white paper No. 30 <i>MEC in an Enterprise Setting: A Solution Outline</i> | Published |
| 5G ESSENCE | ETSI ISG MEC | Contribution to ETSI white paper No. 20 <i>Developing Software for Multi-Access Edge Computing</i> | Published |
| 5G ESSENCE | ETSI MCX | Participation to MCX/MPCTT Plugtest events, collaborate in preparation of MCX/MPCTT test cases and test | June 2018, Dec 2018-Jan 2019, |

| Project Name | Targeted SDO | Title or short description of contribution related to radio and edge architecture | Status |
|----------------|--------------|---|--|
| | | architecture | and March 2019. Planned September 2019. |
| 5G ESSENCE | 3GPP SA6 | Developing the study on Mission Critical working group CT1 | Revision of 3GPP TS 24.281 |
| 5G ESSENCE | 3GPP SA1 | Definition of requirements to support maritime communication services over 3GPP system related to MC services | Revision of 3GPP TS 36.579-2 |
| 5G ESSENCE | MEF | Involvement in the MEF 3.0 "5G Implementation project" and an implementation of a PoC demonstrated at the MEF 18 event. | MEF 18 event October-November 2018 |
| 5G MoNArch | 3GPP-RAN3 | Slice information exchange over NG | In progress, R3-180479 |
| 5G MoNArch | 3GPP-RAN3 | Slice information exchange over NG | In progress, R3-181104 |
| 5G MoNArch | 3GPP-RAN3 | Available slice information exchange for NG mobility | In progress, R3-181904 |
| 5G MoNArch | 3GPP-RAN2 | Support for SRB duplication with CA | Accepted, R2-1803233 |
| 5G MoNArch | 3GPP-RAN2 | RLC handling upon duplication deactivation | Accepted, R2-1803318 |
| 5G MoNArch | 3GPP-RAN3 | Slice support of IAB nodes | Noted with consensus, R3-186014 |
| 5G TRANSFORMER | ETSI MEC | Instantiating a Network Slice integrating MEC applications, using 3GPP elements | Accepted |
| 5G TRANSFORMER | ETSI MEC | Creation of WI ETSI MEC by 5G-TRANSFORMER | Agreed |
| 5G TRANSFORMER | ETSI MEC | Requirements for MEC Systems with 3rd Parties | Presented |
| 5G XCAST | 3GPP-RAN1 | New WID on dedicated 5G MBMS for LTE | RP-171603 |
| 5G XCAST | 3GPP-RAN | New SID Proposal: Study on MBMS for NR | RP-171807 |
| 5G XCAST | 3GPP-RAN | New WID on LTE-based 5G Terrestrial Broadcast | RP-181342 |
| 5G XCAST | 3GPP-RAN | Information document on "Trials, Tests and Projects Relating to 5G Broadcast" | RP-180652 |
| 5G XCAST | 3GPP-RAN1 | Public service broadcaster requirements and background information relevant to LTE-based 5G Terrestrial Broadcast | R1-1810319 |
| 5G XCAST | 3GPP-RAN1 | Scenarios and simulation assumptions for the LTE based 5G terrestrial broadcast gap analysis | R1-1811588 |
| 5G XCAST | 3GPP-RAN1 | Evaluation Results for LTE-Based 5G Terrestrial Broadcast | R1-1812430 |
| 5G XCAST | 3GPP-RAN1 | Evolved Universal Terrestrial Radio Access (E-UTRA); Study on LTE-based 5G terrestrial broadcast | TR36.776 |
| 5G XCAST | 3GPP-RAN1 | Evaluation Results for LTE-Based 5G Terrestrial Broadcast | R1-1902130 |
| 5G XCAST | 3GPP-RAN1 | Network Simulations Regarding the Performance of the CAS | R1-1905330 |

| Project Name | Targeted SDO | Title or short description of contribution related to radio and edge architecture | Status |
|--------------|------------------------------|---|----------------------------------|
| 5G XCAST | 3GPP-RAN1 | Information For Time Variation Models | R1-1905331 |
| 5G XCAST | DVB TM-WIB | Fundamentals of 5G Wideband Broadcasting | TM-WIB0049 |
| 5G XCAST | DVB TM-WIB | Implementation Aspects of 5G Wideband Broadcasting | TM-WIB0050 |
| 5G XCAST | DVB TM-WIB | Methodology Approach to SIC in Network Simulations | TM-WIB0074 |
| 5G XCAST | DVB TM-WIB | Network Simulations with SIC in MFN and SFN | TM-WIB0076 |
| IoRL | ITU-R SM.2422-0, (06/2018) | Visible light for broadband communications | Being presented in late May 2019 |
| IoRL | COST Action CA15104 (IRACON) | Contribution to "Whitepaper on New Localization Methods for 5G" | Presented and published publicly |
| SAT5G | 3GPP-RAN1 | Creation of SI "FS_NR_nonterr_nw on NR"; Title: Study on NR to support non-terrestrial networks, TR38.811 | RP-171450 |
| SAT5G | ETSI TC-SES SCN | Edge delivery in 5G through satellite multicast | In-progress |

| Project Name | Targeted SDO | Title or short description of contribution related to core and transport architecture | Status |
|--------------|--------------|---|------------|
| 5G MoNArch | 3GPP-SA2 | Clarification on key issue: Network slicing for eV2X | S2-183735 |
| 5G MoNArch | 3GPP-SA2 | Updated SID: Study on Enhancement of network slicing | S2-186185 |
| 5G MoNArch | 3GPP-SA2 | LS from FS-eNA to SA5/RAN3 | S2-186667 |
| 5G MoNArch | 3GPP-SA2 | Discussion paper on V2X slicing KI | S2-188307 |
| 5G MoNArch | 3GPP-SA2 | Updates to Impacts and Evaluation of Solution 12 | S2-1810696 |
| 5G MoNArch | 3GPP-SA2 | Updates to Solution 1 for Network Data Analytics Feedback | S2-1860695 |
| 5G MoNArch | 3GPP-SA2 | Solution for KI#2 on Analytics Exposure to AF | S2-1810694 |
| 5G MoNArch | 3GPP-SA2 | Solution to NWDAF assisting traffic routing using MEC information | S2-1810334 |
| 5G MoNArch | 3GPP-SA2 | Updates to Solution 19 | S2-1812173 |
| 5G MoNArch | 3GPP-SA2 | Overall Conclusion for Key Issue 4 | S2-1812175 |
| 5G MoNArch | 3GPP-SA2 | Updates to Solution 12 | S2-1812174 |
| 5G MoNArch | 3GPP-SA2 | Updates to Solution 24 | S2-1812172 |
| 5G MoNArch | 3GPP-SA2 | Adding reference to new TS 23.288 in TS 23.502 | S2-1901040 |
| 5G MoNArch | 3GPP-SA2 | TS 23.288 skeleton for 5G analytics framework | S2-1901041 |
| 5G MoNArch | 3GPP-SA2 | CR for TS 23.501 based on conclusion of eNA TR 23.791 | S2-1901042 |
| 5G MoNArch | 3GPP-SA2 | Adding Selected Solutions #12 from eNA to TS 23.288 | S2-1900949 |

| Project Name | Targeted SDO | Title or short description of contribution related to core and transport architecture | Status |
|----------------|-----------------|--|--------------------|
| 5G MoNArch | 3GPP-SA2 | Adding Selected Solutions #24 from eNA to TS 23.288 | S2-1901024 |
| 5G MoNArch | 3GPP-SA2 | TS 23.288: Update to Data Collection from OAM | S2-1902400 |
| 5G MoNArch | 3GPP-SA2 | P-CR TS 23.288: Setup of Network Map for Data Collection | S2-1903814 |
| 5G MoNArch | 3GPP-SA2 | Update to NF Load Analytics Procedures | S2-1903917 |
| 5G MoNArch | 3GPP-SA2 | Update to Network Performance Analytics Procedures | S2-1903939 |
| 5G TANGO | IETF | YANG models for ACTN TE Performance Monitoring Telemetry and Network Autonomics | Draft |
| 5G TRANSFORMER | IETF (CCAMP WG) | draft-ietf-ccamp-microwave-framework-07.txt : 'A framework for Management and Control of microwave and millimeter wave interface parameters' | Draft |
| 5G TRANSFORMER | IETF (CCAMP WG) | Finite state machine YANG model augmentation for Transponder Reconfiguration | Draft |
| 5G TRANSFORMER | 3GPP SA2 | Network slices cannot co-exist within a single PLMN | In-progress |
| 5G TRANSFORMER | 3GPP SA2 | Clarification on the establishment procedure of proxied MPTCP connections | In-progress |
| 5G TRANSFORMER | 3GPP SA2 | 23.502 CR1053 (Rel-16, 'B'): Slice Specific Secondary Authentication | In-progress |
| 5G TRANSFORMER | 3GPP SA2 | 23.501 CR0951 (Rel-16, 'B'): Slice Specific Secondary Authentication | In-progress |
| 5G TRANSFORMER | IETF (CCAMP WG) | A YANG Data Model for Microwave Topology | Draft |
| 5G TRANSFORMER | IETF (CCAMP WG) | A framework for management and control of microwave and millimeter wave interface parameters | IETF RFC 8432 |
| 5G TRANSFORMER | IETF (CCAMP WG) | A YANG Data Model for Microwave Radio Link | Draft |
| 5G XCAST | 3GPP-CT4 | Support for PWS-IWF | C4-184445 |
| 5G XCAST | 3GPP-CT1 | Removal of Extended Repetition-Period IE for NG-RAN | C1-183005 |
| 5G XCAST | 3GPP-CT1 | PWS in NR -clause 9.1.3.5 | C1-181689 |
| 5G XCAST | 3GPP-CT1 | PWS in NR -clause 9.2.0 | C1-181690 |
| 5G XCAST | 3GPP-CT1 | PWS in NR -clause 9.2.X | C1-181711 |
| 5G XCAST | 3GPP-CT1 | PWS in NR -clause 9.3.X | C1-181746 |
| 5G XCAST | 3GPP-CT1 | Service Based Interface for 5G system | C1-181647 |
| 5G-PICTURE | ITU-T SG15 | The Requirements of Mobile-optimized OTN(M-OTN) | in progress |
| 5G-PICTURE | ITU-T SG15 | FEC for FlexO-LR interfaces rates of 200 Gbit/s and 400 Gbit/s | in progress |
| 5G-PICTURE | ITU-T SG15 | OTU4 long-reach interface | ITU-T Rec. G.709.2 |

| Project Name | Targeted SDO | Title or short description of contribution related to core and transport architecture | Status |
|--------------|--------------|---|---|
| blueSpace | ITU-T SG15 | Include latency as parameter in Recommendations | Presented to SG |
| blueSpace | ITU-T SG15 | Correlation OTDR for accurate fibre delay measurement | Presented to SG |
| blueSpace | ITU-T SG15 | Modifications to G.697 to include fibre propagation delay | Presented to SG |
| blueSpace | ITU-T SG15 | Proposal to initiate 25G application in G.698.4 | Presented to SG |
| blueSpace | ITU-T SG15 | Adding group delay as a parameter into G.671 | Presented to SG, draft revised version of G.671 contains proposed changes |
| METRO-HAUL | ONF | Open Transport API (TAPI) | Complete (v2.1), In Progress (v.2.2) |
| METRO-HAUL | ITU-T SG15 | Variance for Gaussian noise emulation | Approved |
| METRO-HAUL | ITU-T SG15 | EVM and OSNR penalty measurement for draft revised G.698.2 | Approved |
| METRO-HAUL | ITU-T SG15 | EVM calculation for G.698.2 | Approved |
| METRO-HAUL | ITU-T SG15 | Text proposal for draft G.698.2 defining modulation format of 100G coherent signals | Approved |
| METRO-HAUL | ITU-T SG15 | Equalizer parameters for reference receiver in G.698.2 | Approved |
| METRO-HAUL | IETF | YANG data model for Flexi-Grid Optical Networks | Draft |
| METRO-HAUL | IETF | YANG models for VN & TE Performance Monitoring Telemetry and Scaling Intent Autonomics | Draft |
| METRO-HAUL | IETF | YANG data model for Flexi-Grid media-channels | Draft |
| METRO-HAUL | IETF | A Framework for Enhanced Virtual Private Networks (VPN+) Service | Draft |
| METRO-HAUL | IETF | Applicability of Abstraction and Control of Traffic Engineered Networks (ACTN) to Network Slicing | Draft |
| METRO-HAUL | OpenROAD M | OpenROADM v2 Device Whitepaper | Released |

| Project Name | Targeted SDO | Title or short description of contributions related to management and orchestration architecture | Status |
|--------------|-----------------|--|---------------------------|
| 5G City | ETSI OSM | Initial implementation of vimconn_fos for Eclipse fog05 VIM | Accepted |
| 5G ESSENCE | linuxfoundation | unikraft | In-progress |
| 5G MoNArch | NGMN NWMO | Cross-slice user stories | Completed |
| 5G MoNArch | 3GPP SA5 | Add Data Analytics Management Service for Network Slice and Network Slice Subnet | Accepted, S5-183560 |
| 5G MoNArch | 3GPP SA5 | Add example of functional management architecture | Accepted, S5-183409 |
| 5G MoNArch | ETSI ZSM | Proposal on the overview and architecture of ZSM framework | Accepted, ZSM(18)000236r2 |
| 5G MoNArch | ETSI ZSM | Proposed ZSM Architecture Diagram | Accepted, |

| Project Name | Targeted SDO | Title or short description of contributions related to management and orchestration architecture | Status |
|--------------|--------------|--|---------------------------|
| | | Changes | ZSM(18)000325r2 |
| 5G MoNArch | ETSI ZSM | Automated discovery of services offered by a management domain | Accepted, ZSM(18)000364r2 |
| 5G MoNArch | ETSI ZSM | Definition of integration fabric | Accepted, ZSM(18)000378r1 |
| 5G MoNArch | ETSI ZSM | Management service related to network service orchestration | Accepted, ZSM(18)000445 |
| 5G MoNArch | ETSI ZSM | Management service related to service performance assurance | Accepted, ZSM(18)000446 |
| 5G MoNArch | ETSI ZSM | Add domain performance report service | Accepted, ZSM(18)000450 |
| 5G MoNArch | ETSI ZSM | Architecture Diagram Changes | Accepted, ZSM(18)000501 |
| 5G MoNArch | ETSI ZSM | Clarify capability of domain orchestration and some clarifications | Accepted, ZSM(18)000442 |
| 5G MoNArch | 3GPP SA5 | YANG definitions for network slicing NRM | Accepted, S5-185532 |
| 5G MoNArch | 3GPP SA5 | Update the UC and requirements for performance data streaming | Accepted, S5-186429 |
| 5G MoNArch | ETSI ENI | Use case on "Elastic resource management and orchestration" | Accepted, ENI(18)000162r1 |
| 5G MoNArch | ETSI ENI | Proof of concept on "Elastic network slice management" | Accepted, ENI(18)000175r4 |
| 5G MoNArch | 3GPP SA5 | Update NRM IRP Solution Set to support slice priority | Accepted, S5-187439 |
| 5G MoNArch | 3GPP SA5 | Update NRM root IOCs to support slice priority | Accepted, S5-187370 |
| 5G MoNArch | 3GPP SA5 | Solution for performance data streaming | Accepted, S5-187372 |
| 5G MoNArch | ETSI ZSM | Add capabilities to Analytics Service | Accepted, ZSM(18)000596r2 |
| 5G MoNArch | ETSI ZSM | Add E2E SLA Management | Accepted, ZSM(18)000601r2 |
| 5G MoNArch | ETSI ZSM | Policy management service for E2E | Accepted, ZSM(19)00021 |
| 5G MoNArch | ETSI ZSM | Update of the analytics service | Accepted, ZSM(19)000121 |
| 5G MoNArch | ETSI ZSM | Discussion on mapping the ZSM002 list of services | Accepted, ZSM(19)000122 |
| 5G MoNArch | ETSI ZSM | Update mapping ZSM002 to SA5 | Accepted, ZSM(19)000192 |
| 5G MoNArch | 3GPP SA5 | pCR 28.861 Add Multi-dimensional Resource Optimisation | Accepted, S5-193221 |
| 5G MoNArch | 3GPP SA5 | Update NRM requirement to support SBA management | Accepted, S5-193396 |
| 5G MoNArch | ETSI ZSM | ZSM002 update of service feasibility check | Accepted, ZSM(19)000195r2 |

| Project Name | Targeted SDO | Title or short description of contributions related to management and orchestration architecture | Status |
|----------------|-----------------|---|---------------------------|
| 5G MoNArch | ETSI ZSM | ZSM002 Management communication service to solve pub-sub debate | Accepted, ZSM(19)000032r3 |
| 5G MoNArch | ETSI ZSM | Informative examples on ZSM deployment architectures | Accepted, ZSM(19)000203r2 |
| 5G TANGO | ETSI OSM | Novel packaging formats aligned with ETSI NFV SOL004 | Part of OSM FIVE |
| 5G TANGO | ETSI OSM | Slice Manager allowing the deployment of 5G Network Slices with OSM | Part of OSM FIVE |
| 5G TANGO | IETF | Methodology for VNF Benchmarking Automation | Draft |
| 5G TANGO | ETSI ZSM | Zero-touch Network and Service Management (ZSM); Reference Architecture | Work in progress |
| 5G TANGO | ETSI ZSM | Zero-touch Network and Service Management (ZSM); End to end management and orchestration of network slicing | Work in progress |
| 5G TRANSFORMER | IETF (COMS BoF) | Problem Statement of Common Operation and Management of Network Slicing | Draft |
| 5G TRANSFORMER | ETSI NFV | contribution to ETSI NFV IFA013: NFVIFA(18)000955 | In-progress |
| 5G TRANSFORMER | ETSI NFV | Change re quests IFA 013 | Approved |
| 5G TRANSFORMER | IRTF (NFVRG) | IPv6-based discovery and association of Virtualization Infrastructure Manager (VIM) and Network Function Virtualization Orchestrator (NFVO) | Draft |
| 5G TRANSFORMER | IETF (COMS BoF) | COMS Architecture | Draft |
| MATILDA | ETSI OSM | Contributions are related to the support for multi-site deployments as well as the support of runtime policies enforcement. | Work in progress |
| METRO-HAUL | ETSI OSM | WAN Infrastructure Manager (WIM) Plugin Model | Complete - Release 5 |
| NGPaaS | ETSI NFV | DGR/NFV-IFA029, PaaS with capability supporting container service | Accepted |
| NGPaaS | ETSI NFV | DGR/NFV-IFA029, Adding container infrastructure management to appendix | Accepted |
| SAT5G | 3GPP SA5 | SI FS_5G_SAT_MO | In-progress |
| SAT5G | ETSI-SES SCN | WI DTR/SES-00446 | In-progress |
| SLICENET | ETSI ZSM | PoC on zero-touch network slices management and orchestration on a multi-domain environment | In progress |
| SLICENET | ETSI ENI | PoC proposal for Predictive Fault management of E2E Multi-domain Network Slices | Accepted, ENI |