



“5G for Drone-based Vertical Applications”

D5.4 – Report on contribution to standardisation and international fora – 2nd Version

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Executive Summary

5G!Drones D5.4 deliverable aims at reporting standardisation activities and contributions at international fora achieved during the whole duration of the project, from M1 (June 2019) to M42 (November 2022). It is an update of D5.3, which covered the activities during the first period from M1 (June 2019) to M18 (November 2020). In the present document, we recall some outstanding contributions from the first period, extracted from D5.3, and describe new contributions and progress achieved from M19 to M42.

Since the beginning of the project, 5G!Drones consortium has established a complete landscape of the Standards Development Organization (SDOs) as well as various associations relevant within 5G!Drones frameworks, including 3GPP, GSMA, GUTMA, ACJA, CEPT/ECC, ASTM, ETSI, IETF, BNAE, Drone REGIM, 5G-PPP (Pre standardization working group), ITU-T, FAA, SESAR JU, NASA, EUROCAE, EASA, ASD-STAN, ISO, LAANC, ARC.

Members of 5G!Drones consortium have not only closely monitored standardisation activities of these associations, so that the project technical work packages could take into account relevant outcomes, but have also actively contributed, providing inputs within the context of the project. In particular, they are interested in the following topics: RAN slicing for NR, Multi-RAT Dual-Connectivity, NR Sidelink relay, industrial IoT and URLLC support for NR, UE power saving enhancements for NR, Access to Network Slice, Mission Critical Services, Remote Identification of UAS, Data Service for coverage information, MOPS and MASPS development for cellular, Multi-access Edge Computing, Air traffic management, and others detailed in this document.

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List of Abbreviations

3GPP	3 rd Generation Partnership Project
5G	5 th Generation Cellular Technology
5G-PPP	5G Infrastructure Public Private Partnership
5GS	5G System
5QI	5G Quality Identifier
AAM	Advanced Air Mobility
AAS	Active Antenna System
ACJA	Aerial Connectivity Joint Activity
ADS-B	Automatic Dependent Surveillance Broadcast
AFNOR	Association Française de Normalisation
ANSP	Air Navigation Service Provider
API	Application Programming Interface
APN	Access Point Name
ARC	Aviation Rulemaking Committee
ARIB	Association of Radio Industries and Businesses (Japan)
ARMD	Aeronautics Research Mission Directorate
ASD-STAN	AeroSpace and Defense Industries Association of Europe – Standardization
ASTM	American Society for Testing and Materials
ATIS	Alliance for Telecommunications Industry Solutions (USA)
B5G/6G	Beyond 5G / 6G
BAN	Body Area Network
BNAE	Bureau de Normalisation de l'Aéronautique et de l'Espace
BRID	Broadcast Remote Identification
BS	Base Station
BVLOS	Beyond Visual Line of Sight
C2	Command and Control
C3	Command, Control, Communication
CAA	Civil Aviation Authority
CAPIF	Common API Framework
CCSA	China Communications Standards Association
CEN	European Committee for Standardization
CEPT	European Conference of Postal and Telecommunications Administrations
CORUS	Concept of Operation for European UTM Systems
CP	Control Plane
CR	Change Request (3GPP)

D2D	Device to Device
DAA	Detect And Avoid
DET	DRIP Entity Tag
DIG	Drones Interest Group
DL	Downlink
DPI	Deep Packet inspection
DRIP	Drone Remote Identification Protocol
Drone REGIM	Drone Regulation Implementation (UVS International)
E2E	End-to-End
EASA	European Union Aviation Safety Agency
EC	European Commission
ECC	Electronic Communications Committee
eMBB	Enhanced Mobile Broadband
ERA	Enhanced RPAS Automation
ETSI	European Telecommunications Standards Institute
EU	European Union
EUROCAE	European Organization for Civil Aviation Equipment
FAA	Federal Aviation Administration
FDIS	Final Draft International Standard
FFS	For Further Study (3GPP)
GCS	Ground Control Station
GOF	Gulf of Finland
GPS	Global Positioning System
GSM	Global System for Mobile Communications
GSMA	GSM Association
GTP-C	GPRS Tunneling Protocol Communication
GUTMA	Global UTM Association
HTTP	Hypertext Transfer Protocol
ICAO	International Civil Aviation Organization
ICT	Information and Communication Technologies
IEEE	Institute of Electrical and Electronics Engineers
IESG	Internet Engineering Steering Group
IETF	Internet Engineering Task Force
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IoT	Internet of Things
ISO	International Organization for Standardization
ITU-R	International Telecommunication Union – Radio communication

ITU-T	International Telecommunication Union – Telecommunication Standardization
KPI	Key Performance Indicator
LAANC	Low Altitude Authorization and Notification Capability
LAN	Local Area Network
LS	Liaison Statement (3GPP)
LTE	Long-Term Evolution
MASPS	Minimum Aviation System Performance Standards
MC	Mission Critical
MCX	Mission Critical Services
MEC	Multi-access Edge Computing
MFCN	Mobile/Fixed Communication Networks
MIMO	Multiple Input Multiple Output
mMTC	Massive Machine-Type Communications
MNO	Mobile Network Operator
MOPS	Minimum Operational Performance Standards
NASA	National Aeronautics and Space Administration
NPA	Notice of Proposed Amendment
NR	New Radio
NS	Network Slice
NSI	Network Slice Instance
OGC	Open Geospatial Consortium
OOBE	Out of Band Emission
PLMN	Public Land Mobile Network
QCI	QoS Class Identifier
QoS	Quality of Service
RAN	Radio Access Network
RAT	Radio Access Technology
RF	Radio Frequency
RILTE	Roaming in LTE
RPAS	Remotely Piloted Aircraft System
RTCA	Radio Technical Commission for Aeronautics
SA	System Aspects (3GPP)
SAE International	Society of Automotive Engineers International
SAM	Specific Authentication Method
SDO	Standards Development Organization
SDSP	Supplemental Data Service Providers
SEAL	Service Enabler Architecture Layer
SESAR JU	Single European Sky Air Traffic Management Research Joint Undertaking

SLC	Secure Land Communications
SmartBAN	Smart Body Area Network
SORA	Specific Operations Risk Assessment
SSB	Synchronization Signal Beam
TF	Task Force
TR	Technical Report
TS	Technical Specification
TSDSI	Telecommunications Standards Development Society, India
TSG	Technical Specification Group
TTA	Telecommunications Technology Association (South Korea)
TTC	Telecommunication Technology Committee (Japan)
UAS	Unmanned Aircraft System
UAS RID	UAS Remote Identification and tracking
UAV	Unmanned Aerial Vehicle
UE	User Equipment
UL	Uplink
UP	User Plane
UPF	User Plane Function
URLLC	Ultra-Reliable Low Latency Communication
USPTO	United States Patent and Trademark Office
USS	UAS Service Suppliers
USSP	U-Space Service Provider
UTM	UAS Traffic Management
UVS	Unmanned Vehicle Systems
V2X	Vehicle-to-Everything
WG	Working Group
WI	Work Items
Wi-Fi	Wireless Fidelity
WP	Work Package

1. INTRODUCTION

1.1. Objectives of the document

5G!Drones D5.4 deliverable aims at reporting standardization activities and contributions at international fora achieved during the whole duration of the project, from M1 (June 2019) to M42 (November 2022). It is an update of D5.3, which covered the activities during the first period from M1 (June 2019) to M18 (November 2020). In the present document, we recall some outstanding contributions from the first period, extracted from D5.3, and describe new contributions and progress achieved from M19 to M42.

1.2. Structure of the document

After a general overview of the standardization landscape, this document will be structured by standardization organization and association. Each subsection will:

- Detail the organizations or associations that has been identified as relevant for 5G!Drones standardization activities and their purpose,
- Present how they relate to 5G!Drones,
- Present the strategy used to contribute to these organizations and associations, and
- Present the work achieved: The Working Groups in which consortium members contributed. Specifying the different meetings attended, 5G!Drones role in the meeting as well as specific contributions. We will recall outstanding contributions from the first period, extracted from D5.3, and introduce new contributions.

2. 5G!DRONES CONTRIBUTIONS TO STANDARDISATION AND INTERNATIONAL FORA

2.1. General overview

5G!Drones project brings together partners from the UAS vertical and the telecommunication industry, creating a unique mix that initiates the cooperation establishment between SDOs of the Global UTM association and the GSMA.

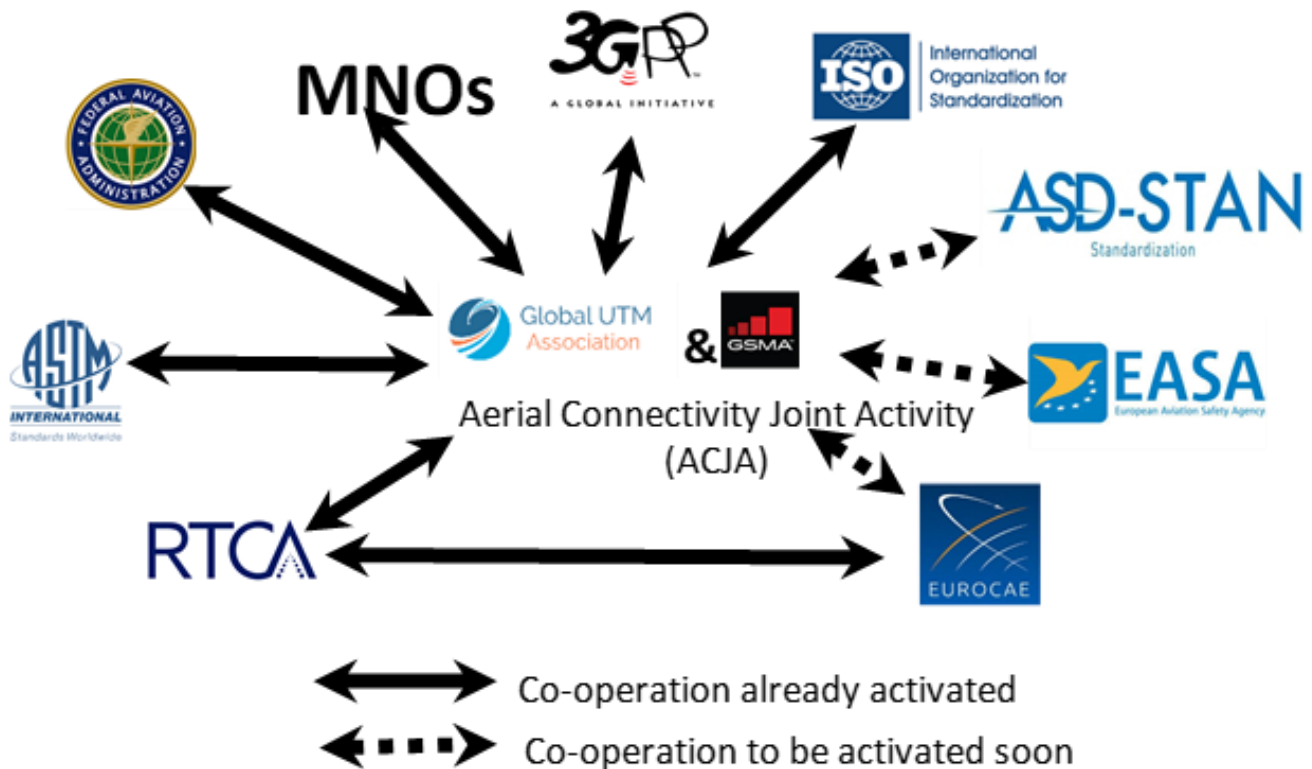


Figure 1 - Standardization landscape from 5G!Drones point of view

Figure 1 above represents a global view of standardization status for UAS vertical on telecommunication networks. At the center of the picture, stands:

- GSMA, the GSM association which is an industry organization that represents the interests of mobile network operators worldwide;
- GUTMA, which is the global UTM association which is a consortium of worldwide UTM stakeholders and whose purpose is supporting and accelerating the transparent implementation of globally interoperable UTM systems.

GSMA and GUTMA have launched together the ACJA, which stands for the 'Aerial Connectivity Joint Activity'. They have realized that cellular connectivity is a key to unlocking the full potential of drones: allowing them to operate at greater distances from the pilot, beyond the pilot's line of sight, enabling critical functions such as search-and-rescue or traffic safety monitoring. With connected drone use cases set to multiply rapidly over the next few years, therefore, the aviation and mobile ecosystems need appropriate leads through which their collaborative work can be carried out. Let us say that ACJA aims at addressing any misalignment between the aviation and cellular communities in aerial cellular. They provide a forum to facilitate communication between the two communities, they implement a

stronger alignment of the SDOs from the two communities and they try to establish acceptable architectures and interfaces between the components and assets respectively provided by the two communities.

Around this central organization, other interesting bodies have been identified as relevant within the framework of 5G!Drones project. These bodies will be detailed in the next paragraphs according to specific work and studies achieved by 5G!Drones consortium partners throughout the whole duration of the project:

- RTCA: Radio Technical Commission for Aeronautics, which is a US volunteer organization developing technical guidance for use by government regulatory authorities and by industry.
- ASTM: American Society for Testing and Materials, which develops and publishes standards for a large range of products and in particular UAS.
- FAA: Federal Aviation Administration, which is a governmental body with powers to regulate all aspects of civil aviation in that nation as well as over its surrounding international waters.
- MNOs: with presence of international partners, US have already activated; Europe and Asia are currently activating their collaboration
- 3GPP: 3rd Generation Partnership of course in charge of 5G standards, main focus for 5G!Drones partners.
- ISO: International Organization for Standardization: in particular Technical Committee 20 ("ISO/TC 20 Aircraft and space vehicles"), subcommittee 16 dedicated to Unmanned Aircraft System with a scope including but not limited to classification, design, manufacture, operation & safety management of UAS operations.
- ASD-STAN: This is an associated body to CEN, European Committee for Standardization for Aerospace standards.
- EASA: European Aviation Safety Agency having responsibility for civil aviation safety and carrying out certification, regulation and standardization activities.
- EUROCAE: The European Organization for Civil Aviation Equipment which deals exclusively with aviation standardization, for both airborne and ground systems and equipment and which collaborates with RTCA for consolidating published standards.

2.2. 3GPP

Cellular-Connected UAVs is a promising technology that can become a reality in the near future. Enabling ultra-reliability, low latency and high data rates is important in order to guarantee ubiquitous communications between UAVs and GCS/Users regardless of their locations. The main advantages of using cellular-connected UAVs compared to the traditional Ground-to-UAV communications can be summarized as follows:

- **Ubiquitous accessibility.** Thanks to the almost ubiquitous accessibility of cellular networks worldwide, cellular-connected UAV makes it possible for the ground pilot to remotely command and control (C2) the UAV with essentially unlimited operation range.
- **Enhanced performance.** With the advanced cellular technologies and authentication mechanisms, cellular-connected UAV has the potential to achieve significant performance improvement over the simple direct ground-to-UAV communications, in terms of reliability, security, and communication throughput.

- **Ease of monitoring and management.** Cellular-connected UAV offers an effective means to achieve large-scale air traffic monitoring and management.
- **Robust navigation.** Traditional UAV navigation mainly relies on satellites such as the Global Position System (GPS), which is however vulnerable to disruption of satellite signals due to, e.g., blockage by high buildings or bad weather conditions. Cellular-connected UAV offers one effective method, among others such as differential GPS (D-GPS), to achieve more robust UAV navigation by utilizing cellular signals as a complementary for GPS navigation.
- **Cost-effectiveness.** Cellular-connected UAV is also cost-effective. On one hand, it can reuse the millions of cellular base stations (BSs) already deployed worldwide, without the need of building new infrastructures dedicated for UAS alone, thus significantly saving the network deployment cost. On the other hand, it may also help saving the operational cost, via bundling UAV C2 and other numerous types of payload communications into cellular systems, which will create new business opportunities for both cellular and UAV operators [1].

Connectivity over mobile networks has a lot of advantages for the UAS ecosystem:

- The mobile network can be a part of UTM solutions;
- The general identification and registration schemes for mobile UEs (IMSI, IMEI) can be used for UAVs identification and registration in connected systems;
- The mobile network can assist law enforcement by enabling identification and tracking of drones, as well as no-flight zones;
- The mobile network ensures transmission reliability, privacy and data protection.

The 3rd Generation Partnership Project (3GPP) unites seven telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC), known as “Organizational Partners” and provides their members with a stable environment to produce the Reports and Specifications that define 3GPP technologies. The project covers cellular telecommunications technologies, including radio access, core network and service capabilities, which provide a complete system description for mobile telecommunications. The 3GPP specifications also provide hooks for non-radio access to the core network, and for interworking with non-3GPP networks. 3GPP specifications and studies are contribution-driven, by member companies, in Working Groups (WG) and at the Technical Specification Group (TSG) level.

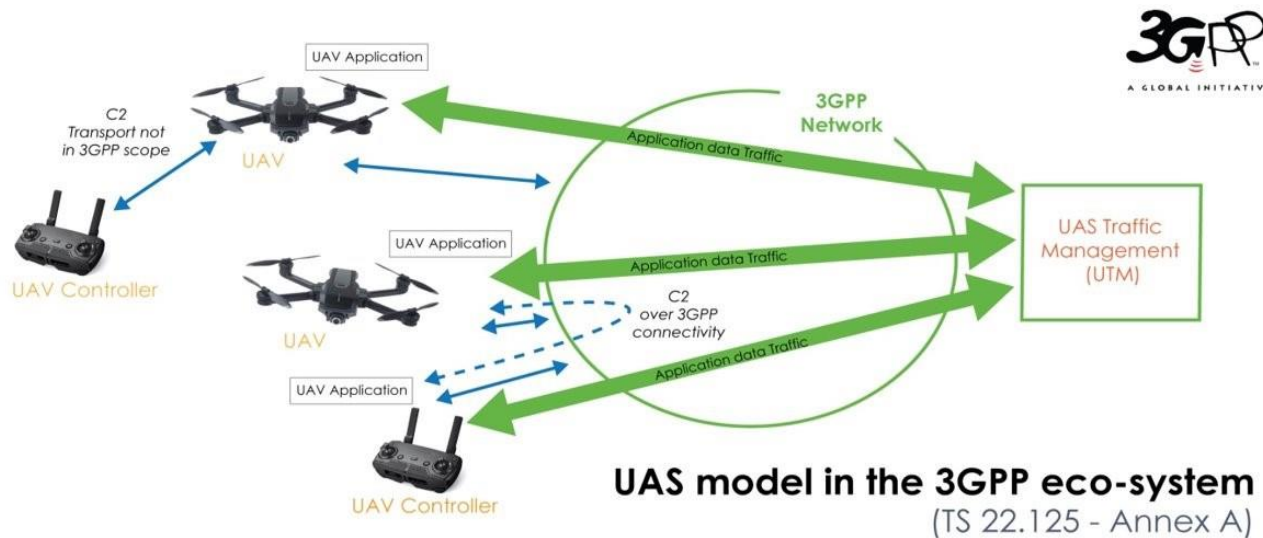


Figure 2 - 3GPP UAS model in the 3GPP ecosystem

The Figure 2 above represents 3GPP UAS model in the 3GPP ecosystem and the various connections taken into account for specifications.

The foundations of UAS communication services support by the 3GPP 5G system (5GS) are primarily in definition of the 5GS architecture [2] followed by definition of 5GS procedures [3], which provide various important concepts and functions for UAS. First, network slicing (NS) is an inherent part of the 5GS vision. Until now, the mobile network was built as a universal network, supporting services with very divergent characteristics in a uniform manner. As a result, the compromise did not sufficiently satisfy the requirements of any of them. The LTE network operating in this logic will be replaced by a federation of parallel virtual networks, each of which is individually tailored to the requirements of different classes of services defined by ITU-R and followed also by 3GPP. This way, the traffic belonging to different communication links (C2, real-time video, sensors, etc.) will be directed to the right network, which will transmit and process it through the User Plane Function (UPF) in the best possible way.

The support of NS within the 5GS includes network slice instance (NSI) selection and admission control on per-user level (identified by IMSI). Currently, it is assumed that a 5G terminal can be attached to a maximum of 8 different NSIs of the same network operator, which is considered as an adequate number for typical usage scenarios. The User Plane (UP) in the 5GS is no longer just a user traffic tunnel anchored at the Packet Data Network (PDN) gateway, with user mobility provided. The UPF is now a service- and/or network slice-specific chain of functions processing the user traffic (e.g., firewall, Deep Packet Inspection – DPI, packet classification, redirection and alteration), i.e., the functionalities of SGi LAN in 4G are now incorporated to the 5GS UP.

All 5GS entities (UE, RAN, Core Network, and also MEC if exists) have to be NS-aware. In 4G and earlier generations, the UE requested only an access to a specific Packet Data Network identified by its APN. In 5G UEs will also specify a path to this data network, i.e., request an access to specific NSI with a commonly recognized identifier. In case the requested NSI is unavailable in the specific area (due to inexistence or congestion), the 5G network will have to substitute the requested NSI with the best possible alternative.

The 5GS supports classification of traffic for QoS assurance. The standardized 5QI (5G Quality Identifiers) used for stamping of traffic are a significantly extended 4G QCI (QoS Class Identifier) list. The 5QI definition contains currently 27 classes (see 2.2.3) with processing types (guaranteed bit rate, non-guaranteed bit rate, delay-critical guaranteed bit rate) and allocated default priority level, E2E

packet delay budget, allowed packet error rate; default maximum data burst volume (maximum size of user data in a packet); default averaging window (timeframe for measuring e.g., error rate) and example applications.

The architecture of 5GS Control Plane (CP) is designed according to service-oriented principle, which makes it easy to expand the CP functionally and enable new features. Additionally, the number of protocols used for exchange between the CP functions has been consolidated and now the protocol for interactions between all control-plane entities is HTTP instead of previously used telecom operator specific ones like Diameter or GTP-C (GPRS Tunneling Protocol Communication). The CP functional applications will be designed as stateless ones, i.e., the state of each network procedure will be stored centrally and e.g., session request may be successively processed by various instances of the same CP application without a need of troublesome transferring a context to be able to complete a procedure.

With regards to 5G!Drones topics, significant work has been achieved in 3GPP since 2017 in the context of Releases 16, 17 and 18. 5G!Drones consortium has studied relevant items and took them into account in the project:

- TR 36.777 [4] – this study concerned the analysis of various aspects of UAS support in LTE networks. The conclusions are mainly focused on the issue of interference mitigation, to a lesser extent on mobility performance and aerial UE identification.
- In TS22.125 (Rel-16 SA1, and Rel-17) [5], potential requirements and identification services have been analyzed for different drone use cases. This technical standard defines a variety of UAS use cases and their requirements (aviation domain-related, including C2, UTM and remote identification, as well as specific to drone usage), especially functional and in terms of performance targets: data rates, E2E delays, reliability rates, allowed altitudes above ground levels and ground speeds and positioning latencies/accuracies.
- TS 22.261 (Rel-15 to Rel-19) [6] – this technical standard provides supplementary information, as it is dedicated to general 5G service use cases and requirements. Despite the fact that the UAS support area has been excluded from it and moved to the separate aforementioned document (TS 22.125), here the overall picture is complemented (e.g., tampering detection and prevention).
- Further study was conducted in TR 23.754 (Rel-17) [7] to support drone connectivity, identification and tracking, with a special focus on detection and reporting of unauthorized UAVs towards the UTM. For Release 17, SA6 analyzed the potential impact on the application layer, considering support/enabler functionalities for UTM and service interactions between UAS and UTM (e.g., fly route authorization or location management). The architectures and solutions already developed for mission critical and V2X services have been considered for re-use in aerial systems, and new KPIs and communication needs of the UAV with a 3GPP subscription have been issued.
- TR 23.755[8] – this report of the architectural study on application layer support for UAS deals with different aspects of UAS applications:
 - applicability and possible needs for enhancements of service enabler architecture layer (SEAL – set of functions for management of location, group, configuration, identity, key and network resources) – common to all vertical industry applications – for UAS services;
 - broadcast communication amongst UAVs both in off-network and on-network scenarios;
 - UAV location information – both verification of location reported by UAV, which cannot be fully-trusted, by the 3GPP network and possible supplementing of 3GPP system-based location information to the location reporting towards UTM;

- UAS services capabilities exposure – real-time monitoring of the UAV status information (e.g. location of UAV, communication link status) and exposure to a 3rd party of the information about UAV service status in a certain geographical area and/or at a certain time.
- As part of Rel-17, TS 23.255 [9] specifies the overall application layer architecture to enable application support for UAS applications over 3GPP networks.
- Generic support for UAS applications were specified in the SEAL layer as outlined in 3GPP TS 22.434 [10], while general UAS-related aspects for the 3GPP-architecture were specified in 3GPP TS 23.256 [11].
- Finally in TR 23.700-55 (Rel-18) [12], the report develops how the UAS application layer architecture requires enhancements to further improve and enhance functionality in 3GPP for improved support assisting the aviation industry.

It should be noted that the technical standards are normative documents, while study reports provide concepts or proposals, which after further validation may be incorporated to normative documents. Hence, the 3GPP support needs standardization of functionalities and mechanisms, which will respond to already standardized UAS services requirements.

2.2.1. 3GPP RAN (WG 1, 2 & 3)

The 3GPP has started a new RAN WI on NR support for UAV (Uncrewed Aerial Vehicles) in Release 18 (NR_UAV) in August 2022. This 3GPP WI is justified by the recent developments and activities on unmanned aerial vehicles in industry, regulatory and other standardization fora. Although the similar work for LTE Release 15 has concluded on the feasibility and required enhancements have been verified for the support of aerial vehicles via terrestrial cellular systems, in terms of UL and DL interference as well as mobility, it was also determined that some limitations remain e.g., due to the higher latency, reduced MIMO capabilities, and some requirements for aerial services still cannot be met. These limitations can be addressed in NR, which enables more diversified applications for aerial vehicles, with the lower latency for control and higher data rate for multi-media services. Moreover, the interference issues that may be generated by aerial UEs have to be considered in order not to disrupt the operation of a network designed for terrestrial UEs.

The objectives of this 3GPP WI have been prepared in early 2022, and the description includes the following objectives:

1. Specify the following enhancements on measurement reports (RAN2):

- UE-triggered measurement report based on configured height thresholds.
- Reporting of height, location and speed in measurement report.
- Flight path reporting.
- Measurement reporting based on a configured number of cells (i.e., larger than one) fulfilling the triggering criteria simultaneously.

Note: Work done in LTE is a starting point for this objective. NR-specific enhancements can be considered, if needed, while overall the LTE and NR solutions should be harmonized as much as possible.

2. Specify the signaling to support subscription-based aerial-UE identification (RAN3/SA2 interaction/RAN2)

Note: Work done in LTE is a starting point for this objective. NR-specific enhancements can be considered, if needed, while overall the LTE and NR solutions should be harmonized as much as possible.

3. Study and specify, if needed, enhancements for UAV identification broadcast (RAN2, SA2).

Applicable to both LTE and NR.

Note: This study should consider existing techniques based on non-3GPP technologies, or unlicensed bands as the baseline.

Note: This description is a placeholder for a more detailed objective to be drafted once SA2 will have concluded their study on the architectural aspects.

4. Study UE capability signaling to indicate UAV beamforming capabilities and, if necessary, RRC signaling (RAN1, RAN2):

- FR1 with directional antenna at UE side

The 3GPP RAN WG#1 work, addressing primarily the objective 5 on UAV beamforming capabilities is due to start in October 2022.

In the 3GPP RAN WG#2 meeting #119 (August 2022), the discussions focused on measurement-related UAV enhancements defined in LTE and their adoption to NR [R2-2207518 (CATT), R2-2207194 (DOCOMO), R2-2207925 (Vodafone) and R2-2207329 (Nokia)]. It was generally agreed that the starting point is the adoption of the LTE mechanisms and keep for further study potential improvements in NR:

1. Using LTE principle as a baseline, introduce similar event H1 (aerial UE height becomes higher than threshold) and H2 (aerial UE height becomes lower than threshold. FFS if further NR enhancements are needed. FFS study scaling of RRM parameters (e.g., which parameters and what is the purpose/benefit of the scaling and how)

FFS how to limit excessive measurements and measurement reporting.

FFS if user consent is needed for location reporting in CONNECTED.

FFS study the vertical movement and associated mobility for UAV UEs.

2. Rel-18 NR supports reporting of UAV UE's height, location and velocity. It is for further study what accuracy and reporting mechanisms are required and if further enhancements are needed.

3. As in LTE, flight path plan reporting will be introduced. Location list of waypoints (3D location information) and timestamp is adopted as the basic content of flight path report.

FFS if timestamp is mandatory or optional for NR.

FFS if further enhancements are needed.

4. Introduce similar functionality to LTE (numberOfTriggeringCells).
FFS whether numberOfTriggerBeams for NR is required or other enhancements.
FFS study how to avoid sending the measurement reports mainly due to reportOnLeave.

The 3GPP RAN WG#3 work is due to start after WG#1 and WG#2 have reached their first conclusions or identified WG#3 related problems.

2.2.2. 3GPP SA1

Release 17 became stable in June 2022. The work item ID_UAS, « Remote Identification of Uncrewed Aerial Systems », has issued a new version of TS.22.125 for R17. This document focuses on 3 different types of C2 communications, namely:

- Direct C2 communications (when the UAV controller and UAV establish a direct C2 link to communicate with each other);
- Network-Assisted C2 communications (when the UAV controller and UAV communicate with each other via 5G network);
- UTM-Navigated C2 communication (for pre-scheduled autonomous flights).

And 4 types of control modes for the drone:

- Steer to waypoints (when the control message contains flight declaration, such as waypoints);
- Direct stick steering (when the control message contains direction instructions);
- Automatic flight by UTM (when the control message contains a pre-scheduled flight plan);
- Approaching autonomous navigation infrastructure (when the control message contains direction for landing/departing).

TS22.125 proposes requirements for Remote ID and UAS traffic management, UAV usages and performances. Listed KPIs target UAV applications, C2 communications and positioning.

Next, the work towards Release 19 has just started and a new study item, FS-UAV_Ph3 « Study on UAV Phase 3 », has been initiated within SA1. It aims to identify additional use cases and potential service requirements to:

- Support pre-flight preparations and in-flight operation, for example through the provisioning of information on flight path recommendation, flight monitoring and control;
- Support enhanced UAV flight/route management thanks to QoS information;
- Support UAV detection and DAA (Detect and Avoid) for improved aviation safety;
- Identify further requirements on 5GS for UAS operation, in particular with respect to redundancy and reliability of the C2 link.

The technical report TR 22.843, « Study on Additional capabilities of mobile networks for drone operations and managements », is under progress and currently targets 2 use cases: UAV pre-flight preparation and UAV detection, which has been proposed by ORANGE. The objective is to activate an “aerial subscription” flag in a UE subscription when the network detects this UE is flying, based on altitude tracking.

2.2.3. 3GPP SA2

In 3GPP SA2, a study item FS_UAS was agreed in Rel-17 to study the system enablers for supporting UAS. The scope of the Rel-17 study was to identify the architectural enhancements needed to support Identification, authentication/authorization and tracking of UAS that are connected through the 3GPP network. The study is documented in the technical report TR 23.754, and based on the study conclusions a new 3GPP technical specification, TS 23.256 “Support of Uncrewed Aerial Systems (UAS) connectivity, identification and tracking” was published in 3GPP Rel-17. The specification covers functionalities provided by the 5GC to support UAS that are connected to 5GS and EPS.

It defines a mechanism to authenticate and authorize a UAS by the USS before allowing connectivity through the 3GPP system. The authentication and authorization may be performed when the UE (used with the UAS) registers to the 3GPP network or alternatively it may be performed during the time when the UE (used with the UAS) requests for data connectivity from the 3GPP network.

The technical specification also defines a mechanism where the USS/UTM can perform dynamic flight path authorization and can also control the C2 (command & control) communication between the UAV and the ground station controller when 3GPP connectivity is used for the C2 communication.

Further technical enhancements were also specified to allow periodic monitoring of the UAS(s) location, support geo fencing requirements and identify unauthorized UAS flying in an area.

During this work 3GPP SA2 also coordinated with GSMA ACJA to clarify/understand requirements from the aviation industry. Based on the coordination with GSMA ACJA, 3GPP SA2 defined a RESTful API based interface to support the authentication, authorization and tracking of the UAS by the USS/UTM or other aviation applications that are deployed outside of a network operators' domain.

In continuation of the work done in Rel-17, 3GPP SA2 has agreed on a phase 2 of the study FS_UAS_Ph2 in Rel-18. The main objectives of the work in Rel-18 are to study:

- how to support the Broadcast Remote Identification (BRID) in the 3GPP system,
- how to support C2 communications using D2D (device-to-device) direct communication via the 3GPP system,
- how to support Detect and Avoid (DAA) mechanism in the 3GPP system.

The study is documented in the technical report TR 23.700-58 and is expected to conclude in Q4, 2022. The normative specification work will then follow in Q1, 2023. Some of the active companies in the discussions have been Qualcomm, LGE, InterDigital, Nokia, Ericsson, Huawei, Lenovo and Samsung. Orange provided a revision to prevent drones to be operated with SIM cards not meant for drones. It has not been approved but will be handled in stage 3.

2.2.4. 3GPP SA6

As a reminder from 5G!Drones deliverable D5.3, with regards to UAS work in 3GPP SA6, a specific study item FS_UASAPP “Study on application layer support for Unmanned Aerial System” has emerged in April 2019 (as Rel-16 item). It targets at:

- Analyze the re-use of functionalities from SA6 specifications.
 - MCX: A platform for mission critical (MC) communications and MC Services has been a key priority of 3GPP SA6 in recent years and is expected to evolve into the future by taking more requirements, from different sectors of the global critical communications industry, on board.

In particular, MCX are key in 5G!Drones considering Public safety use cases, supporting secured communications between first responders.

- V2X: One important and critical topic for 5G!Drones project is allowing Drone-to-Drone communication via 5G to avoid and prevent collisions and coordinate routes. V2X research is the most relevant for that.
- The Common API framework, so called CAPIF: The main purpose of CAPIF is to have a unified northbound API framework across several 3GPP functions. There is a single and harmonized approach for API development, with a number of 3GPP specifications on the work – to specify a framework to host APIs of PLMN and also to allow for third parties to leverage the CAPIF framework to host their APIs. So, the main goal consists in allowing quick on-boarding for verticals, the Vertical Application Enablers for support for the creation of actual applications, including drones.
- Provide suitable application layer APIs.

In the first period, 5G!Drones consortium got involved and participated in discussions leading to the writing of TR 23.755. Nonetheless, the progress on this topic has been quite slow, mainly because this needs results from the SA2 study as input. Nonetheless, Airbus DS has been particularly active in 3GPP SA6 (co-chairing). The SDO suffered from COVID19 with cancellation of all 3GPP face-to-face meetings now conducted as e-meeting and with less but still stable and high-quality output. The work was mainly focused on completion of Rel-16. More and more new vertical industry service proposals are brought to 3GPP and among them drone services. 3GPP aims at avoiding past experience with specific features developed for niche markets and now privileges global approaches. Drone chapter is twofold: eMBB with regards to data captured by drones and URLLC with regards to their remote control. FS_UASAPP corresponds to Study on application layer support for Unmanned Aerial System. Active companies in the discussions have been Interdigital, Tencent, Airbus, China Unicom, Huawei, DT, Vodafone, Samsung, Qualcomm, KRR, Ericsson, CATT. Two outgoing LSs approved, both to SA1 asking for clarifications. The first one (544) is asking whether SA1 defined a 1-to-1 or 1-to-N relation between a UAV-controller and UAV(s). TS 22.125 has some internal misalignments on this issue. The second LS was a trickier one, asking clarifications on SA1 requirements that listed a bunch of parameters delivered between UAV and UTM, most of them being out-of-3GPP-scope. Airbus DS has written two change requests (CR) to SA1 referring to the above LS clarifying that these parameters are not visible to the 3GPP system.

In the second period, activities in 3GPP SA6 with regards to drones, focused on potential enhancements to the UAS architecture and Service Enabler Architecture Layer (SEAL). In particular, direct communications between UAVs for improving performance and connectivity supported by enhanced PC5 has been highlighted but this feature is out of the scope of the 5G!Drones innovations and is highly dependent on the work performed in SA2, so 5G!Drones consortium has decided to not contribute to this item. On the contrary, 5G!Drones consortium has been more involved in discussions for supporting multi-USS (UAS Service Supplier) deployments especially through activities led in ACJA (more information below). The resulting key issue aims to investigate how the UAS application Enabler layer can be enhanced to change USS/UTM during flight as it is very likely that a long flight will span the service area of more than one USS/UTM. The work on this study item will continue. The results of this study will be part of 3GPP Release 18.

2.3. GSMA

The GSM Association (Global System for Mobile Communications, originally Groupe Spécial Mobile) [13] represents the interests of mobile operators worldwide and gathers more than 750 operators and around 400 companies in the broader mobile ecosystem, including handset and device makers, equipment providers or internet companies.

As further detailed in D5.3, the GSMA initiated a Drones Interest Group (DIG) to promote the use of mobile cellular connectivity (4G and 5G) for drone operations, to explore use cases and business opportunities, and to support the regulation and standardization efforts towards the efficient integration of cellular technologies within aviation operations. Recent updates are as follows.

Regarding ecosystem and business aspects, the GSMA published in 2021 a white paper entitled « Exploring Future Opportunities for Mobile Networks and the Drone Industry: Benefits and Use Cases ». It investigates the key products and services anticipated, under development or already delivered by mobile operators. They encompass connectivity services, but also end-to-end packages and value-added complementary services, e.g., for population density awareness. In 2022, the GSMA initiated a series of deep dive sessions, covering, for example, real life experiences supporting drones, UAS related activities in 3GPP or project showcases.

From a technical perspective, the GSMA Network Group RILTE (“Roaming in LTE”) has published the deliverable “LTE UNI Aerial Profile” in November 2021. This document is based on the white paper “LTE Aerial Profile v1.00”, proposed in 2020 by ACJA – WT3. It identifies a minimum mandatory set of features, defined in 3GPP specifications, which are considered essential to ensure interoperable aerial service over LTE radio access.

Finally, regarding regulatory aspects, the GSMA wrote a position letter to respond to EASA’s consultation on the Notice of Proposed Amendment 2021-09 for “Regular update of the acceptable means of compliance and guidance material to Regulation (EU) 2019/947 on the rules and procedures for the operation of unmanned aircraft”. Indeed, Article 11 (« Rules for conducting an operational risk assessment this regulation ») was covering direct C2 (e.g., via Wi-Fi) only, and could have excluded other types of communication, including cellular technologies.

ORANGE is active within GSMA and continues to participate to bi-monthly DIG meetings. ORANGE took part in the redaction of the response to EASA’s consultation.

Nokia has been participating, promoting DIG events in research communities and continues its participation to DIG events.

2.4. GUTMA

The Global UTM Association (GUTMA) [14] is a non-profit consortium of worldwide Unmanned Aircraft Systems Traffic Management (UTM) stakeholders promoting the drone services ecosystem. It was established to foster the safe, secure and efficient integration of drones in national airspace systems. Its mission is to support and accelerate the transparent implementation of globally interoperable UTM systems. GUTMA gathers various types of stakeholders starting from UTM companies, Drone Manufacturers, Aircraft manufacturers, CAAs, ANSPs and Airlines. As a strong player in the UTM world,

GUTMA is working with FAA / EASA, SDOs and European Commission to provide market driven recommendations and standards.

In April 2022, as the contribution to the European Commission's Drone Strategy 2.0, GUTMA released the document entitled "The future of aviation has arrived! -The next steps to build the drone service ecosystem" [15], which is the result of debates among the members of the Policy Task Force established by GUTMA at the end of 2021. The main points characterizing the requirements for new U-space, presented in this paper are following:

- The U-space should be a fully automated, machine-to-machine system, which will be not constrained by human capabilities, like manned Air Traffic Management.
- Deconfliction should be possible during all stages of the mission (planning, pre-flight, during the flight) and available to all participants through federated set of services. Common protocol should be developed to exchange data between different entities.
- Access to the airspace should be fair, accessible for all.
- Certification procedures for U-space services providers should be defined and implemented.
- Crewed and uncrewed air traffic should be as soon as possible treated on equal footing.

GUTMA has launched this year the series of the conferences "Harmonized Skies 2022", which is featuring the key industry and policy stakeholders from around the world to discuss the most topical issues surrounding the drone ecosystem. The first meeting was held in Europe, and the next ones are going to be held this year in Asia and the United States, showing the real global footprint of GUTMA influence.

INVOLI has been a member of GUTMA since its incorporation in 2017. INVOLI has always actively participated in all GUTMA meetings, presenting itself as "the bridge between the drone and telecommunication world" and supporter of 5G services to unleash never-seen-before drone operations. INVOLI's CEO and Co-founder, Manu Lubrano, was a member of the Board of Directors of GUTMA, as of June 2020, until June 2021. INVOLI is also participating in the new Market Working Group, aiming to identify and analyze the challenges to establish competitive UTMs and drone operations and services markets, which will be accessible to all.

Nokia was a founding member in 2016 and joined back to GUTMA 2020 and since then has been active on a GUTMA – GSMA collaboration – The Aerial Connectivity Joint Activity (ACJA).

2.5. ACJA

ACJA, which stands for Aerial Connectivity Joint Activity (ACJA) [16] [17], is a collaboration initiative between GUTMA and GSMA. ACJA focuses on promoting interchange and understanding between the aviation and cellular communities. The ACJA's most important role and main aim is to synchronize contributions between the existing Standard Development Organizations (SDOs) of each community, in order to avoid incompatibilities between them.

Several 5G!Drones project members are also participating in ACJA work tasks groups. The cellular networks possibilities for unmanned traffic management (UTM) and aviation are studied in the 4 ACJA work tasks, already described in D5.3. Recent updates include:

- Work Task #1: Aviation coordination with 3GPP, which published in March 2022 a deliverable entitled "Leveraging 3GPP Cellular Network Mechanisms to support UAS operations" and

currently investigates spectrum aspects for UAS operations (document under preparation). Published document focuses on analyzing how cellular networks and related services can be leveraged to support UAS operations (including Networked Remote ID, UAV connectivity for command and control, location and flight tracking, and security), including how they support ASTM 3411-19 Standard Specification for Remote ID and Tracking and future versions. This includes an analysis of how additional broadcast mechanisms can be supported in a future revision of F3411. The document also leverages the 3GPP architecture and mechanisms defined in 3GPP Release 17 for UAS, providing a reference to how they can be used but without mandating the use of any of such mechanisms. It assumes a high reliance by the mobile network operators on the USS for UAV authentication and authorization, and for policing of UAV communications via the cellular infrastructure. As per the Work Task #1 Terms of Reference, this deliverable contains technical views and contributions meant as input to the 3GPP work, to ASTM, and to other relevant fora.

- Work Task #2: Supplementary Data Service for coverage information, which delivered in Feb 2021 the document “ACJA Interface for Data Exchange between MNOs and the UTM Ecosystem: Network Coverage Service Specification”, describing the network parameters required by UTM, for safe and efficient Operation Flight Planning in BVLOS conditions. A second deliverable, “Reference Method for assessing Cellular C2 Link Performance and RF Environment Characterization for UAS”, is expected for the end of 2022. It proposes a methodology, best practices and recommended experimental set-ups (including technical pre-conditions, drone operation planning, UAS configurations, flight execution, KPI reporting, etc.) for harmonized characterization of cellular aerial coverage.
- Work Task #3: Standard Aviation Service Profile, which has been finalized by end 2020.
- Work Task #4: Is continuing work on “MOPS and MASPS development for cellular”, and landscape description, which aims at supporting SDOs and Work Groups, but not limited to RTCA SC-228 and EUROCAE WG-105 SG2 C2 LTE MOPS on understanding the 3GPP specifications like naming, quality of service mechanisms, even potential antenna standards relevant to aviation in detail.

INVOLI was active in WT2 works, participating to the bi-weekly WT2 meetings and submitting its comments about the document. INVOLI is also participating to the ACJA plenary bi-monthly meetings, where the status of each work task group is reported.

Within WT1, ORANGE participates to discussions on UAS spectrum and has raised the question of no-transmit zones, as proposed by French spectrum and telecommunication regulatory agencies (ANFR and ARCEP). ORANGE also contributes to the deliverable “Reference Method for assessing Cellular C2 Link Performance and RF Environment Characterization for UAS”, to be published within WT2.

Within ACJA board and WT4 Nokia has been active on collaboration and reviewing plus cross-checking documents towards existing and upcoming 3GPP specifications like the document on minimum operational performance specifications for cellular for aviation. We have also held collaboration meetings with other SDOs on presenting and collecting feedback on the current landscape of cellular connectivity specifications for aviation.

2.6. CEPT/ECC

The ECC [18] (Electronic Communication Committee) is an autonomous committee of the Confederation of European Posts and Telecommunications Administrations (CEPT). The CEPT target is to harmonize telecommunication, radio spectrum, and postal regulations. One of the targets for the ECC is to harmonize the efficient use of radio spectrum in Europe. There are several working groups and project teams to deliver to the ECC's "Decisions" and "Recommendations".

In order to carry on the fast-growing demand to operate aerial UE (User Equipment supporting UAS services with an aerial subscription) in particular under beyond-visual-line-of-sight (BVLOS) conditions and professional usage, CEPT has reported two documents assessing analysis of communications between aerial UE and mobile/fixed communication networks (MFCN) using bands harmonized for MFCN. Notice that civil aviation regulation is out of scope of these documents.

ECC Report 309 [19] provides analyses of the conditions for the usage of aerial UE for communications in the following MFCN harmonized bands: 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2 GHz, 2.6 GHz, 3.4-3.8 GHz (without beamforming).

ECC Report 348 [20] provides further studies about harmonized technical conditions for the usage of aerial UE for communications in the following MFCN harmonized bands: 1800 MHz, 2 GHz and 2.6 GHz.

The initial ECC studies mainly focused on LTE which provides extensive MFCN coverage in CEPT countries. ECC Report 348 also includes a technology comparison between LTE and 5G NR (without beamforming). Therefore, the conclusions in ECC Report 309 are valid for both and are confirmed in principle in ECC Report 348.

Studies results are valid for standardized LTE and 5G NR UE with usage of aerial UE operating up to 10000 m altitude with the assumption of existing MFCN Base Stations (BS), which provide effective coverage for UE at ground level.

More recent studies highlighted the need to define some spectrum operational restrictions, such as "no-transmit zones" which are geographical areas defined at national level where aerial UE are not allowed to operate in a certain frequency band, or additional Out Of Band (OOB) emission limits specific to aerial UE in order to avoid interferences with primary services in adjacent bands. This requirement may apply to aerial UE according to their operational frequency band, e.g., aerial UE operating in a specific band or specific channel (see no-fly zone definition set out in ECC Report 309, referred here to as "no-transmit zone"). In some cases, operation of aerial UE also requires respective cross-border coordination agreements.

The final ECC Decision UAS "Harmonized technical conditions of the usage of aerial UE for communications based on LTE and 5G NR in the MFCN harmonized bands 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2 GHz, and 2.6 GHz" is finalized and passed public consultation from July-August 2022. This report concludes that no additional regulatory measure, in addition to those identified by ECC report 309, is required for aerial UE connecting to an AAS BS network operating in 1.8 GHz, 2 GHz, and 2.6 GHz bands.

For other bands, there are specific OOB limits for aerial UE required which differ from current OOB emission limits applicable to terrestrial UE. It would be welcomed to get further views from the industry on how these specific requirements could be achieved while maintaining harmonization objectives.

On 15.-18.11.2022, during ECC 60th Plenary, the ECC adopted ECC Decision (22)07 "Harmonized technical conditions of the usage of aerial UE for communications based on LTE and 5G NR in the bands 703-733 MHz, 832-862 MHz, 880-915 MHz, 1710-1785 MHz, 1920-1980 MHz, 2500-2570 MHz and 2570-2620 MHz harmonized for MFCN" also referred as Decision (22)-07.

The decision states that in CEPT countries there is a fast-growing demand to operate aerial UE (User equipment) in particular under beyond-visual-line-of-sight (BVLOS) conditions, mainly for professional purposes. To enable these kinds of applications, there is the need for communication links between the aerial UE and mobile/fixed communication networks (MFCN) using bands harmonized for MFCN.

ECC Decision (22)07 stipulates 5G 700MHz frequency restrictions for drone take-off and landing up to 30m above the ground. Detailed analysis is provided in 5G!Drones deliverable D1.7 subchapter 3.1.3

“Radio Communication Regulation in Europe for the use of 5G communication to control UAVs”. National regulation and restrictions are developed by each country based on ECC Decision (22)-07. CAFA Tech has forwarded the inputs from the drone company's point of view, based on the trials conducted during the 5G!Drones project, to the Estonian National Communications Agency, which started the development of the corresponding regulation in Estonia.

2.7. CEPT/ECC SE21

Inside Electronic Communications Committee (ECC), Working Group Spectrum Engineering (WG SE) is responsible for developing technical guidelines and sharing and compatibility arrangements for radio spectrum use by various radiocommunications services.

Under the direction of WG SE, the Project Team SE21:

- is responsible for unwanted emissions and receiver's characterization in general;
- is responsible for maintaining ERC/ECC Recommendations on unwanted emissions and receiver's characterization and will co-operate with ETSI on this matter;
- is responsible to assist ETSI in relation to the revision of standards;
- shall co-ordinate the relevant activities in ITU-R;
- on a temporary basis, is responsible in developing methods of AAS measurement in the field of both in-band emissions and unwanted emission aspects

Nokia has representatives in SE21. The Work Item SE21_25 for AAS measurement in the field has been ongoing since July 2020. SE21 completed the work for in-band measurements in March 2022. Draft ECC Report 345 was sent by WGSE to Public Consultation in May 2022.

Drone measurements were performed in Oulu, Finland during 2021-2022 by Nokia. ECC In-band report includes measurements from 3 vendors:

- Drone measurements of SSB and traffic beams on BS in a test mode, Nokia;
- Ground based measurements of the SSB on BS in normal mode, Huawei;
- Ground-based measurement by attracting a traffic beam with a test UE, Ericsson.

The ongoing Public Consultation is ongoing for draft ECC Report 345 addressing the in-band measurements. Resolutions are being discussed in dedicated web meetings (e.g., 23 August 2022).

2.8. ASTM

ASTM is a globally recognized leader in the development and delivery of voluntary consensus standards. INVOLI has been a member since 2019, being particularly interested in the participation to meetings of F38 UAS Committee, in charge of issues related to design, performance, quality acceptance tests, and safety monitoring for unmanned air vehicle systems. INVOLI is specifically involved in the standardization regarding Supplemental Data Service Providers (SDSP).

Since January 2020, INVOLI has participated to weekly meetings in the context of the ASTM standard WK69690 “Surveillance SDSP for UTM”. The objective of this effort is to standardize the way in which U-Space Service Providers (“USSPs”) will provide air traffic positions or tracks to drone operators. It

will define the minimum level of accuracy, type of information provided and documents that have to be exchanged between the data provider and the data consumer.

The efforts were focusing on several aspects:

- Standard should be applicable and compatible with European (EASA) and American (FAA) legislations.
- It should remain generic for a wide array of technologies, aiming to detect cooperative and non-cooperative air traffic.
- The drone manufacturers should see the benefits of the SDSP system, as additional operations security level, on top of what drones can detect around itself.

The standard is currently under the review and voting process. This encompasses two phases: comments and voting about draft documents from working group members (sub-committee), and later, the voting from the main community. The sub-committee ballot was passed successfully by reaching the 60% of voters needed. The second phase of voting is under preparation now.

Manu Lubrano from INVOLI, is co-leader of the Working Group and, in this capacity, he participated to the weekly meetings during the discussion about standard and to separate weekly strategic discussions and planning meetings.

2.9. ETSI MEC

The ETSI Industry Specification Group (ISG) on Mobile Edge Computing (MEC) produces normative Group Specifications that will enable the hosting of third-party applications in a multi-vendor MEC environment. MEC enables applications and services to be hosted 'on top' of the mobile network elements. MEC APIs will also help in the future drone and UTM application and services development. Nokia is a member of ETSI MEC.

Unfortunately, 5G!Drones partners did not find the opportunity to provide contributions to this working group. However, the consortium still followed its progress and took into consideration its output for the definition of trials.

2.10. ETSI SmartBAN

The ETSI SmartBAN Technical Committee is responsible for standardization to support the development and implementation of Smart Body Area Network (BAN) technologies (Wireless BAN, Personal BAN, Personal Networks etc.) in health, wellness, leisure, sport, and other relevant domains. This technology uses small, low power devices to support a range of applications. Lately, there have been activities in expanding the work to also cover machine bodies, which can be better served by recent extensions of the Technical Specifications (TSs), including Hub-to-Hub communications and connectivity guarantee by relay communications.

The SmartBAN technology has been perceived as a viable option for inter-drone communications, especially for drone swarms. However, the rate of progress of the standardization activity is very slow. The already at M18 ongoing relay communications specifications are still under technical writing as a separate work item to the base standard. Hence, the technology runs a risk of being overlooked in

search for currently more viable alternatives. UO has been and is an active member of the SmartBAN Technical Committee since its foundation. UO acts as the rapporteur for the medium access control related Work Items. UO has been one of the major contributors in the development of the Technical Specifications and it is actively contributing into amending the standard for additional versatility and usability in new domains. UO is also making patent applications related to the SmartBAN developments. The currently ongoing patent application “Method for establishing relay connectivity in ETSI SmartBAN” received the first USPTO office action on August 22nd, 2022 and UO is currently preparing a response to the action.

The 5G!Drones representative of UO, Jussi Haapola, in ETSI SmartBAN occasionally attends the standardization meetings but more often leaves the attendance to the MAC rapporteur having previously worked together in preparation of the standardization actions. Jussi Haapola is very active in innovating and refining the technical contributions to be proposed for SmartBAN development. During the 5G!Drones project he has been UO internally actively contributing to the inclusion of the Hub-to-Hub communications and relay mechanisms to the TSs.

2.11. IETF DRIP

The IETF DRIP group [21] [22], co-chaired by ORANGE, was chartered to specify how RID can be made trustworthy and available in both Internet and local-only connected scenarios. The DRIP Entity Tag is currently being specified for that purpose. This tag can be leveraged in other contexts, for example, it can be used as the 3GPP CAA-level UAS ID for Remote Identification purposes. The following updates can be reported:

- At least two DRIP implementations were disclosed. One of them is public and can be found at [23].
- RFC9153 (Drone Remote Identification Protocol (DRIP) Requirements and Terminology) was published in 02/2022.
- Both draft-ietf-drip-arch-29 (Drone Remote Identification Protocol (DRIP) Architecture) and draft-ietf-drip-rid-32 (DRIP Entity Tag (DET) for Unmanned Aircraft System Remote ID (UAS RID)) have passed the DRIP WGLC and IETF LC. The documents are currently in the IESG Review.
- draft-ietf-drip-auth-18 (DRIP Entity Tag Authentication Formats & Protocols for Broadcast Remote ID) is currently in the DRIP WGLC. An action is still pending from ICAO to set up a registry for Specific Authentication Methods (SAMs).
- The WG adopted draft-ietf-drip-registries-05 (DRIP Entity Tag (DET) Registration & Lookup) to specify the various registration interfaces.

Part of IETF DRIP work is parallel to 3GPP work thus ASTM standards like RID references both technical solutions as alternatives. 3GPP based solutions promoted for network based remote ID using licensed spectrum enabling more safety critical and industrial cases.

2.12. BNAE

The **Bureau de normalisation de l'aéronautique et de l'espace (BNAE)** is a standard body for standardization in the field of Aeronautics and space construction [24]. The BNAE has an AFNOR (Association Française de Normalisation) delegation for establishing standards. The BNAE has been supporting experts in the development of national and international standards since 1941. It is dedicated to:

- Take part in the production of standards following French, European, and international processes;
- Guide experts in their standardization choices;
- Support experts through technical secretariat and watch activities.

The BNAE abides by:

- Openness – Standardization works are open to all interested parties;
- Consensus – Consensus is a general agreement, characterized by the absence of sustained opposition by any important part of the concerned interests;
- Transparency – Sufficient up-to-date information is issued in order to enable any interested group to participate;
- Balance – A balanced repartition of interests within working groups is essential.

2.13. Drone REGIM

The Drone REGIM initiative has ended early 2021 due to the bankruptcy of the association leading this initiative.

Drone REGIM was a drone community action launched by UVS International to contribute to the harmonization of the national approaches in the EU Member States relative to the implementation of the new European drone regulation. It consisted of the following 5 Focus Groups (FGs) and 13 Working Groups (WGs):

- Focus Group 1 – Training & Qualification & Using SORA
 - WG 1.1 – Training Operators in the Use of SORA
 - WG 1.2 – Drone Operations Manual
 - WG 1.3 – Flight School & Examination Qualification
 - WG 1.4 – Specific Category Drone Pilot Training & Licensing & Examination
 - WG 1.5 – Making Professional Drone Pilot an Officially Recognized Profession
 - WG 1.6 – Open Category: Online Pilot Training & Examination
 - WG 1.7 – Safety Rules for Training / Test / Validation / Demonstration Sites
- Focus Group 2 – Operations
 - WG 2.1 – UTM / U-Space Implementation & U-Space Service Provision & Air Navigation Service Providers (ANSPs)

- WG 2.2 – Controlled Airspace Operations
- WG 2.4 – Regulatory Oversight & Enforcement
- Focus Group 3 – Awareness Creation
 - WG 3.1 – Awareness Creation & Communications
- Focus Group 4 – Standards
 - WG 4.1 – Review of draft standard documents (in coordination with & for recognized Standard Development Organizations)
- Focus Group 5 – Standard Scenarios

WG 5.1 -Standard Scenarios (EU & non-EU) & Database to Compare Them + Standard to Produce a Standard Scenario & Relevant Template

2.14. 5G-PPP activities

As a reminder, 5G!Drones project joined the 5G-PPP Pre-standardization WG from 2019. Serge Delmas, Airbus DS SLC expert, 5G!Drones WP5 leader and 5G!Drones T5.2 standardizations activities leader is 5G!Drones representative in this working group.

The WG has specific goals that can be summarized as:

- Collect and monitor inputs from the family of 5G-PPP projects across the three funding phases to relevant standards bodies, e.g., 3GPP, ETSI, IETF, ITU, IEEE, and several industry associations,
- Influencing pre-standardization on 5G and related R&D: Potentially propose where topics should be standardized; Influence timing on R&D work programs (e.g., EC WPs). Foster the development of globally harmonized standards,
- Tracking progress towards EU priority topics as defined by the EC (Unit E1),
- Identify gaps to be targeted in future funding programs,
- Develop a roadmap of relevant standards. Inputs from projects are tracked in a regularly updated file,
- Collaborate with other WGs and Task Forces (TF) as required, e.g., forthcoming white paper of the 5G-PPP Architecture WG on relevant standards, as well as the Verticals TF and a recently formed TF with selected market representation partners attending 3GPP WGs.

The working group is regularly following standardization activities and keeps updated an excel document that tracks the status of this activity, and made available to all 5G!Drones consortium members in a shared folder within the project website.

5G!Drones consortium has actively contributed to the following actions during this period:

- Webinar participation:
 - “3GPP Release 18: Opportunities for Industry Verticals” Webinar which took place on the 30th of November 2020 (Final day of the first period and could not be reported in D5.3 as deliverables must be ready for review 1 month before release). During this workshop, the industry vertical view points and technical requirements were presented and an interactive session was done between verticals and 3GPP TSG chairs.
- B5G/6G Standardization Roadmap creation: the main purpose of this activity was to provide a “tool” in order to help projects to make impact, e.g., suggesting what kind of research output should be produced in a given moment in time, in order to be ready when SDO may use such results. 5G!Drones took part in the work around this topic and especially to the:
 - Elaboration of the 6G vision

- Coordination activities with other WGs in order to avoid conflicts
- Input from 5G!Drones companies on their B5G/6G vision and roadmap
- B5G/6G Roadmap report
- SDO impact survey: 5G!Drones contributed to the survey by providing the most notable achieved impacts of the project on the relevant 5G standards and helping at identifying areas of improvement to maximize technology transfer “from research to standards” for future research frameworks.

During all the project duration, this working group has been coordinated by Riccardo Trivisonno from Huawei company and organized regular synchronization bi-weekly meetings.

2.15. ITU-T

ITU (International Telecommunication Union) is the oldest global international organization, established on May 17th, 1865, in Paris as International Telegraph Union. Currently, it is one of the United Nations specialized agencies, dedicated specifically to standardization and regulation of the telecommunications and radiocommunication market. The activities of ITU are based on the Constitution and Convention of the International Telecommunication Union [25], which is an international treaty signed and ratified by 193 countries in the world (all except Cook Islands, Niue, Palau, and the State of Palestine).

ITU is divided into three sectors:

- ITU-T – Telecommunications Standardization Sector,
- ITU-R – Radiocommunication Sector,
- ITU-D – Telecommunications Development Sector.

The first two are the most relevant in the scope of the 5G!Drones project.

The main tasks performed by the Radiocommunication Sector are:

- the allocation of radio spectrum frequency bands, the reservation of frequencies and the recording of frequency assignments, and the reservation of positions for satellite services in geostationary orbit and satellite parameters in other orbits, so as to avoid harmful interference between radio stations of different countries;
- coordinating activities aimed at eliminating harmful interference between radio communication stations of individual countries and increasing the efficiency of the use of the radio frequency spectrum for radiocommunication services, as well as the orbits of geostationary satellites and other satellite orbits.

ITU-T creates standards covering all areas of telecommunications. According to the Constitution and the ITU Convention, its members are:

- the governmental administrations of all ITU members by operation of law;
- entities or organizations authorized in accordance with the relevant provisions of the ITU Convention (e.g., network operators in states, academic and specialized telecommunications research institutions, etc.).

The ITU-T standards are developed by its Study Groups (SG) as international standards known as ITU-T Recommendations according to a contribution-led and consensus-based approach with equal rights of all ITU-T members. The SGs standardization activities are road-mapped in ITU-T Study Periods

during which SGs work on specifically defined Questions. The 5G!Drones project's life time was spanned by two periods, i.e., 2017-2021 [26] and 2022-2024 [27].

Orange Polska is an ITU-T affiliated member entitled to participate in ITU-T standardization activities. From the 5G!Drones project's scope and goals as well as the Orange Polska project team's expertise the most relevant SG is SG13 – Future networks. The contributions related to the project scope are:

SG13, Question 20: Networks beyond IMT-2020 and machine learning: Requirements and architecture

- Draft recommendation IMT2020-AINDO-req-frame: “Requirements and framework for AI-based network design optimization in future networks including IMT-2020” – the contribution concerning inclusion of the KPI prediction requirement, extension of Network design optimization orchestration requirements, and extension of the functional architecture to include KPI prediction and coordination components as well as reconfiguration and KPI databases.
- Draft recommendation Y.IMT2020-SOCN-req-frame: “Future networks including IMT-2020: requirements and framework for self-organizing core network” – the contribution concerning addition of new requirements associated with discovery of resources and services, implementing energy-efficient operations, exploiting mobility of terminals/nodes (e.g., vehicular, UAVs, etc.), ability to cope with unreliable or constrained resources, and recommended use of stateless and intent-driven protocols.

SG13, Question 21: Networks beyond IMT-2020: Network softwarization

- Draft recommendation Y.IMT-2020-DL-AINW-fra: “A communication model for AI-based management in IMT-2020 and beyond” – the contribution concerning management interfaces, slice tenant ability to reconfigure slice-allocated resources, slice KPIs, and providing the prediction probability values for trends/failures predictions.
- Draft recommendation Y.IMT2020-IBNMO: “Intent-based network management and orchestration for network slicing in IMT-2020 networks and beyond” – the contribution concerning management architecture interfaces adaptations to provide the feedback to the tenant's management layer.
- Draft recommendation Y.IMT2020-IBNMO: “Intent-based network management and orchestration for network slicing in IMT-2020 networks and beyond” – the contribution concerning slice level classification definitions (inclusion of the perspective of slice tenant).
- Draft recommendation Y.SLOA-arch: “End-to-end service level objective assurance architecture for future networks including IMT-2020” – the contribution concerning modifications of the functional architecture to reflect the business relationships, introduction of Service Level Indicator (SLI) term previously confused with Service Level Objective (SLO) and explaining the interactions in case of parameters monitoring.
- Draft recommendation Y.IMT-2020-DL-AINW-fra: “A communication model for AI-based management in IMT-2020 and beyond” – the contribution concerning addition of definitions of metadata related to network security and network accounting (both before deployment and during the slice run time).
- Draft recommendation Y.IMT2020-AINDO-req-frame: “Requirements and framework for AI-based network design optimization in future networks including IMT-2020” – the contribution concerning addition of the requirements of analysis and prediction of terminals' mobility patterns (in case of UAVs, in 3D), identification of their clusters, and exploitation of nodes' mobility for network optimization, e.g. with UAV-based base stations.

2.16. FAA

The FAA (Federal Aviation Administration) [28] was founded in April 1967. There is a long history in US aviation for government actions to improve and maintain safety standards before FAA. The aviation history of plane collisions highlights the need for air traffic control. Those historical lessons are integrated in FAA's mission: "Our continuing mission is to provide the safest, most efficient aerospace system in the world". The impact of FAA activities related to UAS is monitored in the framework of 5G!Drones. As we said earlier, there is a close connection with GUTMA in which some 5G!Drones consortium members are key contributors.

2.17. SESAR JU

As the technological pillar of Europe's ambitious Single European Sky (SES) initiative, SESAR is the mechanism which coordinates and concentrates all EU research and development (R&D) activities in ATM, pooling together a wealth expert to develop the new generation of ATM. Today, SESAR unites around 3,000 experts in Europe and beyond. In 2007, the SESAR Joint Undertaking was set up to manage this large scale and truly international public-private partnership [29].

Air traffic management (ATM) is an essential part of European air transport and aviation, connecting cities and citizens as well as boosting jobs and growth. Europe's ATM system is based on aging technology and procedures and needs updating particularly considering the expected traffic growth between now and 2035. This is where SESAR comes in. As one of the most innovative infrastructure projects ever launched by the European Union, SESAR's role is to define, develop and deploy what is needed to increase ATM performance and build Europe's intelligent air transport system.

SESAR's vision builds on the notion of trajectory-based operations' and relies on the provision of air navigation services (ANS) in support of the execution of the business or mission trajectory — meaning that aircraft can fly their preferred trajectories without being constrained by airspace configurations.

5G!Drones consortium has identified SESAR JU activities as relevant to the project and has been monitoring the activities related to SESAR JU funded projects such as GOF, GOF2.0, CORUS, and several other U-space related initiatives. These projects cover various topics that are highly relevant to the use of mobile networks, and 5G technology. Some of the projects are:

1. GOF2.0
2. PJ34 – AURA
3. CORUS-XUAM
4. AMULED
5. SAFIR MED
6. Uospace4UAM

The topics include, but not limited to:

1. UTM
2. Strategic & tactical deconfliction
3. Separation management
4. Conformance monitoring
5. Conspicuity management
6. Connectivity, and communication
7. Mobile network coverage
8. Remote ID

2.18. NASA

NASA's vision for Advanced Air Mobility (AAM) is to help emerging aviation markets to safely develop an air transportation system that moves people and cargo between places previously not served or underserved by aviation – local, regional, intraregional, urban – using revolutionary new aircraft that are only just now becoming possible. AAM includes NASA's work on Urban Air Mobility. [30]

The primary purpose of the AAM ecosystem working groups is to share input, information and opinions that may help to accelerate the development of safe, high-volume AAM flight operations in the existing and anticipated future national airspace system. A broad participation from many organizations will enable NASA, the Federal Aviation Administration (FAA), and the AAM community to supplement the existing efforts in the industry, focusing on understanding the viewpoints of a diverse group of stakeholders and an understanding of the ecosystem as a whole. The AAM ecosystem working groups, in coordination with the National Campaign series, industry developments and other ARMD efforts, will contribute to the enablement of AAM markets.

NASA seeks to accomplish the following goals:

- Communicate the current and future state of the AAM ecosystem and align on terminology, challenges, barriers, and solutions.
- Provide a forum to forge collaborative opportunities to advance the state of the art AAM, including establishing new industry partnerships.
- Increase awareness of NASA's research and planned transition paths.
- Develop a NASA-curated "Book of Requirements" for AAM technology, systems, and operations.
- Support discussions of regulatory and standards development activities at the federal, state, and local level.
- Inform the community on the current state of the industry to identify research gaps and areas of highest industry need.
- Engage the public on AAM, including stakeholders from state and local governments.

5G!Drones project has identified NASA AAM initiative as highly relevant to the consortium and has been monitoring the activities related to NASA AAM working groups and topics related to:

1. Command and control
2. Network coverage
3. Air & ground risk
4. Remote ID
5. Separation and deconfliction
6. Integration of mobile network with UAS ecosystem

2.19. EUROCAE

5G!Drones consortium has identified as relevant EUROCAE monitoring and followed activities related to WG-105 dedicated to UAS. EUROCAE (European Organization for Civil Aviation Equipment) is a non-profit organization with the objective to develop standards for European civil aviation. Here is an extract from their website [31]:

WG-105 is tasked to develop standards and guidance documents that will allow the safe operation of UAS in all types of airspace, at all times and for all types of operations.

The work of WG-105 is organized in six Focus Teams working in a specific area. The current Focus Areas are:

- UAS Traffic Management (UTM)
- Command, Control, Communication (C3)
- Detect and Avoid (DAA)
- Design and Airworthiness Standards
- Specific Operations Risk Assessment (SORA)
- Enhanced RPAS Automation (ERA)

The work of the Focus Teams is coordinated by a Steering Committee ensuring consistency across their developments. WG-105 works in coordination with RTCA SC-228 for Unmanned Aircraft Systems.

2.20. RTCA

The Radio Technical Commission for Aeronautics (RTCA) is a US volunteer organization developing technical guidance for use by government regulatory authorities and by industry. RTCA works with the Federal Aviation Administration (FAA) to develop comprehensive, industry-vetted and endorsed standards that can be used as means of compliance with FAA regulations.

Unfortunately, 5G!Drones partners did not find the opportunity to provide contributions to this working group. However, the consortium still followed its progress and took into consideration its output for the definition of trials.

2.21. EASA

5G!Drones consortium has also taken into account outcomes of EASA activities, in order to prepare its different trials. In particular, rules published in April 2020 [32]:

The European Union Aviation Safety Agency (EASA) has published the first view worldwide on the use and control of drones in an urban environment, balancing the desire to maximize the commercial and convenience benefits of drones against the need to ensure the safety and privacy of citizens and the potential environmental impact on our cities.

The challenge of integrating drones into urban environments is that these areas are already densely used by ground traffic, other types of air traffic – such as commercial airplanes, other civil aviation and police or hospital helicopter services – and also people, concerned about noise, privacy and the possibility of low-level flights causing accidental injury.

RXB also significantly contributed to the publication of a proposal for implementation of U-space by EASA (NPA 2021-14). They were leaders for one of the experts working groups formed by EASA. The objective of this Notice of Proposed Amendment (NPA) is to maintain a high level of safety for unmanned and manned aircraft operations in the U-space airspace [33].

2.22. ASD-STAN

ASD-STAN (AeroSpace and Defense Industries Association of Europe – Standardization) is an Associated Body to CEN (European Committee for Standardization) for Aerospace Standards. Its role is to establish, develop and maintain standards on behalf of European aerospace industry. During this project, 5G!Drones consortium was following activities achieved within ASD-STAN body and reported relevance for taking into account some inputs like “BS 9129. Unmanned aircraft systems (UAS). Registration and identification” [34].

2.23. ISO

ISO/TC 20/SC 16, Unmanned Aircraft Systems, was formed in 2014. Its scope is the following: Standardization in the field of unmanned aircraft systems (UAS) including, but not limited to: Classification, Design, Manufacture, Operation (including maintenance) & Safety Management of UAS operations [35].

ISO has consolidated its reputation in the fields of safety and quality and published widely accepted certification mechanisms. Several working groups with assigned work items are defined within ISO TC/20 SC/16:

- WG 1: General. This Working Group specifies general requirements for UAS for civil applications in support of other standards created within ISO/TC 20/SC 16. 5G!Drones consortium has identified as relevant:
 - ISO/CD 21384-1, Unmanned aircraft systems -- Part 1: General specification
 - ISO/CD 21384-4, Unmanned aircraft systems -- Part 4: Vocabulary
 - Published May 2020.
 - ISO/CD 21895, Categorization and classification of civil unmanned aircraft systems
 - Published February 2020.
- WG 2: Product manufacturing and maintenance. This Working Group specifies the quality and safety requirements for components of unmanned aircraft systems (UAS) to influence the design and manufacturing process.
 - This group is focusing on the individual components that comprise a UAS to further operational safety.
 - The standards will include information regarding components associated with the unmanned aircraft, any associated remote control station(s), the command and control links, any other required data links (e.g., payload, traffic management information, vehicle identification) and any other system elements as may be required.
 - Future standards may include technical specifications for the design and manufacturing of UAS components, where creating a standard will enhance UAS safety or interoperability.
 - 5G!Drones is interested in the evolution of two work items:
 - ISO/CD 21384-2, Unmanned aircraft systems -- Part 2: Product systems
 - Published December 2021.
 - ISO/WD 24356, General requirements for tethered unmanned aircraft system
 - Published August 2022.

- WG 3: Operations and procedures (including training). This Working Group details the requirements for safe commercial UA operations and applies to all types, categories, classes, sizes and modes of operation of UA. It develops international standards that detail the requirements for safe civil RPAS/UAS operations. More specifically, the working group aims to provide international quality standards for operational safety and applies to all types, categories, classes, sizes, and modes of operation of UAS. Work items:
 - ISO 21384-3, Unmanned aircraft systems -- Part 3: Operational procedures
 - Published November 2019.
 - ISO/DIS 23665, Unmanned Aircraft Systems -- Training of Operators
 - DIS ballot opened 28 September 2022.
 - ISO/NP 5015-2, Operation of vertiports for vertical take-off and landing (VTOL) unmanned aircraft (UA)
 - Published August 2022.
- WG 4: UAS Traffic Management. WG4 scope consists in establishing international standards and guidelines in the area of Unmanned Aircraft Systems Traffic Management. The standards and guidelines are to be developed aligned with the rules and guidance provided by aviation authorities. Work items identified:
 - ISO TR 23629-1, UTM - Part 1: General requirements for UTM -- Survey results on UTM
 - Technical Report published in April 2020.
 - ISO/WD 23629-5, UTM – Part 5: UTM functional structure
 - Under development.
 - ISO/CD 23629-7, UTM – Part 7: Data model for spatial data
 - Published September 2021.
 - ISO/PWI 23629-8, UTM – Part 8: Remote identification
 - Under development.
 - ISO/23629-12, UTM – Part 12: Requirements for UTM services and service providers
 - Published July 2022.
- WG 5: Testing and evaluation. Testing and evaluation of UAS for safety and quality of product.
 - ISO/DIS 4358, Test methods for civil multi-rotor unmanned aircraft system
 - Final text received or FDIS registered for formal approval, November 2022.
 - ISO/AWI TR 4595, Suggestion for improvement in the guideline for UA testing classification
 - Under development.
 - ISO/CD TR 4594, UA wind gust test
 - Under development, voting closed November 2022.
 - ISO/AWI TS 4584.2, Improvement in the guideline for UA testing/design of accelerated lifecycle testing (ALT) for UAS/Sub-system/components
 - Under development.
- WG 6: UAS Subsystems. Development of standards for UAS subsystems
 - ISO/FDIS 24352, Tech Requirements for small UAS Electric Energy System

- Final text received or FDIS registered for formal approval, October 2022.
- ISO/DIS 24354, Payload interface for Small, Civil UAS
 - DIS ballot initiated, September 2022.
- ISO/DIS 24355, Flight control system for Small Multirotor UAS
 - Final text received or FDIS registered for formal approval, November 2022.
- Ad Hoc group: Collision Avoidance (AG04). Created at 9th SC 16 plenary in November 2019, this group will review detect and avoid systems and autonomous collision avoidance. There is no relevant activity so far 5G!Drones consortium is monitoring.

Some liaisons are set up to ISO TC/20 SC/16: ASD-STAN, EUROCAE, GUTMA, IEEE, OGC, SAE International.

2.24. LAANC

LAANC is the Low Altitude Authorization and Notification Capability, a collaboration between FAA and Industry. It directly supports UAS integration into the airspace, that is why it was revealed as relevant within 5G!Drones to better understand its role. [36]

LAANC provides:

- Drone pilots with access to controlled airspace at or below 400 feet.
- Awareness of where pilots can and cannot fly.
- Air Traffic Professionals with visibility into where and when drones are operating.

Through the UAS Data Exchange, the sharing of airspace data between the FAA and companies approved by the FAA is facilitated by LAANC, to provide its services. The companies are known as UAS Service Suppliers – and the desktop applications and mobile apps to utilize the LAANC capability are provided by the UAS Service Suppliers (USS).

LAANC automates the application and approval process for airspace authorizations. Through automated applications developed by an FAA Approved UAS Service Supplier (USS), pilots apply for an airspace authorization.

Requests are checked against multiple airspace data sources in the FAA UAS Data Exchange such as UAS Facility Maps, Special Use Airspace data, Airports and Airspace Classes, as well as Temporary Flight Restrictions and Notices to Airmen. If approved, pilots can receive their authorization in near-real time.

Unless specifically requested in an authorization, drone pilots do not need to notify the tower before they fly.

LAANC provides airspace authorizations only. Pilots must still check Notices to Airmen, weather conditions, and abide by all airspace restrictions.

2.25. ARC

The Federal Aviation Administration (FAA or the Agency) chartered the Unmanned Aircraft Systems (UAS) Identification (ID) and Tracking Aviation Rulemaking Committee (ARC) (UAS-ID ARC) to provide recommendations to the FAA regarding technologies available for remote identification and tracking of UAS, which will be a crucial topic when implementing 5G!Drones use cases. This was used as a basis for the FAA proposed rule on Remote Identification [37].

ARC reports on available technologies for UAS remote ID tracking identified eight viable technologies for UAS ID tracking: Automatic Dependent Surveillance Broadcast (ADS-B); Low Power Direct RF; Networked Cellular; Satellite; SW-based Flight Notification with Telemetry; Unlicensed Integrated C2; Physical Indicator; and Visual Light Encoding.

3. CONCLUSION

This document presents all the standardisation activities and contributions at international fora achieved by the consortium during the whole duration of the project, from M1 (June 2019) to M42 (November 2022). It is an update of D5.3.

Since the beginning of the project, 5G!Drones consortium has established a complete landscape of the Standards Development Organization (SDOs) as well as various associations relevant within 5G!Drones frameworks, including 3GPP, GSMA, GUTMA, ACJA, CEPT/ECC, ASTM, ETSI, IETF, BNAE, Drone REGIM, 5G-PPP (Pre standardization working group), FAA, SESAR JU, NASA, EUROCAE, EASA, ASD-STAN, ISO, LAANC, ARC.

This deliverable presents an overview of those different organizations, their vision and objectives, identified as relevant for 5G!Drones. It describes the role of each Working Group, and particularly those in which 5G!Drones partners are involved. Consortium members emphasized on their strategy to contribute to the different organizations and associations, in relation with the project's subjects of interest. In this document, we also recall some outstanding contributions from M1 to M18 (extracted from D5.3), and of course introduce new contributions achieved until M42.

During the whole duration of the project, many partners of 5G!Drones consortium have closely monitored standardization activities of these associations, so that the project technical work packages could take into account relevant outcomes but have also actively contributed, providing inputs within the context of the project.

REFERENCES

- [1] Y. Zeng, J. Lyu and R. Zhang, "Cellular-Connected UAV: Potential, Challenges, and Promising Technologies," vol. 26, no. 1, 2019.
- [2] 3GPP Release 16, "Release 16," 3GPP, [Online]. Available: <https://www.3gpp.org/release-16>. [Accessed 21.09.2022].
- [3] 3GPP TS 23.502, "Procedures for the 5G System (5GS)," 3GPP Technical Specification.
- [4] 3GPP TR 36.777 V15.0.0 (2017-12), "Enhanced LTE support for aerial vehicles," Technical Specification Group Radio Access Network (Release 15).
- [5] 3GPP TS 22.125, "Unmanned Aerial System (UAS) support in 3GPP," 3GPP Technical specification, SA1 (Release 26).
- [6] 3GPP TS 22.261 V17.2.0 (2020-03), "Service requirements for the 5G system," 3GPP Technical specification (Release 17).
- [7] 3GPP TR 23.754 V0.1.0 (2020-01), "Study on supporting Unmanned Aerial Systems (UAS) connectivity, Identification and tracking," 3GPP Technical report (Release 17).
- [8] 3GPP TR 23.755 V0.7.0 (2020-04), "Study on application layer support for Unmanned Aerial Systems (UAS)," 3GPP Technical report (Release 17).
- [9] 3GPP TS 23.255 V17.3.0 (2022-03), "Application layer support for Uncrewed Aerial System (UAS); Functional architecture and information flows" 3GPP Technical specification (Release 17).
- [10] 3GPP TS 22.434 V17.7.0 (2022-09), "Service Enabler Architecture Layer for Verticals (SEAL); Functional architecture and information flows" 3GPP Technical specification (Release 16).
- [11] 3GPP TS 23.256 V17.4.0 (2022-09), "Support of Uncrewed Aerial Systems (UAS) connectivity, identification and tracking; Stage 2" 3GPP Technical specification (Release 17).
- [12] 3GPP TR 23.700-55 V1.1.0 (2022-10), "Study on enhanced Application Architecture for UAS applications" 3GPP Technical report (Release 18).
- [13] GSMA, "GSMA web site," GSMA, [Online]. Available: <https://www.gsma.com/>. [Accessed 21.09.2022].
- [14] GUTMA, "GUTMA Web site," The Global UTM Association, [Online]. Available: <https://gutma.org/>. [Accessed 21.09.2022].
- [15] GUTMA, "GUTMA publishes Position Paper on EU's Drone Strategy 2.0," The Global UTM Association, [Online]. Available: <https://gutma.org/blog/2022/03/17/gutma-publishes-position-paper-on-eus-drone-strategy-2-0/>. [Accessed 02.11.2022].
- [16] ACJA, "ACJA Web site," ACJA, [Online]. Available: <https://gutma.org/acja/>. [Accessed 21.09.2022].

- [17] "GSMA and GUTMA launch new joint initiative to align mobile and aviation industries," GSMA, [Online]. Available: <https://www.gsma.com/iot/news/gsma-and-gutma-launch-new-joint-initiative-to-align-mobile-and-aviation-industries/>. [Accessed 21.09.2022].
- [18] ECC, "ELECTRONIC COMMUNICATIONS COMMITTEE," CEPT, [Online]. Available: <https://cept.org/ecc/>. [Accessed 21.09.2022].
- [19] CEPT/ECC, "ECC Report 309," Eco documentation. [Online]. Available: <https://docdb.cept.org/document/15236>. [Accessed: 03-Nov-2022]
- [20] CEPT/ECC, "ECC consultation," CEPT. [Online]. Available: <https://cept.org/ecc/tools-and-services/ecc-consultation>. [Accessed: 03-Nov-2022]
- [21] IETF, "IETF web site," Internet Engineering Task Force, [Online]. Available: <https://www.ietf.org/>. [Accessed 21.09.2022].
- [22] IETF, "Drone Remote ID Protocol (drip)," IETF, [Online]. Available: <https://datatracker.ietf.org/wg/drip/about/>. [Accessed 21.09.2022].
- [23] IETF DRIP, "Public release of Drip Code 0.1," IETF DRIP, [Online]. Available: <https://www.ida.liu.se/~andqu38/drip/>. [Accessed: 03-Nov-2022]
- [24] BNAE, "BUREAU DE NORMALISATION DE L'AÉRONAUTIQUE ET DE L'ESPACE," 2020. [Online]. Available: <https://bnae.fr/>. [Accessed 21.09.2022].
- [25] ITU, "Constitution and Convention of the International Telecommunication Union," ITU, [Online]. Available: <https://treaties.un.org/Pages/showDetails.aspx?objid=08000002800b0730&clang=en>. [Accessed: 03-Nov-2022]
- [26] ITU-T, "ITU-T study groups (study period 2017 - 2021)," ITU-T. [Online]. Available: <https://www.itu.int/en/ITU-T/studygroups/2017-2020/Pages/default.aspx>. [Accessed: 03-Nov-2022]
- [27] ITU-T, "ITU-T study groups (study period 2022 - 2024)," ITU-T. [Online]. Available: <https://www.itu.int/en/ITU-T/studygroups/2022-2024/Pages/default.aspx>. [Accessed: 03-Nov-2022]
- [28] FAA, "Unmanned Aircraft Systems (UAS)," FAA, [Online]. Available: <https://www.faa.gov/uas/>. [Accessed 21.09.2022].
- [29] S. JU, "SESAR JU: HIGH PERFORMING AVIATION FOR EUROPE," 2020. [Online]. Available: <https://www.sesarju.eu/>. [Accessed 21.09.2022].
- [30] N. AAM, "NASA AAM," 2020. [Online]. Available: <https://www.nasa.gov/aam/>. [Accessed 21.09.2022].
- [31] EUROCAE, "EUROCAE," 2020. [Online]. Available: <http://www.eurocae.net/>. [Accessed 21.09.2022].
- [32] EASA, "EASA publishes first rules for safe drone operations in Europe's cities," EASA, 06 Apr 2020. [Online]. Available: <https://www.easa.europa.eu/newsroom-and-events/news/easa-publishes-first-rules-safe-drone-operations-europes-cities>. [Accessed 21.09.2022].

- [33] EASA, "NPA 2021-14 Development of acceptable means of compliance and guidance material to support the U-space regulation" [Online]. Available: <https://www.easa.europa.eu/en/document-library/notices-of-proposed-amendment/npa-2021-14>. [Accessed 27.09.2022].
- [34] ASD-STAN, "Unmanned aircraft systems (UAS). Registration and identification," ASD-STAN, [Online]. Available: <https://asd-stan.org/downloads/18-30379527-dc/>. [Accessed 21.09.2022].
- [35] ISO, "ISO/TC 20/SC 16 - Unmanned aircraft systems," ISO, [Online]. Available: <https://www.iso.org/committee/5336224.html>. [Accessed 21.09.2022].
- [36] LAANC, "LAANC," 2020. [Online]. Available: https://www.faa.gov/uas/programs_partnerships/uas_data_exchange/. [Accessed 21.09.2022].
- [37] ARC, "FAA Releases UAS Remote Tracking & ID ARC Report," [Online]. Available: <https://www.faa.gov/news/updates/?newsid=89404>. [Accessed 21.09.2022].