"5G for Drone-based Vertical Applications"

D6.1 – Data Management Plan and quality and risk management plan

Document ID:	**D6.1**
Deliverable Title:	**Data Management Plan and quality and risk management plan**
Responsible Beneficiary:	**UO**

Topic:	**H2020-ICT-2018-2020/H2020-ICT-2018-3**
Project Title:	**Unmanned Aerial Vehicle Vertical Applications' Trials Leveraging Advanced 5G Facilities**
Project Number:	**857031**
Project Acronym:	**5G!Drones**
Project Start Date:	**June 1st, 2019**
Project Duration:	**36 Months**
Contractual Delivery Date:	**M04**
Actual Delivery Date:	**September 30th, 2019**
Dissemination Level:	**Open Research Data Pilot (ORDP)**
Contributing Beneficiaries:	**UO, THA, INV, COS, AIR, NOK**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857031.

Document ID: D6.1
Version: V6
Version Date: 30.9.2019
Authors: Jussi Haapola (UO)

Security: Open Research Data Pilot (ORDP)

Approvals

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Document History

Version	Contribution	Authors	Date
V1	**Initial version of quality and risk management plan**	**Jussi Haapola (UO)**	**23.08.2019**
V2	**Initial version of Data Management Plan**	**UO, AIR, INV**	**28.08.2019**
V3	**Additions**	**Ilkka Kansala (NOK)**	**08.09.2019**
V4	**Review**	**THA, AIR, COS**	**11.09.2019**
V5	**Revision after PMT review**	**Jussi Haapola (UO)**	**16.09.2019**
V6	**Final version**	**Jussi Haapola (UO)**	**30.09.2019**

Executive Summary

This deliverable will provide a Data Management Plan for the 5G!Drones project. It will also define the quality and risk management procedures to be used throughout the project. These procedures will be applied to ensure consistent quality of all project outcomes and deliverables. The Data Management Plan portion of the deliverable is a living document that will be updated during the 5G!Drones project lifecycle.

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List of Abbreviations

3GPP	3rd Generation Partnership Project
5G	5th Generation Cellular Technology
5G-PPP	5G Infrastructure Public Private Partnership
ADS-B	Automatic Dependent Surveillance – Broadcast
API	Application Interface
AR	Augmented Reality
BVLoS	Beyond Visual Line of Sight
CAA	Civil Aviation Authority
CC	Creative Commons
CoTS	Commercial Off-The-Shelf
DMP	Data Management Plan
EAB	External Advisory Board
eMBB	Enhanced Mobile Broadband
EPC	Evolved Packet Core
ETSI	European Telecommunications Standards Institute
FAIR	Findable, Accessible, Interoperable, Re-usable
FCT	Facility Coordination Team
FR	Financial Report
GA	General Assembly
GDPR	General Data Protection Regulation
GNSS	Global Navigation Satellite System
GUI	Graphical User Interface
ICAO	International Civil Aviation Organization
IMT	Innovation Management Team
IoT	Internet of Things
IPR	Intellectual Property Rights
IR	Internal Report
JSON	JavaScript Object Notation
KPI	Key Performance Indicator
LiDAR	Light Detection and Ranging

LADN	Local Area Data Network
LTE	Long-Term Evolution
MANO	Management and Orchestration
MEC	Multi-access Edge Computing
mMTC	Massive Machine-Type Communications.
MoM	Minutes of Meeting
MS	Microsoft
PC	Project Coordinator
PCI	Physical Cell Id
PIA	Privacy Impact Assessment
PID	Persistent Identifier
PMT	Project Management Team
PSI	Public Service Identity
QMR	Quarterly Management Report
RAN	Radio Access Network
RRC	Radio Resource Control
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSSI	Received Signal Strength Indicator
SNR	Signal to Noise Ratio
SORA	Specific Operations Risk Assessment
SSH	Secure Shell
TM	Technical Manager
ToC	Table of Contents
UAS	Unmanned Aerial Systems
UAV	Unmanned Aerial Vehicle
UE	User Equipment
uRLLC	Ultra-Reliable Low Latency Communications
UTM	UAS Traffic Management
VNF	Virtualised Network Function
VPN	Virtual Private Network

VR	Virtual Reality
WP	Work Package
WPL	Work Package Leader

1. DATA MANAGEMENT PLAN

1.1. Data summary

The 5G!Drones project will collect and generate data for mainly two purposes: 1) for trialling unmanned aerial systems (UAS) key performance indicators (KPIs) using 5G technology as a use case enabler; and 2) For trialling 5G technology components KPIs using UAS verticals as service users. For the former there exist three main use cases with a number of scenarios ranging from 3D mapping and data visualisation to operations in non-GPS locations to disaster recovery and unmanned aerial vehicle (UAV)-enhanced internet of things (IoT) data collection. A common use case then is UAS traffic management (UTM) command and control applications. For the latter effective UAV operations can significantly benefit from 5G infrastructure and the trials relate to how well 5G components, such as enhanced mobile broadband (eMBB), ultra-reliable low latency communications (uRLLC), massive machine type communications (mMTC), network slicing, multi-access edge computing (MEC), and management and orchestration (MANO) can service UAVs.

The purpose of the Data Management Plan (DMP) is to provide an analysis of the main elements of the data management policy that will be used in the 5G!Drones project with regard to the project research and trials data. The DMP covers the complete data life cycle. It describes the types of research and trials data that will be generated or collected during the project, the standards that will be used, how the research data will be preserved and what parts of the datasets will be shared for verification and/or reuse.

The DMP is a living document, which will evolve during the project, particularly whenever significant changes arise such as dataset updates, or changes in Consortium policies. This deliverable is the first version of the DMP, delivered in Month 4 of the project. It includes an overview of the datasets to be produced by the project, and the specific conditions that are attached to them. Although this report already covers a broad range of aspects related to the project data management, the upcoming versions provide more detail on particular issues such as data interoperability and practical data management procedures implemented by the 5G!Drones project.

The 5G!Drones project high-level objective 1 is: *Analysis of the performance requirements of UAV verticals' applications and business models in 5G*. The objective provides a deep analysis of the UAV use case requirements in terms of the needed network functionalities and the required application performance to validate. Business models will be also derived. The objective provides definition of the required 5G network functionalities to run the UAV use cases as well as the definition of the KPIs of the UAV applications involved in 5G!Drones use cases. In addition, the objective provides a techno-economic study of UAVs utilising cellular technology as a service enabler. This objective's relation to generated data relates to what actual data will be generated as analysis and evidence of the project trials. Furthermore, processing of the generated data and studies lead to scientific publications, white papers, standardisation input, etc.

The objective 2 is: *Design and implementation of the 5G!Drones software layer (or system) to execute UAV trials*. Designing and implementation of the 5G!Drones trial system, which will be in charge of running the UAV trials using the ICT-17 facility components and 5G!Drones enablers developed during the project. The envisioned 5G!Drones system abstracts the low-level details on the usage of 5G facilities resources, by providing a high-level application interface (API) to describe, run and obtain results on the specific KPIs. This is the trial enabler software that will not generate data itself but will be used for executing trials. The architecture and API descriptions will be public, whereas the software itself will be Consortium confidential. The software is sufficiently close to several of the Consortium Partners core business areas so that confidentiality is required.

The objective 3: *Design a high-level scenario descriptor language to run and analyse the results of the UAV trials* relates to designing a high-level (or Northbound) API to allow a UAV vertical to configure a trial and run the test. The research topics in this objective include devising a northbound API to describe the trial and to configure the UAV use case (e.g., type of 5G service it requires), using a high-level language, such as a JavaScript Object Notation (JSON)-based API. In addition, devising a graphical user interface (GUI) to display results and KPIs and providing data analytics tools to analyse the results are among the topics. Devising a management interface to allow a vertical to have access to the Network Slice(s) running its services, for high-level configuration and management is also required. Again, the specifications of the high-level API are public information, whereas the software itself will be Consortium confidential. The software is sufficiently close to several of the Consortium Partners core business area so that confidentiality is required.

The objective 5: ***Validate 5G KPIs that demonstrate execution of UAV use cases***. According to the envisioned UAV use cases and scenarios, several 5G KPIs need to be demonstrated and tested to validate UAV application requirements. The research and development topics here are performance evaluation of the different 5G!Drones use cases focusing on 5G KPIs. This objective will generate the bulk of research data in the project in addition to the objective 6: ***Validate* UAV KPIs using 5G**. These objectives translate to a number of use cases in the project. The data will be divided into public and private data. Those data that are private relate to partners' own product line development and therefore cannot be disclosed. Public data, where they are perceived to bring additional value to the research and application developer communities will be made available using the FAIR (findable, accessible, interoperable, re-usable), for example via EUDAT [1] or IDA [2] research data storage at fairdata.fi [3].

The objective 8: ***Dissemination, standardisation and exploitation of 5G!Drones*** focuses on distribution of project outcomes. The generated and processed data will be openly distributed through scientific open access fora, standardization inputs, white papers, etc. Partners will exploit the generated knowledge in their own business lines.

The types of data generated by the 5G!Drones project mainly consist of two high-level categories: **5G data** and **UAV Data**. The following subsections provide an overview of the kinds of data produced.

1.1.1. 5G data

1.1.1.1. Air interface data

One example tool to gather 5G data is Nemo Handy [4]. The tool provides the following kinds of data.

- **Status**: System Time, Logging Status, Log File Size, Log File Path, Free Storage, Free Memory, Heap Size, Battery temp, Script status, Script file, GPS status, IMEI, IMSI, System Lock (LTE Only), Band lock (e.g. LTE FDD 2600 band 7), GSM BCCH lock, WCDMA Cell Lock, LTE Cell Lock, APN (e.g. 5GTN Oulu), PDP type (IP), Interface, Address (192.168...), Gateway (192.168...), DNS (185.38.2.36...), and NSAPI. These data are actual metadata that can be stored as metadata using Qvain [5] in order to understand the actual data in the research data storages.
- **Script**: Active transactions and Script commands. These data are not stored and they have no metadata value.
- **Signalling:** requests, master information, system information, radio resource control (RRC) connections, etc. These data can be stored as a part of the research data in case they bring added value to processing the data.

- **Summary:** Serving Carrier RSSI (dBm), Serving SNR (dBm), Serving RSRQ, Serving RSRP, Serving PCI, Detected RSRQ, Detected RSRP, Detected PSI. These data serve a purpose in validating the 5G KPIs and are core validation data generated by the tool.
- **LTE Cell measurements:** Depicts various parameters of the LTE cell. Also produces graphical plotting of the measured information. These data are important in the validations of the trials.
- **Application throughput:** Downlink and uplink. These data are essential in validation of trials and potential material for large data sets.

Specifically, the Nemo Handy provides log file export in a compressed .zip file containing MS Excel comma delimited file as well as and a map file (.nmf). Although, the above describes measurements for LTE communications, similar measurements and data sets will be obtained for 5G radio interfaces.

Table 1: 5G Air-Interface Data Set

Function	Purpose	Objectives
Purpose of the data	5G air interface validation	Verify Trials
Type and format of Data	Log files for post processing	.txt, .xlsx, .nmf, .m, .csv
Text	Readme files to understand data	.txt
Numeric	Log tables	.txt, .xlsx, .nmf, .m, .csv
Reused-data (rd)	No	Data will be generated in the trials.
Observational	Data captured in real-time during trials	Trial validation
Data set is:	Revisable	
Quantity	10s to 1000s of MB per trial.	
Data Security & Storage	Institute network drive, IDA [2], EUDAT [1].	Accessible only with user credentials and strong authentication / VPN. IDA and EUDAT user credentials.
Data value (long term)	Data may be used for offline algorithm development regarding radio environment of 5G both indoors and outdoors.	Data may have value for up to five years after the end of the project.
FAIR data		
Making data findable		
Discoverability of data (metadata provision)	Metadata using Qvain. Descriptive, administrative and structural metadata.	Qvain fields: content description, actors, rights and licenses, temporal and spatial coverage, relations and history, and files.
Identifiability of data	Data will be made available using persistent identifiers (PIDs).	PID generated e.g. using **https://etsin.fairdata.fi/** [6]

Naming conventions used	Naming convention using 5G!Drones, Use Case, Trial Site, version, and date.	
Search keywords approach	E.g., Qvain metadata search using etsin [6].	
Clear versioning approach	E.g., versioning using Qvain Relations and History fields.	Traceability, e.g. using DataCite [7] or Dublin Core metadata standard [9].
Standards or procedures for metadata creation applied	E.g. DataCite metadata schema	
Making data openly accessible		
Data openly available	Data is the property of the 5G!Drones Partners participating in the trials. Data is shared among the 5G!Drones partners based on the Consortium Agreement.	Data that is not in Partners direct business interests can be made public, if they serve a purpose for the community at large.
Data kept closed	Industrial partners	Data close to own product line development. Data from partners own products (e.g. log and telemetry files)
Data kept closed	Academic and research institute partners	Data exposing infrastructure based on background commitments.
How data will be made available	Open research archives: EUDAT, IDA, Zenodo [8]. Use of persistent identifiers and metadata.	
SW documentation and other information needed	Any publicly made available data shall be accompanied by a readme.txt file describing the details required accessing the data.	
Repository for deposit of data, metadata, documentation and code	Private data will be stored in private GIT repositories and Partners' internal storage drives. Publicly available data will use e.g. EUDAT, IDA, or Zenodo repositories with associated metadata using Qvain and persistent identifiers.	
Access restrictions	During trials data generation, processing, and analysis data is kept internal to 5G!Drones.	Data with re-use value will be made public after their respective 5G!Drones deliverables have been published.

Data interoperability assessment	Data interoperability will be ensured by use of e.g. DataCite metadata schema or Dublin Core metadata standard.	By default, no proprietary software is required access public data. Partners' proprietary software data will be exported and method of access to the data is defined in accompanied readme.txt file.
Making data interoperable		
Standard vocabulary or mapping to commonly used ontologies	By use of e.g. ELSST [10] thesaurus or Finto [11].	
Data licensing for wide reuse	Publicly made available data sets are by default under Creative Commons (CC) licensing. The Consortium may adopt specific license terms for specific data sets.	CC0 or CC by, sa, nc, nd, or any combination thereof.
Increase data re-use (through clarifying licenses)		
Timing of data availability for re-use (incl. indications on embargo).	Data can be made public after their reposting in respective deliverables.	A Partner may request an embargo period of up to one year.
Data usability by Third Parties (after the end of the project)	Publicly made data will be available for third parties for up to five years after the end of the project, after which the data is likely stale.	
Restrictions to data re-use	The 5G!Drones Consortium Agreement defines restrictions on making data public or with specific usage terms	Certain data cannot be disclosed due to sensitivity of being close to Partner product line development or they would expose Partners product details.
Quality assurance process	Data to be made public is reviewed and accepted by the 5G!Drones consortium.	Data will be generated for trials. Analysis of the data will verify trial success. Trials are reported in deliverables, whose quality is assured by the quality assurance plan D6.1.
Length of time of data re-usability	It can be expected the data will be re-usable for up to five years after the end of the project.	
Allocation of resources		

Costs estimates for making data FAIR	Costs are expected to be in the range of hundreds to a few thousands of Euros per annum.	During project lifetime, costs can be covered from Equipment costs. After the project, Partners individually bear the costs.
Data Management Responsibilities	Each Partner has their own data management policies. For example, UO policies can be found from **https://www.oulu.fi/university/node/43683**.	

1.1.1.2. User equipment data

User equipment (UE) within the context of 5G!Drones are attached to UAVs. The generated data partially coincides with air interface data and the data set description and FAIR use of data essentially coincides with that of Table 1. In addition to the above-described air-interface data, the UE collect 5G standard based log files, including throughput, latency, jitter, etc. The UE will have an essential role in validating project 5G key performance indicators, such as enhanced mobile broadband, ultra-reliable low latency communications, and massive machine type communications.

1.1.1.3. Base station data

Regardless whether the base station is 4G, 5G non-stand alone, or 5G stand-alone the base station manages signalling, synchronisation and RRC. These data, derived from the 5G!Drones use case trials may be of re-use value and needs to be managed. The base station may be a macro base station servicing outdoors area or a small cell base station servicing from indoor UAV use. The base station data set can be found from Table 2.

Table 2: Base Station Data Set

Function	Purpose	Objectives
Purpose of the data	4G, 5G non-stand alone and 5G stand-alone validation	Verify Trials
Type and format of Data	Log files for post processing	.txt, .xlsx .m, .csv
Text	Readme files to understand data	.txt
Numeric	Log tables	.txt, .xlsx, .m, .csv
Reused-data (rd)	No	Data will be generated in the trials.
Observational	Data captured in real-time during trials	Trial validation
Data set is:	Revisable	
Quantity	10s to 1000s of MB per trial.	
Data Security & Storage	Institute network drive, IDA [2], EUDAT [1].	Accessible only with user credentials and strong

		authentication / VPN. IDA and EUDAT user credentials.
Data value (long term)	Data may be used for offline algorithm development for optimization of radio resource scheduling both indoors and outdoors.	Data may have value for up to five years after the end of the project.
FAIR data		
Making data findable		
Discoverability of data (metadata provision)	Metadata using Qvain. Descriptive, administrative and structural metadata.	Qvain fields: content description, actors, rights and licenses, temporal and spatial coverage, relations and history, and files.
Identifiability of data	Data will be made available using persistent identifiers.	PID generated e.g. using **https://etsin.fairdata.fi/** [6]
Naming conventions used	Naming convention using 5G!Drones, Use Case, Trial Site, version, and date.	
Search keywords approach	E.g., Qvain metadata search using etsin [6].	
Clear versioning approach	E.g., versioning using Qvain Relations and History fields.	Traceability, e.g. using DataCite [7] or Dublin Core metadata standard [9].
Standards or procedures for metadata creation applied	E.g. DataCite metadata schema	
Making data openly accessible		
Data openly available	Data is the property of the 5G!Drones Partners participating in the trials. Data is shared among the 5G!Drones partners based on the Consortium Agreement.	Data that is not in Partners direct business interests can be made public, if they serve a purpose for the community at large.
Data kept closed	Industrial partners	Data close to own product line development. Data from partners own products (e.g. log and telemetry files)
Data kept closed	Academic and research institute partners	Data exposing infrastructure based on background commitments.
How data will be made available	Open research archives: EUDAT, IDA, Zenodo [8]. Use of persistent identifiers and metadata.	

SW documentation and other information needed	Any publicly made available data shall be accompanied by a readme.txt file describing the details required accessing the data.	
Repository for deposit of data, metadata, documentation and code	Private data will be stored in private Partners' internal storage drives. Publicly available data will use e.g. EUDAT, IDA, or Zenodo repositories with associated metadata using Qvain and persistent identifiers.	
Access restrictions	During trials data generation, processing, and analysis data is kept internal to 5G!Drones.	Data with re-use value will be made public after their respective 5G!Drones deliverables have been published.
Data interoperability assessment	Data interoperability will be ensured by use of e.g. DataCite metadata schema or Dublin Core metadata standard.	Partners' proprietary software data will be exported and method of access to the data is defined in accompanied readme.txt file.
Making data interoperable		
Standard vocabulary or mapping to commonly used ontologies	By use of e.g. ELSST [10] thesaurus or Finto [11].	
Data licensing for wide reuse	Publicly made available data sets are by default under Creative Commons licensing. The Consortium may adopt specific license terms for specific data sets.	CC0; or CC by, sa, nc, nd, or any combination thereof.
Increase data re-use (through clarifying licenses)		
Timing of data availability for re-use (incl. indications on embargo).	Data can be made public after their reposting in respective deliverables.	A Partner may request an embargo period of up to one year.
Data usability by Third Parties (after the end of the project)	Publicly made data will be available for third parties for up to five years after the end of the project, after which the data is likely stale.	
Restrictions to data re-use	The 5G!Drones Consortium Agreement defines restrictions on making data public or with specific usage terms	Certain data cannot be disclosed due to sensitivity of being close to Partner product line development or they would expose Partners product details.

Quality assurance process	Data to be made public is reviewed and accepted by the 5G!Drones consortium.	Data will be generated for trials. Analysis of the data will verify trial success. Trials are reported in deliverables, whose quality is assured by the quality assurance plan D6.1.
Length of time of data re-usability	It can be expected the data will be re-usable for up to five years after the end of the project.	
Allocation of resources		
Costs estimates for making data FAIR	Costs are expected to be in the range of hundreds to a few thousands of Euros per annum.	During project lifetime, costs can be covered from Equipment costs. After the project, Partners individually bear the costs.
Data Management Responsibilities	Each Partner has their own data management policies. For example, UO policies can be found from **https://www.oulu.fi/university/node/43683**.	

1.1.1.4. Core network data

The evolved packet core (EPC) network has many functions. A schematic of 5G non-stand alone access with EPC flow can be found from [12]. Within the context of 5G!Drones slice management and end-to-end 5G KPI fulfilment are of significant interest. Significant amounts of data are generated for trialling purposes, but the re-use value of the data may be low. As such, core network data will only be made public if during the project execution the consortium perceives re-use value in the data. The core network data set is described in Table 3.

Table 3: Core Network Data Set

Function	Purpose	Objectives
Purpose of the data	Slicing, end-to-end KPI (eMBB, uRLLC, mMTC) validation	Verify Trials
Type and format of Data	Log files for post processing	.txt, .xlsx .m, .csv
Text	Readme files to understand data	.txt
Numeric	Log tables	.txt, .xlsx, .m, .csv
Reused-data (rd)	No	Data will be generated in the trials.
Observational	Data captured in real-time during trials	Trial validation
Data set is:	Revisable	

Quantity	100s to 1000s of MB per trial.	
Data Security & Storage	Institute network drive, IDA [2], EUDAT [1].	Accessible only with user credentials and strong authentication / VPN. IDA and EUDAT user credentials.
Data value (long term)	Data may be used for slicing and management and orchestration algorithm development.	Data may have value for up to three years after the end of the project.
FAIR data		
Making data findable		
Discoverability of data (metadata provision)	Metadata using Qvain. Descriptive, administrative and structural metadata.	Qvain fields: content description, actors, rights and licenses, temporal and spatial coverage, relations and history, and files.
Identifiability of data	Data will be made available using persistent identifiers.	PID generated e.g. using **https://etsin.fairdata.fi/** [6]
Naming conventions used	Naming convention using 5G!Drones, Use Case, Trial Site, version, and date.	
Search keywords approach	E.g., Qvain metadata search using etsin [6].	
Clear versioning approach	E.g., versioning using Qvain Relations and History fields.	Traceability, e.g. using DataCite [7] or Dublin Core metadata standard [9].
Standards or procedures for metadata creation applied	E.g. DataCite metadata schema	
Making data openly accessible		
Data openly available	Data is the property of the 5G!Drones facility owners participating in the trials. Data is shared among the 5G!Drones partners based on the Consortium Agreement.	Data that is not in Partners direct business interests can be made public, if they serve a purpose for the community at large.
Data kept closed	Industrial partners	Data close to own product line development. Data from partners own products (e.g. log and telemetry files)
Data kept closed	Academic and research institute partners	Data exposing infrastructure based on background commitments.

How data will be made available	Open research archives: EUDAT, IDA, Zenodo [8]. Use of persistent identifiers and metadata.	
SW documentation and other information needed	Any publicly made available data shall be accompanied by a readme.txt file describing the details required accessing the data.	
Repository for deposit of data, metadata, documentation and code	Private data will be stored in private Partners' internal storages or repositories. Publicly available data will use e.g. EUDAT, IDA, or Zenodo repositories with associated metadata using Qvain and persistent identifiers.	
Access restrictions	During trials data generation, processing, and analysis data is kept internal to 5G!Drones.	Data with re-use value may be made public after their respective 5G!Drones deliverables have been published.
Data interoperability assessment	Data interoperability will be ensured by use of e.g. DataCite metadata schema or Dublin Core metadata standard.	Partners' proprietary software data will be exported and method of access to the data is defined in accompanied readme.txt file.
Making data interoperable		
Standard vocabulary or mapping to commonly used ontologies	By use of e.g. ELSST [10] thesaurus or Finto [11].	
Data licensing for wide reuse	Publicly made available data sets are by default under Creative Commons licensing. The Consortium may adopt specific license terms for specific data sets.	CC0; or CC by, sa, nc, nd, or any combination thereof.
Increase data re-use (through clarifying licenses)		
Timing of data availability for re-use (incl. indications on embargo).	Data can be made public after their reposting in respective deliverables.	A Partner may request an embargo period of up to one year.
Data usability by Third Parties (after the end of the project)	Publicly made data will be available for third parties for up to three years after the end of the project, after which the data is likely stale.	
Restrictions to data re-use	The 5G!Drones Consortium Agreement defines restrictions on making data public or with specific usage terms.	Certain data cannot be disclosed due to sensitivity of being close to Partner product line development or

		they would expose Partners product details.
Quality assurance process	Data to be made public is reviewed and accepted by the 5G!Drones consortium.	Data will be generated for trials. Analysis of the data will verify trial success. Trials are reported in deliverables, whose quality is assured by the quality assurance plan D6.1.
Length of time of data re-usability	It can be expected the data will be re-usable for up to three years after the end of the project.	
Allocation of resources		
Costs estimates for making data FAIR	Costs are expected to be in the range of hundreds to a few thousands of Euros per annum.	During project lifetime, costs can be covered from Equipment costs. After the project, Partners individually bear the costs.
Data Management Responsibilities	Each Partner has their own data management policies. For example, UO policies can be found from **https://www.oulu.fi/university/node/43683**.	

1.1.1.5. Multi-access edge computing data

Edge computing as an evolution of cloud computing brings application hosting from centralised data centres down to the network edge, closer to consumers, verticals, and the data generated by applications. Multi-access edge computing is acknowledged as one of the key pillars for meeting the demanding KPIs of 5G, especially as far as low latency and bandwidth efficiency are concerned. [13]

As the MEC does not make any assumptions on the radio infrastructure, it is highly flexible within the scope of 5G!Drones and it can be utilised in trials on LTE, 5G non-stand alone, and 5G stand-alone trials. It can be used also in handovers between the technologies. Due to the virtualised characteristics of MEC, it has never been easier to monitor performance and resource needs of an application. MEC works as an enabler for multiple vertical applications among which the following appear appealing for 5G!Drones:

- Support of Local Area Data Network (LADN) by the 5G Core Network by providing support to connect to the LADN in a certain area where the applications are deployed. The access to a LADN is only available in a specific LADN service area.
- The Session and Service Continuity modes for different UE and application mobility scenarios.
- Local Routing and Traffic Steering: the 5G Core Network provides the means to select traffic to be routed to the applications in the local data network.

While the above have significant importance in the validation of both 5G and UAV verticals' KPIs, the data log files generated by MEC will most likely have little value as re-usable data sets. Still, the MEC data set is described in Table 4.

Table 4: Multi-access Edge Computing Data Set

Function	Purpose	Objectives
Purpose of the data	5G and UAV KPI validation	Validate Trials' performance
Type and format of Data	Log files for post processing	.txt, .xlsx .m, .csv
Text	Readme files to understand data	.txt
Numeric	Log tables	.txt, .xlsx, .m, .csv
Reused-data (rd)	No	Data will be generated in the trials.
Observational	Data captured in real-time during trials	Trial validation
Data set is:	Revisable	
Quantity	Few MBs to 1000s of MB per trial.	
Data Security & Storage	Institute network drive, IDA [2], EUDAT [1].	Accessible only with user credentials and strong authentication / VPN. IDA and EUDAT user credentials.
Data value (long term)	Data will most likely have no long term value.	Data may have value for up to three years after the end of the project.
FAIR data		
Making data findable		
Discoverability of data (metadata provision)	Metadata using Qvain. Descriptive, administrative and structural metadata.	Qvain fields: content description, actors, rights and licenses, temporal and spatial coverage, relations and history, and files.
Identifiability of data	Data will be made available using persistent identifiers.	PID generated e.g. using **https://etsin.fairdata.fi/** [6]
Naming conventions used	Naming convention using 5G!Drones, Use Case, Trial Site, version, and date.	
Search keywords approach	E.g., Qvain metadata search using etsin [6].	
Clear versioning approach	E.g., versioning using Qvain Relations and History fields.	Traceability, e.g. using DataCite [7] or Dublin Core metadata standard [9].

Standards or procedures for metadata creation applied	E.g. DataCite metadata schema	
Making data openly accessible		
Data openly available	Data is the property of the 5G!Drones facility owners participating in the trials. Data is shared among the 5G!Drones partners based on the Consortium Agreement.	Data that is not in Partners direct business interests can be made public, if they serve a purpose for the community at large.
Data kept closed	Industrial partners	Data close to own product line development. Data from partners own products (e.g. log and telemetry files)
Data kept closed	Academic and research institute partners	Data exposing infrastructure based on background commitments.
How data will be made available	Open research archives: EUDAT, IDA, Zenodo [8]. Use of persistent identifiers and metadata.	
SW documentation and other information needed	Any publicly made available data shall be accompanied by a readme.txt file describing the details required accessing the data.	
Repository for deposit of data, metadata, documentation and code	Private data will be stored in private Partners' internal storages or repositories. Publicly available data will use e.g. EUDAT, IDA, or Zenodo repositories with associated metadata using Qvain and persistent identifiers.	
Access restrictions	During trials data generation, processing, and analysis data is kept internal to 5G!Drones.	Data with re-use value may be made public after their respective 5G!Drones deliverables have been published.
Data interoperability assessment	Data interoperability will be ensured by use of e.g. DataCite metadata schema or Dublin Core metadata standard.	Partners' proprietary software data will be exported and method of access to the data is defined in accompanied readme.txt file.
Making data interoperable		
Standard vocabulary or mapping to commonly used ontologies	By use of e.g. ELSST [10] thesaurus or Finto [11].	

Data licensing for wide reuse	Publicly made available data sets are by default under Creative Commons licensing. The Consortium may adopt specific license terms for specific data sets.	CC0; or CC by, sa, nc, nd, or any combination thereof.
Increase data re-use (through clarifying licenses)		
Timing of data availability for re-use (incl. indications on embargo).	Data can be made public after their reposting in respective deliverables.	A Partner may request an embargo period of up to one year.
Data usability by Third Parties (after the end of the project)	Publicly made data will be available for third parties for up to three years after the end of the project, after which the data is likely stale.	
Restrictions to data re-use	The 5G!Drones Consortium Agreement defines restrictions on making data public or with specific usage terms.	Certain data cannot be disclosed due to sensitivity of being close to Partner product line development or they would expose Partners product details.
Quality assurance process	Data to be made public is reviewed and accepted by the 5G!Drones consortium.	Data will be generated for trials. Analysis of the data will verify trial success. Trials are reported in deliverables, whose quality is assured by the quality assurance plan D6.1.
Length of time of data re-usability	Most likely the data will not be re-usable. In the case data can be re-used the time is expected to be up to three years after the end of the project.	
Allocation of resources		
Costs estimates for making data FAIR	Costs are expected to be in the range of hundreds to a few thousands of Euros per annum.	During project lifetime, costs can be covered from Equipment costs. After the project, Partners individually bear the costs.
Data Management Responsibilities	Each Partner has their own data management policies. For example, UO policies can be found from **https://www.oulu.fi/university/node/43683**.	

1.1.2. Unmanned aerial vehicle data

UAV data are divided between traffic management and application data, and UAV sensor data. The unmanned aerial systems (UAS) traffic management (UTM) data is very close to several of the partners core business and therefore much of them will not be made publicly available.

1.1.2.1. Unmanned aerial systems traffic management data

Drones will be an important component of 5G communications, through their use within cellular architectures in which they facilitate both wireless broadcast and point-to-point transmissions. The command and control link provides safety critical information for the control of the drone to deal with flight and flight management.

Beyond visual line of sight (BVLoS) drone operations entails long-range commercial drone control, for applications such as drone delivery. The command and control application will demonstrate features such as automatic collision avoidance of drones, especially those flying in swarm, which requires sending large amounts of data in near real time to assess the potential risks in the sky and enable an enhanced flight awareness of all types of flying objects. Some BVLoS applications enable secure controlling of the drone (telepresence) using the VR/AR equipment. Already existing custom-made and/or openly available 3D data can be used here in such cases, hence existing data sets may be used. For example, the National Land Survey of Finland (**https://www.maanmittauslaitos.fi/en**) has made freely available spatial data from aerial images and laser scans.

In drone operations both pre-flight and after flight data must be generated. All use case trials must be performed according to regulations. The regulations for each trial site location are defined in 5G!Drones deliverable D1.2. As per agreement UTM will be part of all use cases. This includes strategic pre-flight steps:

- Registration of
  - Operator,
  - Drone, and
  - Crew.
- E-Identification of
  - Means to localize drones and
  - Means to identify drones.

The following important tactical pre-flight steps shall be considered as well:

- Risk Assessment – SORA,
- Mission Planning in coordination with the domain specific stakeholder,
- Flight Planning and Approval with the respective UTM counterpart, and
- Business Case related topics – E.g. financial aspects in getting approval for flights

After a flight tactical steps are part of all scenarios:

- Sufficient legal recording shall in be in place.
- Recorded monitoring and test data to be used for Study reports need to be collected
- Business case related topics need to be handled (closing transactions started in tactical pre-flight phase).

Coverage of these topics is ensured by the respective 5G!Drones's UTM Partners in the project. Even though significant amounts of data will be generated in the UTM use cases, it has little to none re-use value that should be shared. The UTM data set can be found from Table 5.

Table 5: Unmanned Aerial Systems Traffic Management Data Set

Function	Purpose	Objectives
Purpose of the data	Air traffic information aimed at unmanned traffic management	UTM Trials
Type and format of Data	Stream of live data	JSON
Text		JSON
Numeric		JSON
Discipline specific information	Aviation	ADS-B, FLARM, Mode S, Mode A/C
Reused-data (rd)	In 3D visualization – Yes, Otherwise – No.	e.g. **https://www.maanmittauslaitos.fi/en** Data will be generated from own hardware/software.
Observational	Real time information from standard aviation identification technology, coming from Partners' sensors' readings	UTM, Trial validation
Data set is:	Growing	
Quantity	About 5GB/sensor/day	
Data Security & Storage	Secure WebSocket	Private server protected by SSH authentication
Data value (long term)	Drone operators, Air Traffic Controllers, Sky Authorities. Data are confidential for business reasons.	
FAIR data		
Making data findable		
Discoverability of data (metadata provision)	Data detailed in a specification document.	Metadata: GNSS coordinates, timestamps
Identifiability of data	Link with external aviation databases	Aircraft identifiable through their ICAO number / tail number
Search keywords approach	ICAO number / tail number	
Clear versioning approach	Based on timestamp	Based on timestamp

Standards or procedures for metadata creation applied	No reference, internal to Partners Metadata: timestamp, GNSS coordinates created by Partners' sensors'.	
Making data openly accessible		
Data openly available	Partner's ownership, not open data since it would disclose core information and parts of the production lines to direct competitors. Data essential to project trials openly available	
Data kept closed	Drone operators, Air Traffic Control, Sky Authorities.	It would disclose core information and part of Partners' production lines to direct competitors.
How data will be made available	WebSocket data stream	
Methods or software (SW) tools for data access	Application Interface, API	
SW documentation and other information needed	File specifying the stream protocol and architecture is available on demand and subject to confidentiality.	
Repository for deposit of data, metadata, documentation and code	Private data will be stored in private Partners' internal storages or GIT repositories.	
Access restrictions	Access to data is limited in time as per the Consortium Agreement.	
Data interoperability assessment	High level of interoperability (GNSS coordinates and timestamp)	no license / limitations
Making data interoperable		
Standard vocabulary or mapping to commonly used ontologies	Specification document.	
Data licensing for wide reuse	N/A	N/A
Increase data re-use (through clarifying licenses)		
Timing of data availability for re-use	Embargo on commercial use, especially for statistics	One year

(incl. indications on embargo).		
Data usability by Third Parties (after the end of the project)	Restrictions to use for statistical analysis (e.g. use of the sky, traffic analysis, etc.) for commercial or non-commercial use.	
Restrictions to data re-use	Core business Confidentiality agreement	Data re-use could disclose large parts of Partners' core business to competitors and would thus be a threat to its survival. Existing confidentiality agreements also apply.
Quality assurance process	Cross validation, Multilateration, other algorithms	Partner internal control processes and quality guidelines
Length of time of data re-usability	N/A	
Allocation of resources		
Costs estimates for making data FAIR	20.000 €/year	Own resources
Data Management Responsibilities	Each Partner has its own data management policies. Appointed Data Management Leader.	

1.1.2.2. Unmanned aerial vehicle sensor data

UAV sensor data covers major amounts of data. The utilised sensors and their data collection rates depend on the particular use case. Without loss of generality at least the following sensors collecting data will be used:

- Light Detection and Ranging (LiDAR),
- 3D accelerometer,
- Gyroscope,
- Video camera,
- Still camera,
- Air Pressure,
- Sound power level,
- Various radio technology analysers,
- Bluetooth positioning (indoor applications),
- Magnetometer, and
- Drone telemetry.

The amount of data generated is particularly high for LiDAR (< 100 Mbps) making the data sets large. The collected sensor data have significant re-use value, both for public purposes and for Partners' product line development and testing purposes. With regards to privacy, all stored data shall not contain

any information that would raise the EU General Data Protection Regulation (GDPR) Act (EU) 2016/679 [16] related privacy issues. The UAV sensor data set is described in Table 6.

Table 6: Unmanned Aerial Vehicle Sensor Data Set

Function	Purpose	Objectives
Purpose of the data	UAV operations, trial validation, collection of data for post-processing	Safe drone operations, UAV and 5G KPI testing, data sets for algorithm development.
Type and format of Data	Log files for post processing, video, still photos	.txt, .xlsx, .m, .mpeg-4 (.mp4), jpg, .raw
Text	Readme files to understand data	.txt
Numeric	Log tables	.txt, .xlsx, .m
Reused-data (rd)	No	Data will be generated in the trials.
Observational	Data captured in real-time during trials	Trial validation
Data set is:	Growing	
Quantity	100s MB to 10s of GB per trial.	
Data Security & Storage	Institute network drive, IDA [2], EUDAT [1].	Accessible only with user credentials and strong authentication / VPN. IDA and EUDAT user credentials.
Data value (long term)	Data will have mid-term value.	Data may have value for up to ten years after the end of the project.
FAIR data		
Making data findable		
Discoverability of data (metadata provision)	Metadata using Qvain. Descriptive, administrative and structural metadata.	Qvain fields: content description, actors, rights and licenses, temporal and spatial coverage, relations and history, and files.
Identifiability of data	Data will be made available using persistent identifiers.	PID generated e.g. using **https://etsin.fairdata.fi/** [6]
Naming conventions used	Naming convention using 5G!Drones, Use Case, Trial Site, Sensor, version, and date.	
Search keywords approach	E.g., Qvain metadata search using etsin [6].	

Clear versioning approach	E.g., versioning using Qvain Relations and History fields.	Traceability, e.g. using DataCite [7] or Dublin Core metadata standard [9].
Standards or procedures for metadata creation applied	E.g. DataCite metadata schema	
Making data openly accessible		
Data openly available	Data is the property of the 5G!Drones Partners participating in the trials. Data is shared among the 5G!Drones partners based on the Consortium Agreement.	Data that is not in Partners direct business interests can be made public.
Data kept closed	Industrial partners	Data close to own product line development. Data from partners own products (e.g. log and telemetry files)
Data kept closed	Academic and research institute partners	Data exposing infrastructure based on background commitments.
How data will be made available	Open research archives: EUDAT, IDA, Zenodo [8]. Use of persistent identifiers and metadata.	
SW documentation and other information needed	Any publicly made available data shall be accompanied by a readme.txt file describing the details required accessing the data.	
Repository for deposit of data, metadata, documentation and code	Private data will be stored in private Partners' internal storages or repositories. Publicly available data will use e.g. EUDAT, IDA, or Zenodo repositories with associated metadata using Qvain and persistent identifiers.	
Access restrictions	During trials data generation, processing, and analysis data is kept internal to 5G!Drones.	Data with re-use value will be made public after their respective 5G!Drones deliverables have been published.
Data interoperability assessment	Data interoperability will be ensured by use of e.g. DataCite metadata schema or Dublin Core metadata standard.	Partners' proprietary software data will be exported and method of access to the data is defined in accompanied readme.txt file.
Making data interoperable		

Standard vocabulary or mapping to commonly used ontologies	By use of e.g. ELSST [10] thesaurus or Finto [11].	
Data licensing for wide reuse	Publicly made available data sets are by default under Creative Commons licensing. The Consortium may adopt specific license terms for specific data sets.	CC0; or CC by, sa, nc, nd, or any combination thereof.
Increase data re-use (through clarifying licenses)		
Timing of data availability for re-use (incl. indications on embargo).	Data can be made public after their reposting in respective deliverables.	A Partner may request an embargo period of up to one year.
Data usability by Third Parties (after the end of the project)	Publicly made data will be available for third parties for up to ten years after the end of the project, after which the data is likely stale.	
Restrictions to data re-use	The 5G!Drones Consortium Agreement defines restrictions on making data public or with specific usage terms.	Certain data cannot be disclosed due to sensitivity of being close to Partner product line development or they would expose Partners product details.
Quality assurance process	Data to be made public is reviewed and accepted by the 5G!Drones consortium.	Data will be generated for trials. Analysis of the data will verify trial success. Trials are reported in deliverables, whose quality is assured by the quality assurance plan D6.1.
Length of time of data re-usability	Data will in parts be re-usable. The time is expected to be up to ten years after the end of the project.	
Allocation of resources		
Costs estimates for making data FAIR	Costs are expected to be in the range of hundreds to a few thousands of Euros per annum.	During project lifetime, costs can be covered from Equipment costs. After the project, Partners individually bear the costs.
Data Management Responsibilities	Each Partner has its own data management policies. For example, UO policies can be found from **https://www.oulu.fi/university/node/43683**.	

1.2. Allocation of resources, data security, and data policy

The consortium will use the free-of-charge repositories, EUDAT [1], IDA [2], and Zenodo [8] for making the datasets that will be public accessible. On the other hands costs will incur, especially in personnel resources making the data available and maintaining the data that are live. An issue may arise as, for example, the live data in EUDAT are limited to 20 GB in size and six months usage restrictions. As several data sets are revisable, they need to be live data and therefore, IDA and Zenodo may be better alternatives. There are no such restrictions for frozen data. The project deliverables, which are public, will be published on 5G!Drones own web pages. The project deliverables, which are not public, will be stored in the project internal data repository platform, MS Teams, and submitted to the commission through the EC Participant Portal. These actions are to ensure that data are safely stored and accessible to entities with access rights to utilize the data. EUDAT, IDA, and Zenodo function as repositories for long term preservation and curation if the project generates any data having more than mid-term value.

The handling of the EUDAT, IDA, and Zenodo repositories on behalf of 5G!Drones is the responsibility of the project Partners that generated the data. The coordinator's responsibility is to maintain track of the data management issues related to the project. The project Partners responsibility is to make the coordinator and the project aware that such FAIR data will be made available and to seek from the consortium.

As for the publications, where the analyses of the empirical research data will be presented, the consortium will publish them in scientific journals that allow various open access mechanisms. At minimum the authors shall use their institutions' data policy defined mechanisms for self-archiving of the final draft version of the publication. The costs related to open access will be claimed as part of the Horizon 2020 grant. For example, UO uses self-archiving in the university's open publication repository Jultika [14].

Members of the 5G!Drones consortium involved have their own data management policies. As examples, the UO responsible research data management policy can be found from [15]. For AIR, they have Privacy Impact Assessment (PIA) conducted and data protection officer appointed for their Tactilon AGNET; a hybrid solution in Professional Mobile Radio industry that expands the critical communication perimeter with extended teams and new technical capabilities. It will be used in 5G!Drones.

1.3. Ethical aspects

As stated in the project plan: "No ethics issues have been entered in the ethical issues table in the administrative proposal forms." Therefore, in 5G!Drones information collected can be released without privacy restrictions because it does not constitute private information about identified human subjects.

The project will monitor if ethical or privacy implications arise and use a general strategy for the monitoring of the implications. Should ethical implications arise, the project shall follow the GDPR act [16] on the protection of natural persons with regard to the processing of personal data and on the free movement of such data. The steps taken to monitor ethical and privacy implications are:

- Knowledge acquisition: This step includes the study of the needs of the trials of the project.

- Privacy impact assessment: a PIA will be conducted to study of all the use case trials in which, during the project lifecycle, personal data rights are identified to be at stake. Special attention will be paid to activities involving data collection from project external sources.

As evolution to this Data Management Plan, procedures shall be defined in order to collect and process data that have not been identified at this step. Such data includes items such as:

- legal basis,
- consent process,
- anonymization,
- storage,
- protection,
- retention,
- destruction,
- reuse,
- etc.

1.3.1. Informed Consent

For managing the Consortium and being able to disseminate the project information 5G!Drones Consortium has requested Partner and personnel consent on

- Taking photos of individuals during meetings, events, social dinners, etc.
- Publishing photos of individuals at 5G!Drones website, social media, newsletters, leaflets, posters, etc.
- Uploading photos at the Microsoft Teams repository.
- Mentioning individuals' names and organisations at 5G!Drones website, social media, newsletters, articles, etc.
- The project will not use personnel names unless agreed on beforehand.

When dealing with personnel external to the Consortium, similar request for informed consent shall be made prior to storage or publication of any personal identifiable information.

2. PROJECT OVERVIEW

2.1. Members of the Project

Table 7: Members of The 5G!Drones Consortium

Participant No.	Part. Short name	Participant organisation name	Country
1 (Admin. Coordinator)	UO	OULUN YLIOPISTO	Finland
2 (Tech. Coordinator)	THA	THALES SIX GTS FRANCE SAS	France
3	ALE	ALERION	France
4	INV	ONESKY SARL (INVOLI)	Switzerland
5	HEP	Hepta Group Airborne OÜ	Estonia
6	NCSRD	NATIONAL CENTER FOR SCIENTIFIC RESEARCH “DEMOKRITOS"	Greece
7	AU	AALTO KORKEAKOULUSAATIO SR	Finland
8	COS	COSMOTE KINITES TILEPIKOINONIES AE	Greece
9	AIR	AIRBUS DS SLC	France
10	UMS	UNMANNED SYSTEMS LIMITED	United Kingdom
11	INF	INFOLYSIS P.C.	Greece
12	NOK	NOKIA SOLUTIONS AND NETWORKS OY	Finland
13	RXB	ROBOTS EXPERT FINLAND Ltd	Finland
14	EUR	EURECOM	France
15	DRR	DRONERADAR Sp z o.o.	Poland
16	CAF	CAFA TECH OÜ	Estonia
17	FRQ	FREQUENTIS AG	Austria
18	OPL	ORANGE POLSKA SPOLKA AKCYJNA	Poland
19	MOE	MUNICIPALITY OF EGALEO	Greece
20	ORA	ORANGE SA	France

2.2. Project Objectives

The overall and ultimate objective of 5G!Drones is to design, implement, and run trials of unmanned aerial vehicle use cases on top of a 5G infrastructure provided by ICT-17 and other complementary facilities, addressing the following challenges.

- What are the missing components of current ICT-17 facilities to enable the trials of UAV use cases and to validate their key performance indicators (KPIs)?
- What current 5G components need to be improved to support UAV use cases?
- How to allow the UAV verticals to run the tests?
- How to abstract the low-level ICT-17 facility-exposed application interface to run the trials?
- How to test UAV service performance using the ICT-17 facilities?
- How to build and secure a network slice (i.e., types of virtualised network functions (VNFs), amount of radio access network (RAN) resources, and RAN split) the way needed to run UAV trials?
- How to allow UAV verticals to monitor and manage Network Slices running UAV applications?
- What are the 5G KPIs that should be met to validate the performance of UAV applications?
- What are the 5G components that need to be improved to guarantee UAV performance?

The main objectives related to the 5G!Drones concept and validation revolve around the following topics. The project will carry out a deep analysis of the UAV use case requirements in terms of the needed network functionalities and the required application performance to validate. Business models will be also derived. The aim is further to design and implement the 5G!Drones trial system, which will be in charge of running the UAV trials using the ICT-17 facility components and 5G!Drones enablers developed during the project. The envisioned 5G!Drones system abstracts the low-level details on the usage of 5G facilities resources, by providing a high-level API to describe, run, and obtain results on the specific KPIs. The project will design a high-level (or Northbound) API to allow a UAV vertical to configure a trial and run the test. 5G!Drones will use the 5G facilities provided by *i)* EURECOM (5G EVE, Sophia Antipolis, France), *ii)* NCSR Demokritos and the Municipality of Egaleo (5GENESIS, Athens, Greece), in addition to *iii)* the 5GTN platform available at the University of Oulu, Finland and *iv)* the X-Network facility available at the Aalto University, Finland. Based on the analysis of the target UAV use cases, 5G features of these platforms will be used, and, when deemed appropriate, additional software will be developed by the project, and additional UAV-relevant hardware will be acquired. These new components represent the 5G!Drones enablers. Particularly, 5G!Drones will focus on improving Network Slicing functionalities, as UAVs require at least two running network slices; one for command and control (type ultra-reliable, low latency communications) and one for the data plane (type enhanced mobile broadband or massive machine type communications). The security of each of these network slices will be also investigated and duly addressed. Moreover, a UAV traffic management service based on virtual reality allowing control and/or supervision of multiple UAVs operating in the same area will be studied. According to the envisioned UAV use cases and scenarios, several 5G KPIs need to be demonstrated and tested to validate UAV application requirements. As per the ambitious requirements of 5G, the most critical ones are:

- End-to-end latency of < 1ms, (URLLC use cases)
- 1000 times higher mobile data volume per geographical area, (eMBB use cases)
- 10 to 100 times more connected devices (mMTC use cases).

Many UAV applications, and particularly Unmanned Aerial Systems (UAS) traffic management (UTM), require very challenging KPIs such as low latency, security, coverage, high data rates, all of which are

hard to attain in current networks. One advantage of 5G is its ability to ensure the aforementioned KPIs. Therefore, 5G!Drones will focus on validating the UAV use case application KPIs, carefully taking care of the UTM use case, as it is the main enabler of all other envisioned UAV use cases.

By using data analytics tools, each use case scenario will be carefully studied in terms of performance, aiming at drawing conclusions and recommendations to the 5G and UAV ecosystems. The feedback can be used as input to standardisation bodies, such as 3rd generation partnership project (3GPP) or European Telecommunications Standards Institute (ETSI) multi-access edge computing (MEC), in order to optimise or update 5G standards for UAV. Dissemination, standardisation, and exploitation of all concepts and technologies developed in the 5G!Drones project will be carried out. A special focus is given to showcasing components of the project in UAV- and 5G-related events.

2.3. Project Structure

The project has been divided into six work packages (WPs), each lead by one of the project beneficiaries. The detailed list of the WPs, their start and end month, is shown in Table 8.

Table 8: 5G!Drones WP list

Work package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End month
1	Use case requirements and system architecture	17	FRQ	208	1	36
2	Trial controller	7	AU	252	3	24
3	Enabling mechanisms and tools to support UAV use cases	2	THA	301	3	27
4	Integration and trial validation	10	UMS	411	6	36
5	Dissemination, standardisation and exploitation	9	AIR	154.08	1	36
6	Project Management	1	UO	42	1	36
				1368.08		

3. PROJECT MANAGEMENT STRUCTURE

The 5G!Drones project management structure is depicted in Figure 1. The roles of each element of the management hierarchy are described in the following subsections.

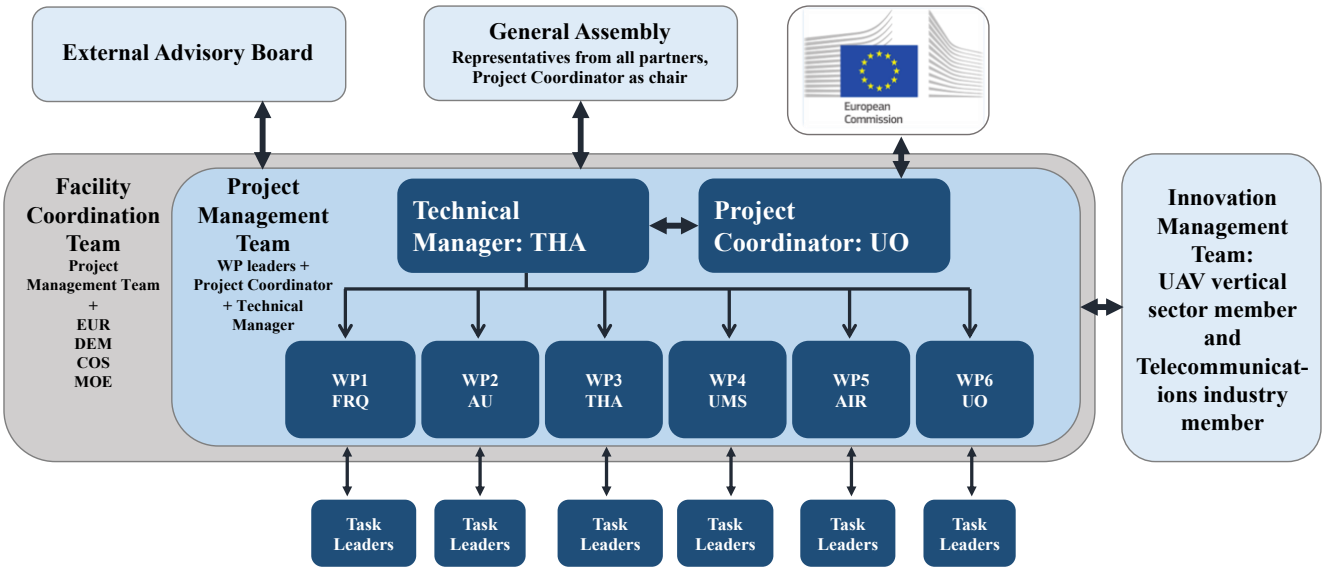

Figure 1: 5G!Drones management structure schematic.

3.1. Project Coordinator

OULUN YLIOPISTO is the Project Coordinator (PC). The PC is the interface between the project and the European Commission. The PC is responsible for coordination and the management of the project, including control of the overall project plan, as well as financial, legal and contractual matters. In particular the PC is responsible for:

In particular, the Coordinator shall be responsible for:

- Monitoring compliance by the Parties with their obligations.
- Keeping the address list of Members and other contact persons updated and available.
- Collecting, reviewing to verify consistency and submitting reports, other deliverables (including financial statements and related certifications) and specific requested documents to the Funding Authority.
- Transmitting documents and information connected with the Project to any other Parties concerned.
- Administering the financial contribution of the Funding Authority.
- Providing, upon request, the Parties with official copies or originals of documents that are in the sole possession of the Coordinator when such copies or originals are necessary for the Parties to present claims.
- Performing the interface role between the Consortium and the Funding Authority.

- Preparing the meetings, proposing decisions and preparing the Agenda of General Assembly meetings, chairing the meetings, preparing the minutes of the meetings and monitoring the implementation of decisions taken at meetings.
- Representing the 5G!Drones project on the 5G-PPP Steering Board.

3.2. Technical Manager

THALES SIX GTS FRANCE SAS is the Technical Manager (TM). The TM is responsible for directing the technical work of the project. The TM works in close collaboration with the PC to secure progress towards the project objectives and targets, as well as to implement general assembly's and project management team's decisions which have an impact on the technical work.

In particular, the TM duties include:

- Supervising the overall technical progress of the project.
- Coordinating all technical WPs.
- Screening, controlling and finally streamlining the development output of the WPs concerning the various technical activities to ensure successful validations and trials of the UAV use cases on ICT-17 platforms and complementary sites.
- Consolidating all technical results through review of the design, validation, and demonstration activities.
- Reviewing the technical reports to ensure clarity in presentation of the progress beyond state of the art.
- Providing technical relationship and coordination activities with other relevant research projects in 5G-PPP.
- Organising and arranging the consolidation of technical results to be promoted towards the targeted standardisation organisations and international fora.
- Representing the project in the 5G-PPP Technology Board.
- Taking lead in the coordination of the project participation in the 5G-PPP Working Groups.

3.3. Work Package Leader

The Work Package Leader (WPL) is the responsible for managing the daily technical and administrative work of a work package. The work is further divided into tasks as a tool to help structure the activities performed and the task leaders have been appointed to support a WPL. The main responsibilities of a WPL are to:

- Design and organise the work package activities.
- Coordinate the technical work and check the progress of the work package.
- Identify, coordinate, and harmonise deliverable content.
- Verify that the work package objectives and targets are met.
- Transfer technical progress to the project coordinator and technical manager in monthly project management team (PMT) meetings and quarterly technical reports.
- Schedule and chair work package meetings and implement decisions.

- Contribute to audits and periodic reports.

Work Package teleconferences are held at least once every two weeks. Regular meetings ensure the WP progresses towards the project objectives and any issues are identified at an early stage.

3.4. Project Management Team

The PMT carries out the day-to-day operations of the project. The PMT consists of the WPLs, the project coordinator, and the technical manager. The responsibilities of the PMT are to:

- Decide the project's overall direction and scope, based on the project objectives and general assembly (GA) decisions.
- Decide the overall technical activities.
- Schedule meetings with and inform the external advisory board (EAB).
- Schedule project-wide physical meetings to discuss WPs activities and their relations.
- Check and guarantee that the work of the work packages is in line with the project plan.
- Keep track of the overall progress of the project, including the milestones achievement.
- Review the overall achievements and major deliverables, prior to submission to the Commission.
- Prevent any risk in the management of the project, taking appropriate actions, also for possible deviations from project plan.

The PMT is scheduled to meet or teleconference once a month. At each meeting the WPLs provide and update of their respective WP progress and cross WP activities are coordinated through the PMT.

3.5. Facility Coordination Team

The Facility Coordination Team (FCT) manages all the interactions with the facilities to schedule the usage of the facilities for trials and tests. It also manages the agreements in terms of IPR of the components to be used in the facilities. The FCT is composed by the project coordinator, technical manager of the project, the WPL and partners involved in the facilities (i.e. EUR, NCSRD, ORA, MoE).

3.6. General Assembly

The General Assembly constitutes of one representative from each consortium member. It is the highest decision-making body in the project. The GA is responsible for the overall direction of the project. The responsibilities of the GA include:

- Budget allocations.
- Launch of new work packages.
- Allocation of responsibilities.
- Approval of project publications.
- Admission of new members of the Advisory Board.

- The GA is free to act on its own initiative to formulate proposals and take decisions in accordance with the procedures set out by the consortium agreement.
- The GA considers and decides upon all proposals made by the Project Management Team.

The GA will have a face-to-face meeting, flexibly, every three to four months. The next face-to-face meeting will be decided upon during every meeting.

3.7. External Advisory Board

The External Advisory Board (EAB) is responsible for providing guidance to the project on direction and content of the major tasks and deliverables in the project. The advisory board consists of companies and organisations that are not part of the consortium, but that can provide input on relevant requirements and solutions in different industry sectors and research areas. The current list of EAB members is found in Table 9.

Table 9: 5G!Drones External Advisory Board Composition

1	FICORA (Finnish Communications Regulatory Authority)	Finland
2	GSMA	UK
3	Drone Think Tank Do	Belgium
4	Business Oulu	Finland
5	Volocopter	Germany
6	Trafi (Finnish Transport Safety Agency)	Finland
7	Aviation and Maritime Department, Ministry of Economic Affairs and Communications of Estonia	Estonia

3.8. Innovation Management Team

The Innovation Management Team (IMT) is a small cross-disciplinary team composed of one representative from the UAV vertical sector and one from the telecommunications industry. The purpose is to represent the two different sectors that are expected to jointly drive innovation in the evolved UAV ecosystem in the 5G era, ensuring the appropriate monitoring of a very fast evolving business environment from different angles. The role of the IMT is to advise the PMT so that the focus of the project is in line with the current technological, business, and regulatory developments, guiding the project towards identifying emerging innovation opportunities and appropriately readjusting the project activities to better respond to them. The IMT initially consists of partners of the consortium. The target is to expand the IMT outside the consortium, for example via 5G-PPP activities at a later stage.

4. PROJECT COMMUNICATION AND MANAGEMENT TOOLS

4.1. Project collaborative platform

The 5G!Drones project uses the Microsoft (MS) Teams online collaboration tool to support project coordination, virtual meetings, and managing, storing, and exchanging document of all kinds. The Teams platform operates over Sharepoint, an online repository supporting version control and secure data storage. The Teams site can be accessed using either a dedicated program for it or directly using

a web browser software. The Microsoft Teams 5G!Drones team site supports a number of channels for organizing documentation and communications, e.g. one for each WP and project management body. The Teams platform is under the control of UO and new channels and teams can be added as required.

All partners have been invited and they access to the Teams site project space. The project space is highly intuitive and support for use is given for partners of the project as needed. The Teams further supports a number of built in programs, e.g. persistent web page access, poll tools, online conversation stream with memory, videoconferencing, online collaborative note making, etc. Lastly, Microsoft office documents can be directly and collaboratively, simultaneously edited by the partners. All persons using the platform have an informed consent on the use of the project space and may opt out at any time as per GDPR [16] guidelines.

A link to the Teams 5G!Drones team as a hypelink is:

https://teams.microsoft.com/l/team/19%3a1aafdcca391248b3bae49d937a5a1a96%40thread.skype/conversations?groupId=f466615e-4440-4c39-95a1-b53b160fc00e&tenantId=9f9ce49a-5101-4aa3-8c75-0d5935ad6525.

When sharing files, similar links can be obtained for all documents on the site and the links are used for referring to documents rather than attaching the files to emails and other communications methods. As a consequence, it is easy to control the outside parties do not gain access to the documents themselves.

4.2. Project mailing lists

The project mailing lists are hosted by NCSRD. They are archiving mailing lists and both NCSRD and UO have administrative access to the lists. The following lists have been created for effective communication between the partners:

- **5gdrones-general@iit.demokritos.gr** for email exchanges concerning most or all of the partners.
- **5gdrones-wp1@iit.demokritos.gr** for email communications concerning WP1 activities of the project.
- **5gdrones-wp2@iit.demokritos.gr** for email communications concerning WP2 activities of the project.
- **5gdrones-wp3@iit.demokritos.gr** for email communications concerning WP3 activities of the project.
- **5gdrones-wp4@iit.demokritos.gr** for email communications concerning WP4 activities of the project.
- **5gdrones-wp5@iit.demokritos.gr** for email communications concerning WP5 activities of the project.
- **5gdrones-wp6@iit.demokritos.gr** for email communications concerning WP6 activities of the project.
- **5gdrones-pmt@iit.demokritos.gr** for email communications concerning the PMT activities of the project.
- **5gdrones-fct@iit.demokritos.gr** for email communications concerning the PMT activities of the project.

New email lists can be created as needed by the project. For convenience the MS Teams site has a file under the General channel that lists the project members in each of the mailing lists. The partners

should notify the PC in case members need to be added or removed from the mailing lists during the course of the project.

4.3. Project social media

A 5G!Drones website has been created to share information regarding the project. The website is intended for dissemination to the scientific and technological community, and to the general public. The website can be found at: **https://5gdrones.eu/** .

The 5G!Drones website will give information of external character; including an overall description of the project (objectives, structure, consortium, use cases, etc.) and the public deliverables, news and events, and articles carried out by the partners of the project. Links shall be included to partner websites and the partners shall also host links from their websites to the project website.

INFOLYSIS P.C is responsible for the maintenance of the website. The website will be kept active for a minimum of 2 years after the project end date.

The project also has webpages on the 5G-PPP area and it can be found at: **https://5g-ppp.eu/5gdrones/** . The webpage contains the basic project information: name, duration, topic, abstract, and the list of partners. It also contains information for contacting the project and 5G!Drones social media links.

In order to attract visibility and have the project easily accessible, 5G!Drones has a number of social media accounts. Specifically, the links to the social media sites are:

Twitter: **https://twitter.com/5gdrones**

LinkedIn: **https://www.linkedin.com/in/5gdrones/**

Facebook: **https://www.facebook.com/5gdrones/**

Instagram: **https://www.instagram.com/5gdrones_project/**

YouTube: **https://www.youtube.com/channel/UChPj4gQ5P5go7Fer6NJxGOQ**

When publishing information containing people or data enabling identification of people the project applies an informed consent approach according to the GDPR [16] guidelines.

4.4. Management and planning

4.4.1. Action point management

Each project WP and consortium body maintains and action point list in the minutes of the meetings. The action point list is reviewed and updated during all meetings, and the meeting minutes are stored in their respective folders in MS Teams. The elements of the action point list can be found from Table 10.

- The ‘ID’ field is a running number so that all actions can be uniquely identified.
- The ‘Action’ field describes the action to be carried out.
- The ‘Responsible’ field identifies the individuals or groups responsible for advancing on the action.
- The ‘Deadline’ field is the date when the action needs to have achieved a defined milestone or if it is a continuous task.
- The ‘Status’ field indicates the progress towards completing the action.

Table 10: Action Point List

ID	Action	Responsible	Deadline	Status
xx	Action to be carried out	Name, partner, consortium body	Date, continuous	Open, done, level of progress

4.4.2. Management instruments

The main management instruments include:

- this document, the Data Management Plan and quality and risk management plan,
- the quarterly management report (QMR) every three months, and
- the financial reports (FR) as indicated in the Consortium Agreement.

The Data Management Plan defines what kinds of data are collected and used, and for what purposes. It describes what data are made public and how the data are stored, and made FAIR (findable, accessible, interoperable, re-usable). It also describes what metadata is associated with the data. The quality and risk management plan defines a consistent set of working procedures, processes and best practice guidelines, in order to ensure highest quality standards of the project outcomes. In particular the plan defines the following aspects:

- the project structure in terms of different roles,
- work processes (delivery of project reports, approval of milestones, etc),
- administrative processes (reporting of person months, costs, etc),
- project tools (project website, project platform procedures, etc),
- Templates,
- Naming conventions, etc.

The QMR is a project internal report to be submitted on quarterly basis by the WPLs to the technical manager. It consists of a report on the description of the work carried out per WP and per Partner. It also contains some analysis at project level. It is a useful tool to track the advance of the work with respect to the description of action and to identify and foresee mitigation plan in case of major deviations. The QMRs will be available in MS Teams Project Management Team Channel at:

https://teams.microsoft.com/_#/school/files/Project%20Management%20Team?threadId=19%3A1a0e1ed5f89c4cc5bac948968ec99930%40thread.skype&ctx=channel&context=Quarterly%2520Management%2520Reports .

The FR is an official deliverable to be submitted on periodic basis to the Coordinator. It consists of an excel file that sums up personnel and other direct (travel, equipment, subcontracting etc.) and indirect costs per partner per WP. The FRs are to be uploaded to MS Teams. Each partner is responsible for the appropriate reporting of their eligible costs following the guidelines of the European Commission.

In addition, the project coordinator has to send a periodic technical report and a periodic financial report to the Commission within 60 days after the end of each reporting period. The periodic technical report contains (i) an explanation of the work carried out by the beneficiaries; (ii) an overview of the progress towards the objectives of the action; (iii) a summary for publication and; (iv) answers to a questionnaire. The periodic financial report includes (i) an individual financial statement from each beneficiary to be made in the participant portal; (ii) an explanation of the use of resources (also in the participant portal) and (iii) a periodic summary financial statement, which is automatically created by the electronic system (participant portal) consolidating the individual financial statements for the reporting period concerned.

4.4.3. Dissemination management

Management of dissemination and standardisation activities in WP5 is carried out using MS Team online excel form. The form can be found at:

https://teams.microsoft.com/l/file/EA4C21AE-20BD-4555-9DA4-0D525B76FC1F?tenantId=9f9ce49a-5101-4aa3-8c75-0d5935ad6525&fileType=xlsx&objectUrl=https%3A%2F%2Funioulu.sharepoint.com%2Fsites%2F5GDrones%2FShared%20Documents%2FWP5%2FT5.1%2FWP5%20Activities.xlsx&baseUrl=https%3A%2F%2Funioulu.sharepoint.com%2Fsites%2F5GDrones&serviceName=teams&threadId=19:580c8a1ddefe4b34a3693394532c1575@thread.skype&groupId=f466615e-4440-4c39-95a1-b53b160fc00e .

An example of the dissemination file ca be found form the Figure 2. Disseminations are identified by a running number. The information includes author(s), Partner name, Title of dissemination, information on target forum, short description of dissemination, status of dissemination, category, related WP and responsible partners. In addition, all the disseminated material is uploaded to MS Teams under WP5 channel.

Item #	Authors/Partners	Activity Title	Target (Event, Location, Date)	Description	Status				Category						Partners	WP
					Planned	Submitted	Rejected	Finalized	Workshop	Publication	Panel	Presentation	Conf	Other		
1	Dr. Jussi Haapola (OULU)	5GIDrones and its vertical use cases/requirements	EMPOWER Empowering Transatlantic Platforms for Advance Wireless Research workshop on June 18th 2019 at EuCNC in Valencia	Dr. Jussi Haapola (University of Oulu), 5GIDRONES project coordinator, presented 5GIDRONES and its vertical use cases/requirements at EMPOWER Empowering Transatlantic Platforms for Advance Wireless Research workshop on June 18th at EuCNC in Valencia				x				x			OULOU	
2	Dr. Jussi Haapola (OULU)	5GIDrones presentation	ICT-19 project session at EuCNC 2019 in Valencia (21 June 2019)	Dr. Jussi Haapola (University of Oulu), 5GDrones project coordinator, officially presented 5GIDrones at 5G PPP ICT-19 session about the "Launching of Advanced 5G validation trials across multiple vertical industries and the next steps" at Eucnc 2019 in Valencia (20 June 2019)				x				x			OULOU	

Figure 2: Example of dissemination excel form.

4.4.4. Acknowledgement and recognising EU funding

All dissemination activities of 5G!Drones shall bear the EU emblem, and the statement:

"This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857031."

All scientific papers and articles published with relation to 5G!Drones activities shall include the above statement, but not necessarily the EU emblem. Applications for IPR Protection of Results should also include the above standard sentence in each application filed by or on behalf of a partner. If results are incorporated in a standard, the beneficiary shall ask the standardisation body to include the above statement in (information related to) the standard.

The EU emblem and the following statement must be displayed on all infrastructure, equipment, and major results funded by the grant:

"This <infrastructure><equipment><insert type of result> is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857031."

5. QUALITY ASSURANCE

This section includes a plan to achieve high-quality project documentation by adhering to the following guidelines:

- Use of specific types of documents that are fit for purpose,
- Use of common convention for naming and versioning of documents,
- Use of document templates by all partners, and
- Following a rigorous deliverable review process.

The following subsections expand on these quality assurance guidelines.

5.1. Document Types

Several types of documents will be generated during the project lifetime to serve various purposes. All reports and text documents have been agreed to be prepared in MS Word, while presentations must be prepared in MS PowerPoint. There exist. templates for the mentioned documents. For formal submission of documents and presentations, PDF format is mandatory.

The document types used are:

- Deliverables: formal task outputs that capture the results of the work undertaken as part of the various WP activities. These documents are part of the contractual deliverables to the EC and should be submitted by the specified deadline through the Participant portal continuous reporting.
- Reports to the EC: management reports that reflect the overall progress of the project and need to be submitted to the EC by the specified deadline through the Participant portal. These include the periodic reports covering Months 1-18 and the final report of the project. In addition, there will be technical reporting of period 1-12.
- Internal Report (IR): documents internal to the consortium that can be used to develop contributions to project deliverables or to facilitate discussions around a specific subject. If the IR is to prepare contributions towards a project deliverable, the Table of Contents of the deliverable should be used with only the relevant sections populated. IRs can also be used as an interim report of a deliverable that is submitted at the end of a WP that runs for a long time.

Although interim reports are not formally submitted to the EC, they might be shared with the project officer and the reviewers to demonstrate progress made or used in GA meetings for review and sign off.

- Presentations: presentations can be prepared both for internal and external audiences. The presentations that need to be shared with external parties should be in PDF format.
- Meeting Agendas: meeting agendas are necessary for the successful implementation of physical and audio conference meetings. A meeting agenda should include the planned schedule and items to be discussed, venue or audio conference details, and any other relevant information (such as suggested hotels). Draft meeting agendas for physical meetings should be distributed as described in the Consortium Agreement and depends on the Consortium Body in question.
- Minutes of Meeting (MoM): MoM provides decisions made, discussion conducted (when appropriate), and action points assigned during a project meeting. The MoM will be prepared by the partner chairing the meeting and should be uploaded to MS Teams and shared with meeting participants via email notification link within a number of days after the meeting, as identified in the Consortium Agreement. The number of days depends on the Consortium Body in question. Action points assigned during the meeting should be summarised in the MoM but also included.
- Publications: this includes scientific papers in journals and conferences, book chapters, standards contributions, whitepapers, inputs to the 5G PPP WGs etc. These will be tracked in WP5 Task 1 and their format will be externally defined.

5.2. Document management

Project document names and versioning will follow a common convention so that consortium members are able to identify the latest version of a document and get some essential information about it. As a general principle, documents shall be named so that the following information can be distinguished:

- Identifier of document,
- type of document,
- descriptive name of document, and
- version.

All 5G!Drones documents use document templates available at MS Teams Templates folder:

https://teams.microsoft.com/_#/school/files/Templates?threadId=19%3Aacda825303154833b9a43c6a02267cae%40thread.skype&ctx=channel .

There exists a template for:

- Deliverables (c.f. Annex I – Deliverable template of this deliverable),
- Meeting agendas,
- Meeting minutes,
- Presentations, and
- Quarterly management reports.

The templates contain at least the following information: project name, project acronym, grant number, date, project logo, EU emblem, and the statement:

"This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857031."

In addition, deliverables contain the information:

- Document ID,
- Deliverable Title,
- Deliverable Number,
- Responsible Beneficiary,
- Programme Topic,
- Project Start Date,
- Project Duration,
- Contractual Delivery Date,
- Actual Delivery Date,
- Dissemination Level, and
- Contributing Beneficiaries.

The template also includes all pre-set styles that should be followed to ensure common formatting in all deliverables. The template provides indications to the contributors and editors on the following points:

- Deliverable No: it must be edited in the cover page and at the footer of a page of the document from which it will automatically be populated in the all pages of the document.
- Fields identified with "<Descriptive Text>": these are in the cover page and second page of the deliverable and should be manually updated.
- Actual delivery date: it should be edited in the cover page.
- Table of Contents: it is generated automatically by using the heading formats provided in the document when creating sections and subsections. The Table of Contents must be however updated before saving.
- List of Figures and List of Tables: these are not automatically created but will be included when necessary. Referencing of figures, tables, references, and other objects must be done using the cross-reference tool of MS Word.
- List of References: references shall be inserted in this list using Numbering where they can be hyperlink cross-referenced. When a reference is cited in the document body, the cross-reference tool of MS Word must be used.
- Description of expected content in relevant mandatory sections.

The meeting related documents contain at least the information:

- Meeting type,
- Date of meeting,
- Place (Venue / Online tool),
- File name,
- Last change date, and
- Dissemination level.

As the MS Teams functions over Sharepoint, there exists automatic version control of the documents.

5.3. Editing and Submitting Deliverables

This section refers to all deliverables apart from the Periodic Management Reports.

Each deliverable has an assigned editor who is responsible for creating the draft Table of Contents (ToC), assigning responsibilities relating to the deliverable in cooperation with the other task participants, collecting contributions, and integrating them in the deliverable. The lead editor partners have been identified in Annex I of the description of action.

Contributions to the deliverable by each contributing partner can be delivered as an IR or by directly editing the draft deliverable document that is available on MS Teams. This should be agreed between the editor and contributors.

The following rules apply in the drafting of deliverables:

- The draft table of contents (ToC) is the starting point for all deliverables.
- For deliverables where several issues of the same document will be submitted at different points in time, a single working document will be kept in MS Teams. The version to be submitted will be the current status of the deliverable at the corresponding point of submission, after having passed the quality assurance process.
- When a contributor or the editor is going to update a deliverable, the following steps must be followed:
    - First, MS Teams offers the opportunity for editing the document online by multiple users simultaneously.
    - If online editing is not conducted the respective deliverable must be checked out using the SharePoint functionality available.
    - If the document is edited offline, editing shall use track changes mode.
    - The document is saved and changes are uploaded in MS Teams.
    - The document is checked in using SharePoint functionality.
- While the document is locked for editing by a partner, no other partner should make changes to the document.
- Every update in a deliverable must be recorded in the history of the document, even if those changes do not imply a version change; in this case, the changes shall be documented in the cell of the document history corresponding to the current version.
- Only the editor or with the editor's permission one is allowed to change the version numbering of the deliverable and the history of the document.
- Documents should be clear and concise to enable easier review. Only the necessary information should be kept within the main body of the deliverable. When it is desirable to provide additional information, this should be done with the use of Annexes at the end of a deliverable.

When a deliverable is ready to be submitted to the EC the PC issues a new version, converts it to PDF and submits it through the Participant portal.

5.4. Review of Deliverables

The following measures are implemented in the project for the purpose of scientific and technical quality assurance of the project results and documentation.

- The technical overview of the deliverables is conducted by members of the PMT. There are at least two members of the PMT assigned for reviewing every deliverable in addition to the TM before submission.
- A first version of a deliverable to be submitted should be ready for review one month before the submission Due Date.
- Regular teleconferences within the various WPs will ensure the effective tracking of activities, identification of issues and action plans.
- Each WP leader shall review the deliverables generated in the respective WP. In case the WP leader is directly involved in the writing of the deliverable the WP internal review will be conducted by an agreed other Partner of the WP.
- The review team should provide their comments in tracked changes mode within one week to the editor. The editor and contributors will then address the comments and proposed changes and prepare the final draft for submission.
- The partners will be expected to put forward appropriate people to act as reviewers for deliverables drafts.

6. RISK MANAGEMENT

A number of risks and their likelihood and severity have been defined already during the project proposal. As well as identifying the list of risks in Table 11, UO will update in every QMR during the project time a Risk Table, with the indication of risks that could arise and the measures taken to mitigate or solve them by the responsible partners.

Table 11: Critical Risks for Implementation

Description of risk (indicate level of likelihood: Low/Medium/High)	Work package(s) involved	Proposed risk-mitigation measures
Deviation of the performed activities with respect to the overall project plan (Low)	WP6 / All	A detailed project quality and risk management plan is delivered in M04 as D6.1.
Deliverable quality and timeliness (Low)	All	A detailed project quality and risk management plan is delivered in M04 as D6.1.
Regulation barriers: Failure to acquire permission by local Civil Aviation Authorities to fly the UAVs at the selected trial sites. This particularly applies to BVLOS and high-altitude flight scenarios. (Low)	WP4	The partners are already aware of the regulation at each trial site location and have taken steps to mitigate the risk of regulatory barriers. Recommendation letters have been granted by the French and the Finnish CAA. Partners are very experienced with UAV trials of various scales. Sets of trials will be carried out in controlled environments outside urban areas, where 5G facilities and trial sites are located. Most of the tests envisioned involve low-altitude flights.
The ICT-17 5G facilities planned to be used and currently under development not supporting critical functionality needed for the use cases. (Medium)	WP3, WP4	5G!Drones has carefully studied the existing ICT-17 facilities and their existing and expected features. Members of the consortium are actively involved in the development of these and are well aware of their capabilities and status.
ICT-17 5G facilities to be used for trials are inaccessible during the execution of trials. (Low)	WP4	Backup trial facilities can be made available by the partners. The 5G!Drones trial plan will evaluate this risk and propose a backup trial strategy using other partner facilities in order to be able to evaluate the target KPIs.
The necessary permission to use the selected ICT-17 5G facilities is not granted. (Low)	WP4	Even though the likelihood for this case is very low, as the members of the consortium are at the same time involved in the ICT-17 5G facilities and explicit permission to execute trials on top of them has been granted, consortium members maintain

		independent 5G facilities which are planned to be contributed to the project.
The required 5G technology on the UAV side (onboard 5G terminal equipment) is not available on time. (Low)	WP3, WP4	Commercial off-the-shelf 5G UE terminals are expected to be in production in due time. Open-source alternatives are already under development (OAI 5G NR UE); features are already being tested and implementations of the components necessary for 5G!Drones are expected to be available after the first quarter of 2019. 5G!Drones aims to test a mix of experimental open-source and CoTS 5G systems.

6.1. Risk management procedure

The overall risk management process to be followed in 5G!Drones is illustrated in Figure 3. The goal of the risk management activities is to identify any risk that might affect the implementation and results of the project, track the risks and, if possible, take mitigation actions against it.

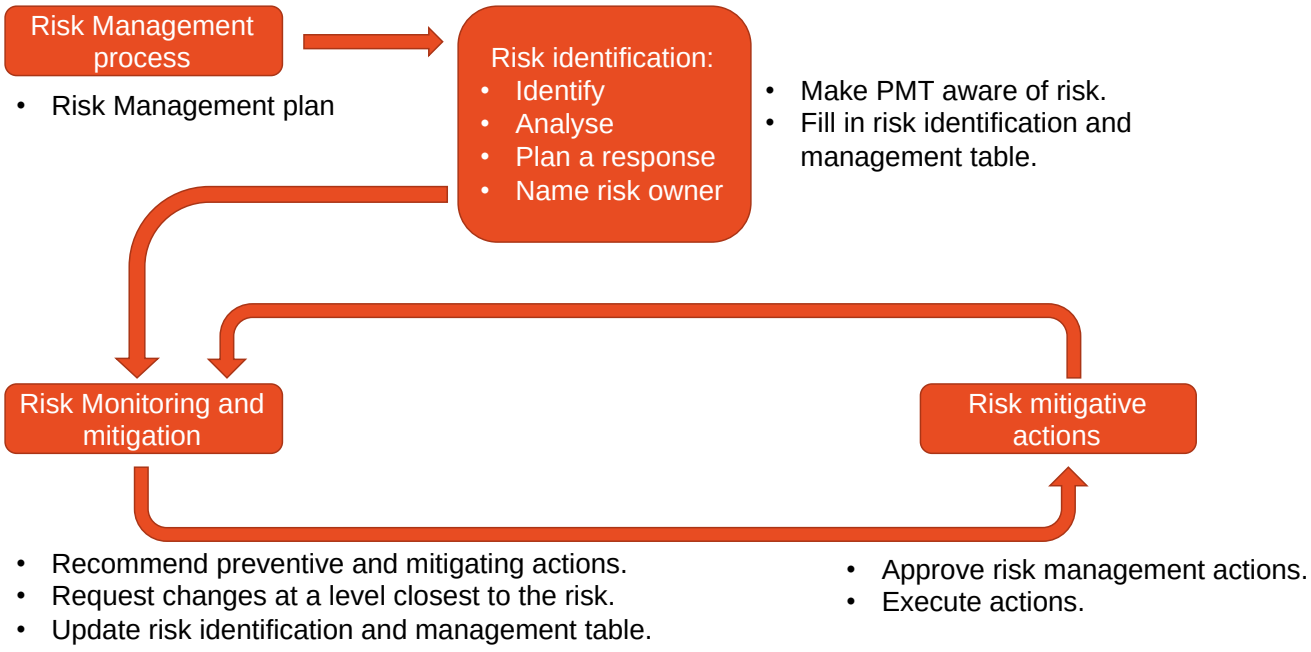

Figure 3: Risk management process.

6.1.1. Risk management process

The risk management process consists of deciding how to approach, plan, and execute the risk management activities. In addition to quarterly monitoring the critical risks of Table 11, there exists in MS Teams a risk identification and management table. The table is available at:

https://teams.microsoft.com/l/file/E13A4740-6BE5-4F75-A614-2E27D243646E?tenantId=9f9ce49a-5101-4aa3-8c75-0d5935ad6525&fileType=xlsx&objectUrl=https%3A%2F%2Funioulu.sharepoint.com%2Fsites%2F5GDrones%2FShared%20Documents%2FProject%20Management%20Team%2FRisk%20Management%2FRisk%20identification%20and%20management%20table.xlsx&baseUrl=https%3A%2F%2Funioulu.sharepoint.com%2Fsites%2F5GDrones&serviceName=teams&threadId=19:1a0e1ed5f89c4cc5bac948968ec99930@thread.skype&groupId=f466615e-4440-4c39-95a1-b53b160fc00e.

The risk identification and management table is illustrated in Table 12 and it has a central role in keeping track of potential risks. Adding items to the table is open for all Partners with an obligation to inform the PMT of the creation of a new risk item.

Table 12: Risk Identification and Management Table

Risk identification and management table						
Risk Type (Technical, cost, schedule, other)	Risk probability (very low, low, moderate, high, unacceptable)	Risk impact (very low, low, moderate, high, unacceptable)	Risk source (Beneficiary, regulation, technology, etc)	Risk owner (Cosnortium beneficiary / body in charge of Risk management)	Risk Status (identified, realised, solved, etc.)	Risk Description

6.1.2. Risk identification

The types of risks fall into various types including technical, cost-related, schedule-related, administrative, technology, etc. Each risk is evaluated on in terms of probability and impact. The risk reporter will provide an initial assessment of the risk severities and the PMT will revisit the risk assessment. The severity levels of those categories are:

- **Very low**: indicates minimal to no actual impact on project execution that could escalate if not addressed.
- **Low**: indicates minor impact on project execution, e.g. not meeting an intermediate deadline.
- **Moderate**: indicates impacting more than one minor activity or, e.g. missing deliverable or milestone deadline by one month.
- **High**: indicates major impact on an activity central for the project, such as trial execution, essential component development, or deliverable or milestone delay by several months.
- **Unacceptable**: indicates a major breach in contractual obligations, such as inability to execute trials, inability meet milestones, or significant overspending of a partner.

After a risk has been identified, it will be analysed by the PMT, which plans the response, optionally with the risk reporter, to take preventive or mitigative actions. The risk will be assigned an owner who takes a more active role in the risk monitoring.

As soon as a risk has been identified and analysed, the PMT needs to plan a response action. The response actions can be divided in four main categories:

- Prevention: measures are taken so that the risk does not materialize.
- Mitigation: measures are taken to reduce the probability and/or impact as much as possible.
- Transfer: this refers to the transfer of the risk management to another party. Transferring liability for risk is most effective in dealing with financial risk exposure.

- Acceptance: in cases when risks have low severity and no measures can be taken against them, the PMT needs to monitor them to ensure that their severity remains low.

6.1.3. Risk monitoring and mitigation

The PMT will bring, in general, risks identified higher than moderate to the attention of the General Assembly, who will review the risk at a regular or extraordinary meeting. Lower level risks are also notified to the General Assembly, and the identified risks are always available at the MS Teams site Table 12. Before addressing a risk in General Assembly, the PMT will produce a recommendation of preventive or mitigating actions so that a plan is ready for execution if the General Assembly approves of it. The modus operandi is to address the risk at the closest level of the risk to contain the amount of resources required for mitigative actions.

The PMT further periodically updates the risk identification and management table in MS Teams. The purpose is to monitor the effects of taken risk mitigative actions and re-assess the risk severities. The risk monitoring and mitigation planning and risk mitigative actions are an iterative process, which goal is to eliminate or contain identified risks to acceptable levels.

6.1.4. Risk mitigative actions

After approval of the General Assembly, the PMT and the risk owner executes the change requests required for effective risk management. The PC is responsible for direct communications with the Commission. If the risk is moderate or lower the PMT with or without the risk owner can execute mitigative actions. The PMT must notify of identified risks to the General Assembly with an execution plan. The General Assembly can promote such risk management to be handled at General Assembly level or at any level of the Consortium it chooses. After mitigative actions execution each identified risk will be further monitored by the PMT and the risk owner.

7. CONCLUSIONS

This deliverable presented the Data Management Plan under the Open Research Data Pilot as well as the management structure, procedures, and available tools for the implementation of the 5G!Drones project. The contents of this deliverable will be reviewed regularly and updated as decided by the Project Coordinator, General Assembly, or Project Management Team. Moreover, the Data Management Plan is a living document and it will be updated throughout the project lifetime to capture realised changes.

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Annex I – Deliverable template

"5G for Drone-based Vertical Applications"

<DX.Y – Name of Deliverable>

Document ID:		**<Preferred ID>**
Delivarable Title:	**<Insert Deliverable Title>**	
Responsible Beneficiary:		**<Beneficiary Name>**

Topic:	**H2020-ICT-2018-2020/H2020-ICT-2018-3**
Project Title:	**Unmanned Aerial Vehicle Vertical Applications' Trials Leveraging Advanced 5G Facilities**
Project Number:	**857031**
Project Acronym:	**5G!Drones**
Project Start Date:	**June 1st, 2019**
Project Duration:	**36 Months**
Contractual Delivery Date:	**<Deliverable delivery month>**
Actual Delivery Date:	**<Date of submission>**
Dissemination Level:	**<Inset type>**
Contributing Beneficiaries:	**<List of Beneficiary short names>**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857031.

Document ID: <Preferred ID>
Version: <Vx>
Version Date: <Date>
Authors: <Names of Authors (Beneficiary)>

Security: <Insert Dissemination Level>

Approvals

	Name	Organization	Date
Coordinator			
Technical Committee			
Management Committee			

Document History

Version	Contribution	Authors	Date
V1			
V2			
V3			

Executive Summary

This Deliverable …

Table of Contents

List of Abbreviations

UAV	Unmanned Aerial Vehicle

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2. <HEADING OF CHAPTER>

2.1. <Heading of Section>

2.1.1. <Heading of sub-section>

2.1.1.1. <Heading of sub sub-section>

References