"5G for Drone-based Vertical Applications"

D6.3 – Mid-term review report

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Approvals

	Name	Organization	Date
Coordinator	Jussi Haapola	UO	30.11.2020
Technical Committee	Pascal Bisson	THA	27.11.2020
Management Committee	Project Management Team and COS	FRQ, AU, THA, UMS, AIR, UO, COS	27.11.2020

Document History

Version	Contribution	Authors	Date
V1	Integration of Quarterly Management Reports QMR#5 and QMR#6, overall introduction, resourcing, gender balance, etc.	Jussi Haapola (UO), All Beneficiaries	13.11.2020
V2	Late inputs and resolution of internal review comments	Jussi Haapola (UO), Fofy Setaki (COS), Hamed Hellaoui (AU)	23.11.2020
V3	Technical Manager review comment resolution and final numbers	Jussi Haapola (UO), Pascal Bisson (THA)	30.11.2020

Executive Summary

The aim of this Mid-term review report, the 5G!Drones Deliverable 6.3, is to deliver the progress of 5G!Drones, as achieved during the months M13 – M18 of the project (June 1st, 2020 – November 30th, 2020). The deliverable describes the overall activities of the project between M13 and M18 and subsequently portrays the technical activities conducted at each Work Package, drilling down to individual Task level and contribution of each Beneficiary of the project. It is noteworthy that there are no specific Milestones for the project during this period.

The report addresses the main achievements of the project between June and November, 2020 including significant changes in the project Consortium that occurred during the period. It elaborates the submitted deliverables and captures the activities taken by the various project internal bodies together with their contributions towards the objectives of the project. The document does not include financial figures, or statements of use of resources, but it provides an estimate of personnel resources expended in terms of person months at project overall, as well as, at Work Package levels.

To elucidate the progress, the actual work carried out in Work Packages is described in detail. The description starts, in each Work Package and per Task, with recapturing on what has been stated in the Description of Action (DoA) followed with the main achievements of each Work Package, the significant results obtained, and deviations from DoA. Subsequently the report addresses each Task of the Work Packages and each Beneficiary's specific contributions to the Tasks. The report also details the dissemination and exploitation activities taken by the project Beneficiaries during the period, while standardisation actions are reported in detail in Deliverable D5.3. The deliverable further details the 5G!Drones project's achievements at 5G-PPP Programme level through participation to various bodies including Working Groups of interest where project has appointed representatives.

This document is intended mainly, as the summary of the 5G!Drones project activities during its M13 to M18 implementation for the EC to review. It also serves for the interested reader to gain an overview of the advances of the project in that period. The Deliverable follows a format similar to that of Deliverable D6.2, which covered the period M1 – M12 and was assessed to have sufficient quality of reporting. This Deliverable D6.3 has made improvements in reporting based on the comments received from the European Commission appointed reviewers' observations.

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List of Beneficiaries

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	INVOLI SA	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

List of Abbreviations and Definitions

CA	Consortium Agreement
DoA	Description of Action
EAB	External Advisory Board
GA	General Assembly
IMT	Innovation Management Team
IMU	Inertial measurement unit
IP	Intellectual Property
ITS	Intelligent Transport Systems
KPI	Key Performance Indicator
M#	Month of the implementation of the project action since June 1st, 2019
MS	Milestone
NSA	Non-Stand Alone
NSD	Network Service Descriptor
PC	Project Coordinator
PM	Person Month
PMT	Project Management Team
PoC	Proof of Concept
RACI	Responsible, Accountable, Consulted, Informed (responsibility assignment matrix)
RTM	Requirements Traceability Matrix
SDO	Standards Development Organisation
SLAM	Simultaneous Localisation And Mapping
TM	Technical Manager
ToC	Table of Contents
ToR	Terms of Reference
Traficom	Finnish Transport and Communications Agency
U2U	UAV-to-UAV
UAS	Unmanned Aerial Systems
UAV	Unmanned Aerial Vehicle
UTM	UAS Traffic Management
UC	Use Case

UCxScy	Use Case Number x Scenario y
UE	User Equipment
V2X	Vehicle-to-Everything
VNFD	VNF Descriptor
WF	Workforce
WP	Work Package
WPL	Work Package Leader
WUI	Web User Interface

Definitions:

Reporting Period: Implementation of action from June 1st, 2020 to November 30th, 2020 (M13 – M18).

U-Space: U-Space is a set of new services relying on a high level of digitalisation and automation of functions and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones.

1. INTRODUCTION

This Deliverable summarises the key topics addressed, achievements and open issues for the period from June 1st, 2020 to November 30th, 2020 of the 5G!Drones project, hereafter termed as Reporting Period. The previous Reporting Period has been covered in the Deliverable D6.2 spanning the project timeframe from June 1st, 2019 to May 31st, 2020 and this Deliverable D6.3 is a continuation of it. The Chapter 0 also recaptures the work done during the period from June 1st, 2019 to May 31st, 2020, in addition to this Reporting Period, in order to provide a more complete understanding the 5G!Drones project's progress towards its overall objectives. Otherwise, repetition of the activities described in D6.2 is minimised.

1.1. Main achievements

The main achievements of the project for the Reporting Period are described in chronological order. A set of Use Case (UC) feasibility tests were conducted in Athens, Greece in June using emulation due to the Covid-19 pandemic restricting travel. Those were followed by planning of physical feasibility tests in all of the 5G!Drones facilities when the pandemic situation permitted. Further Covid-19 pandemic mitigation actions were discussed and evaluated, the most important being the initiation of Amendment 2 in June, 2020 for the project's extension by six months. Shifts were also made in terms of Work Package (WP) durations, Task durations, Deliverable due dates, and Milestones (MSs). There were also some resource shifts between WPs.

The project's first year review was conducted in July 9th, 2020, resulting in a positive outcome by the reviewers. The recommendations provided in the review results have initiated various actions to further improve the project implementation and to prepare for further mitigation measures should the pandemic continue to affect project's implementation.

The feasibility tests were conducted during autumn 2020, with some delay due to the pandemic. Physical feasibility tests were performed at:
- Aalto University X-Network, Espoo, Finland and at University of Oulu 5GTN, Oulu, Finland during the end of August. The feasibility tests included running UAV operator software on edge servers and conducting communications via non-stand alone (NSA) 5G infrastructure and user equipment (UE). At 5GTN, drones were operated remotely from Estonia while the safety pilot and air-boss were physically present.
- 5GENESIS, Athens, Greece facilities during October, where in addition to the Finland tests unmanned aerial systems (UAS) traffic management (UTM) components were included.

The access restrictions due to the pandemic has prohibited conducting physical feasibility tests at the EURECOM 5G-EVE facility in Sophia-Antipolis, France. The tests will be conducted as soon as access restrictions are lifted and preparations are ongoing to minimise the pre-flight operations time.

The project held its first External Advisory Board (EAB) meeting in September, where the state of the project was presented to external experts, and their views and comments on the project outcomes, as well as future recommendations, were considered. The project held a two-day virtual face-to-face meeting at the end of October reviewing the overall progress of work, actions taken and to be taken at General Assembly (GA) level, with dedicated time slots for cross-WP interactions.

The main technical activities during the Reporting Period have focused on development of the trial engine and the enabling mechanisms of the project's system architecture detailed in Deliverable D1.3. Refining the said architecture has started based on the feedback provided by WP2, 3, and 4 developments. The Reporting Period included the submission of four project Deliverables:

- D3.1 – Report on infrastructure-level enablers for 5G!Drones (M18; R; PU; OPL), which is the first WP3 Deliverable
- D5.3 – Report on contribution to standardisation and international fora – 1st Version – (M18; R; PU; AIR),
- D6.3 – Mid-term review report (M18; R; PU; UO), which is this Deliverable, and
- D6.7 – Information on cumulative expenditure incurred, M18 (M18; R; CO; UO).

1.1.1. Changes in the Consortium

The project had two Amendments during the Reporting Period: Amendment 2 was initiated by the project to mitigate Covid-19 related impacts on the project implementation and Amendment 3 was Commission initiated to change the list of complementary grants to 5G!Drones. Amendment 2 major changes to DoA are described in the following subsection.

1.1.1.1. Amendment 2

The Consortium requested a six (6) months extension of the project due to Covid-19 related delays in project implementation. The ongoing Covid-19 outbreak impacts the implementation of 5G!Drones project in a negative manner due to "Force Majeure" conditions. In the short-term the following observations were made.

1. Costs have incurred and will incur for planned events that have already been postponed or cancelled, and events that will be postponed in the forthcoming months.
2. Beneficiaries' countries' restrictions on travel have delayed and will further delay conducting planned feasibility tests on the trial sites. Multiple Beneficiaries from various countries are involved in feasibility tests, and ultimately trials, and due to travel restrictions, the feasibility tests and pre-trials will be delayed.
3. Access limitations due to local government restrictions to work premises and facilities of Beneficiaries delay software and facility functionality development, causing delays in the process towards being able to conduct trials. The delays range from four to seven months, depending on the Beneficiaries Member state policies.
4. Governmental limitations for physical meetings delay implementation Tasks and facility operational Tasks that require multiple people operating in close proximity. These limitations also obstruct aspects like testing of drones and meetings within and in between Beneficiaries in the same area. The delays began since March 2020 and continue to date to some extent.
5. The Covid-19 restriction has stopped personnel recruitment processes from abroad since early March 2020, and continues for an undetermined period. This is especially affecting academic partners as additional workforce recruitment that was planned has delayed, and the new personnel has not yet assumed working for the project as expected.

Moreover, Frequentis AG intents to utilise resources from its affiliation Frequentis Solutions as linked third party to accommodate with the evolving efforts in WP2 and WP3 with respect to design and implementation of U-Space Adaptor – not anticipated to the whole extent at the setup of the activity.

Beneficiary 14 - EURECOM shifted six (6) PM from WP2 to WP3.
Beneficiary 15 - DRONERADAR Sp z o.o. shifted four (4) PM from WP3 to WP4.
Beneficiary 12 - NOKIA SOLUTIONS AND NETWORKS OY (NOK) shifted seven (7) PM from WP4 to WP5.

The majority of the Deliverable due dates were shifted to accommodate the foreseen extension of implementation. The list of changes is as follows.

- D1.6 (from M18 to M24),
- D1.7 (from M36 to M42),

- D2.2 (from M18 to M23),
- D2.3 (from M18 to M24),
- D2.4 (from M21 to M24),
- D2.5 (from M24 to M30),
- D2.6 (from M24 to M30),
- D3.2 (from M24 to M26),
- D3.3 (from M27 to M32),
- D3.4 (from M27 to M33),
- D4.2 (from M18 to M26),
- D4.3 (from M20 to M26),
- D4.4 (from M35 to M42),
- D5.2 (from M18 to M23).
- D5.4, D5.5, and D5.6 (from M36 to M42),
- D6.5 has been renamed as D6.6 and shifted delivery from M36 to M42,
- A new deliverable D6.5: Annual report, year 3, (M36; R; PU; UO) with Due date at M36,
- A new deliverable D6.7: Information on cumulative expenditure incurred, M18 (M18; R; CO; UO) with Due date at M18, and
- A new Deliverable D6.8: Information on cumulative expenditure incurred, M30 (M30; R; CO; UO) with Due date at M30.

Work Packages durations and respective Tasks, as well as project Milestones were shifted accordingly. The Amendment 2 new project timeline is depicted in the revised Project Gantt chart illustrated in Figure 1.
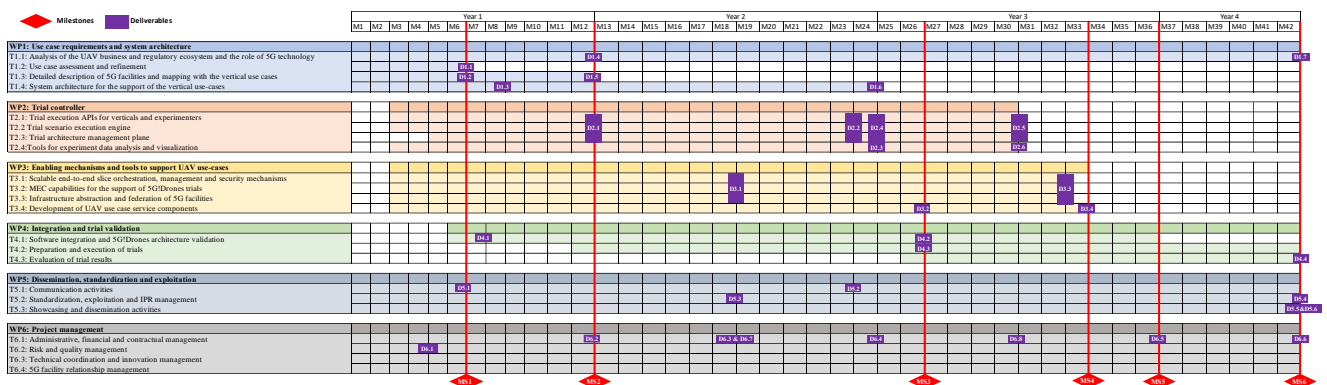
Figure 1: 5G!Drones Amendment 2 Gantt chart.

2. RESOURCE UTILISATION

The resource utilisation table provided here are indicative estimates of the Beneficiaries. Accurate figures shall be provided in the context of periodic reports at M24 and M42. In addition, estimates of costs are provided in 'Information on cumulative expenditure incurred' Deliverables at M18 (D6.7) and M30 (D6.8).

2.1. Estimated overall resource use

The Table 1 depicts the project and its Beneficiaries resource use during the Reporting Period. Significant effort has been expended despite the pandemic affecting work and the activity in the technical WPs has picked up pace, as expected.

Table 1: Estimated Resource Use in PMs between M13 and M18

Reporting Period M13 - M18			Reported effort in PMs						
Participant No.	Part. Short name	Participant organisation name	WP1	WP2	WP3	WP4	WP5	WP6	Total
1 (Admin. Coordinator)	UO	OULUN YLIOPISTO	0,80	5,20	8,55	3,13	0,24	3,40	21,32
2 (Tech. Coordinator)	THA	THALES SIX GTS FRANCE SAS	1,29	1,58	5,91	1,98	1,15	3,40	15,31
3	ALE	ALERION	1,48	-	4,18	1,39	0,90	-	7,95
4	INV	INVOLI SA	1,70	4,50	2,05	2,65	2,70	-	13,60
5	HEP	Hepta Group Airborne OÜ	-	0,50	1,70	5,74	-	-	7,94
6	NCSRD	NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"	1,07	6,92	1,29	3,74	0,28	0,14	13,44
7	AU	AALTO KORKEAKOULUSAATIO SR	2,60	11,05	14,84	2,48	0,39	-	31,36
8	COS	COSMOTE KINITES TILEPIKOINONIES AE	0,50	-	-	6,80	0,70	-	8,00
9	AIR	AIRBUS DS SLC	2,00	2,60	-	4,40	3,00	-	12,00
10	UMS	UNMANNED SYSTEMS LIMITED	0,30	1,00	3,40	5,10	0,20	-	10,00
11	INF	INFOLYSIS P.C.	1,01	0,59	-	1,24	1,77	-	4,61
12	NOK	NOKIA SOLUTIONS AND NETWORKS OY	2,37	2,38	4,20	4,48	0,99	-	14,42
13	RXB	ROBOTS EXPERT FINLAND Ltd	0,73	1,15	0,56	3,24	3,04	-	8,72
14	EUR	EURECOM	1,63	6,37	7,00	1,50	2,00	0,46	18,96
15	DRR	DRONERADAR Sp z o.o.	0,41	2,31	1,60	4,40	-	-	8,72
16	CAF	CAFA TECH OÜ	0,30	1,50	4,20	7,00	1,20	-	14,20
17	FRQ	FREQUENTIS AG	3,76	3,06	2,47	5,27	1,25	-	15,81
18	OPL	ORANGE POLSKA SPOLKA AKCYJNA	1,86	-	2,29	1,95	0,10	-	6,20
19	MOE	MUNICIPALITY OF EGALEO	2,50	1,08	1,44	2,88	0,66	0,18	8,74
20	ORA	ORANGE SA	0,70	0,50	2,20	0,30	1,40	-	5,10
		Total	27,01	52,29	67,88	69,67	21,97	7,58	246,40
		No contractual effort in respective WP							

The cumulative estimated resource use since the project start (M1 – M18) is presented in **Error! Not a valid bookmark self-reference.**. The table shows that most of WP1 effort has been consumed, as two of its four Tasks have already ended. Overall, approximately 45% of the project resources have been used, which reflects the state of the project, in terms of timeline and effort to be on track.

Table 2: Estimated Cumulative Resource Use in PMs between M1 and M18

Reporting Period M1 - M18			Reported effort in PMs								
Participant No.	Part. Short name	Participant organisation name	WP1	WP2	WP3	WP4	WP5	WP6	Total M1 - M18	Partner Total	Parnter % from total
1 (Admin. Coordinator)	UO	OULUN YLIOPISTO	10,98	12,89	11,40	4,26	0,68	9,46	49,67	125	40 %
2 (Tech. Coordinator)	THA	THALES SIX GTS FRANCE SAS	5,29	5,58	18,06	4,48	3,45	9,70	46,56	95	49 %
3	ALE	ALERION	7,09	-	7,20	2,07	0,90	-	17,26	55	31 %
4	INV	INVOLI SA	9,90	12,20	4,65	5,30	7,30	-	39,35	69	57 %
5	HEP	Hepta Group Airborne OÜ	4,30	2,50	2,90	7,69	-	-	17,39	60	29 %
6	NCSRD	NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"	6,97	8,97	4,22	5,58	0,88	0,18	26,80	84	32 %
7	AU	AALTO KORKEAKOULUSAATIO SR	8,16	21,69	26,11	5,34	1,24	-	62,54	98	64 %
8	COS	COSMOTE KINITES TILEPIKOINONIES AE	8,70	-	-	8,50	1,30	-	18,50	30	62 %
9	AIR	AIRBUS DS SLC	11,00	6,90	-	7,40	9,10	-	34,40	72,08	48 %
10	UMS	UNMANNED SYSTEMS LIMITED	7,60	7,00	5,90	8,90	0,75	-	30,15	82	37 %
11	INF	INFOLYSIS P.C.	9,72	1,61	-	1,76	6,51	-	19,60	43	46 %
12	NOK	NOKIA SOLUTIONS AND NETWORKS OY	8,88	7,97	8,14	5,71	1,40	-	32,10	86	37 %
13	RXB	ROBOTS EXPERT FINLAND Ltd	3,33	2,85	0,76	3,84	6,34	-	17,12	50	34 %
14	EUR	EURECOM	11,26	16,39	17,57	2,50	4,26	1,64	53,62	98	55 %
15	DRR	DRONERADAR Sp z o.o.	3,96	7,11	3,80	9,55	-	-	24,42	50	49 %
16	CAF	CAFA TECH OÜ	12,20	3,70	8,90	10,00	2,70	-	37,50	79	47 %
17	FRQ	FREQUENTIS AG	8,56	6,96	7,27	8,47	2,45	-	33,71	72	47 %
18	OPL	ORANGE POLSKA SPOLKA AKCYJNA	5,77	-	6,42	2,48	3,34	-	18,01	60	30 %
19	MOE	MUNICIPALITY OF EGALEO	5,50	2,88	3,88	6,24	1,98	0,90	21,38	40	53 %
20	ORA	ORANGE SA	5,20	2,20	2,40	0,30	1,50	-	11,60	20	58 %
		Total used M1 - M18	**154,37**	**129,40**	**139,58**	**110,37**	**56,08**	**21,88**	**611,68**		
		Total effort from DoA	208	246	303	408	161,08	42	1368,08		
		Percentage used from total	74 %	53 %	46 %	27 %	35 %	52 %	45 %		

3. DELIVERABLES

Table 3 contains the list of deliverables that were due in the reporting period. The table presents the Deliverable number, the name of the Deliverable, its associated WP, responsible Beneficiary, Deliverable type, its dissemination level, its due delivery month from DoA, and its actual submission date to the Commission.

Table 3: Deliverables due during the reporting period

Del. #	Name of Deliverable	WP #	Lead Benefi-ciary	Type	Dissem-ination level	Contr-actual delivery	Actual Delivery date
D3.1	Report on infrastructure-level enablers for 5G!Drones	3	OPL	Report	Public	M18	30.11.2020
D5.3	Report on contribution to standardisation and international fora – 1st Version	5	AIR	Report	Public	M18	27.11.2020
D6.3	Initial description of the 5G trial facilities	6	UO	Report	Public	M18	30.11.2020
D6.7	Information on cumulative expenditure incurred, M18	6	UO	Report	Confidential	M18	27.11.2020

4. MILESTONES

There were no Milestones due during the Reporting Period. Important actions were performed in technical Work Package 3 and the submission of Deliverable D3.1 and in technical Work Package 5 and the submission of D5.3. Overall, all WPs did work in preparation of the next milestone (i.e. MS3) to be passed at end of M26.

5. PROJECT BODIES AND MEETINGS

5.1. General Assembly / Plenary meeting

During the Reporting Period the 5G!Drones project held one 1st year review preparatory meeting with all Beneficiaries present and one virtual Face-to-Face meeting at 26-27 of October 2020 where General Assembly points were discussed and decided. Other General Assembly subjects were conducted through remote voting and consensus.

5.2. Project Management Team

The Project Management Team consisting of the Project Coordinator (PC), Technical Manager (TM), and Work Package Leaders (WPLs) held regular meetings (8/06, 26/06, 04/09, 28/09, 30/10, 27/10) over the Reporting Period where the progress towards the objectives was reviewed to further drive the project according to the work plan defined. For each of these meetings minutes were produced and uploaded on the project's workspace. It has become customary that all partners of the project may partake and contribute to PMT activities, but it is the core PMT, which drives the activities leading to General Assembly matters.

5.3. Facility Coordination Team

The Facility Coordination Team is aligned with Work Package 6 Task 6.4 activities. The purpose is to coordinate the developments and releases of the ICT-17 Facilities with 5G!Drones project and bring to the 5G!Drones projects attention any changes especially with 5GENESIS and 5G-EVE projects. The Facility Coordination Team also serves as the feed in point of 5G!Drones project requirements from the said ICT-17 facilities.

During the Reporting Period, clarification of the complimentary architecture between ICT-17 and ICT-19 experimentation facilities has been achieved. This activity was in major parts Technical WPs' work but also required discussions with 5G!Drones and the ICT-17 projects on a project level. 5GENESIS and 5G-EVE have presented and mapped to the architecture of 5G!Drones the ICT-17 specific components that could be further exploited or expanded for the needs of the 5G!Drones project. Specific contributions were identified at the Trial Enforcement and the abstraction layer definition.

The "5G-trials in Europe" workshop was organised, gathering all the ICT-17 platforms and ICT-19 projects to share experiences and lessons learnt during their 5G experimentation processes, contributing to a more holistic view between vertical experiments and 5G Facilities. The useful outcome in the framework of this task is that the facilities should consider also in collaboration with the vertical industries the assessment of vertical-specific KPIs, beyond the platform specific that are already covered by them. For the successful consideration of vertical-specific KPIs the softwarisation of vertical-specific components is required. This paradigm was followed in the 5G feasibility tests of the project during the reporting period, where UAV core components, were softwarised and deployed at the edge-computing node of the facility.

5.4. External Advisory board

The first EAB meeting was organised in September 22nd. The presentation of the project activities so far resulted in a lucrative discussion and useful feedback considered to strengthen the outcomes of the project. The External Advisory board members are:

- Barbara Pareglio, Senior Director, IoT Technology, GSMA;
- Florian-Michael Adolf, Head of Autonomous Flight, Volocopter;
- Heidi Himmanen, Chief Specialist, Finnish Transport an Communications Agency (Traficom);
- Heikki Huhmo, Project Manager, Open innovation platforms spearhead project, BusinessOulu;
- JC Robert DelHaye, CEO, Drone Think Do;
- Jyrki Penttinen, Senior Technology Manager, North America, GSMA; and
- Priit Rifk, Director of Aviation Division at Ministry of Transport, Estonia.

All WPs did work on early feedback provided EAB members as per topical questions raised at this first EAB. Further discussions will take place in the contact of the next EAB planned for Year 2021.

5.5. Innovation Management Team

The IMT Objectives are:
1. UAV vertical and Telecom Industry experts collaboration to jointly drive innovation.
2. Monitoring of very fast evolving business environment.
3. Consultation to the PMT.
4. Project guidance towards identifying emerging innovation.
5. Readjustment of project activities to better respond to opportunities.
6. Maintain focus of the project in line with:
   • Current technological developments and
   • Regulatory developments.

IMT team consists of representatives from CAF (IMT leader), RXB, FRQ, ORA, DRR, and OPL. IMT held a joint meeting with PMT members at which the top priority topics to be addressed in 2020 were selected. These priority topics are described in Table 4.

Table 4: IMT topics in 2020

Topic	Lead	Description
1. UAV Business case developments	RXB	Major drone services and developments related to 5G Drones activities.
2. Regulation of UAV flights	CAF	Updates of EU Regulation (will take in effect January 01, 2021) and further regulation developments
3. U-Space regulation and roll-out	FRQ	U-Space regulation updates and roll-out in EU
4. Regulation of UAV´s Radio Communication (incl. onboard cellular device)	ORA	EU regulation to use 5G or other cellular devices onboard
5. 5G roll-out and developments of the 5G eco-system incl. 5G IoT	CAF	5G networks (which frequencies) roll-out in EU and development of eco-system and functionalities (SA; MEC etc.)
6. Standardization of 5G (3GPP etc.)	OPL	3GPP technical studies and reports regarding UAVs
7. UAV-s with in-built cellular communication devices (incl.5G, IoT)	ORA	Drones with cellular (incl. 5G) devices on board
8. D2D (Drone2Drone) communication systems	DRR	Developments on the field of C-V2X, V2X, ITS, D2D etc.

The PMT did request a short report on progress from IMT at regular meetings. This has been put in place during the reported period. Further to this, the IMT has per instructions received from TM also supported the PMT in addressing some of the points raised in the context of the project's 1st year review (July 2020), where reviewers asked a number of questions and suggestions, which IMT could help to answer.

In M13-M18, IMT's main focus was on regulation and monitoring developments in D2D standards. For example, the IMT notified that the French regulation was amended with immediate effect on tests in France 2020-2022 (UAVs weighing more than 800 grams must issue an electronic alert from June 29, 2020 (France Decree n ° 2019-1114)).

The list of IMT topics for 2021 will leverage on initial list and it will be based on progress achieved and subsequent needs/demands from PMT.

6. GENDER BALANCE

The Table 5 describes the gender balance of the project. The table describes not only the personnel who directly used the resources of the project but also the staff directly supporting 5G!Drones activities. As can be seen from the table the overall gender balance is 30% female, 70% male, and 0% other genders working for the project. The WP leader positions are dominated by male representation, whereas the support personnel are dominated by female representation. Overall, other project roles vary having 13% to 19% female representation.

Table 5: Gender Balance of the 5G!Drones Project

Gender Balance			Number of personnel	WP Leader			Task Leader			Technical person / researcher			Project manager			Support staff (Admin, legal, financial)			Total			Total
Participant No.	Part. Short	Participant organisation name	Country	Female	Male	Other	Female	Male	Other	Female	Male	Other	Female	Male	Other	Female	Male	Other	Female	Male	Other	Total
																						229
1 (Admin. Coordin.	UO	OULUN YLIOPISTO	Finland		1			1		1	13					3			4	15	0	19
2 (Tech. Coordinat	THA	THALES SIX GTS FRANCE SAS	France		1					3	8			1		4			7	10	0	17
3	ALE	ALERION	France					1			1			1					0	3	0	3
4	INV	INVOLI SA	Switzerland				1	1		1	6			1		3	1		5	9	0	14
5	HEP	Hepta Group Airborne OÜ	Estonia								6			4		4	1		4	11	0	15
6	NCSRD	NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"	Greece					2			8			1					0	11	0	11
7	AU	AALTO KORKEAKOULUSAATIO SR	Finland		1			1			7			1		4	3		4	13	0	17
8	COS	COSMOTE KINITES TILEPIKOINONIES AE	Greece				1			3	6								4	6	0	10
9	AIR	AIRBUS DS SLC	France		1					2	7					5	2		7	10	0	17
10	UMS	UNMANNED SYSTEMS LIMITED	United Kingdom		1						5			1		1			1	7	0	8
11	INF	INFOLYSIS P.C.	Greece					1		5	5			1					5	7	0	12
12	NOK	NOKIA SOLUTIONS AND NETWORKS OY	Finland							2	5			1		6	10		8	16	0	24
13	RXB	ROBOTS EXPERT FINLAND Ltd	Finland					1			2								0	3	0	3
14	EUR	EURECOM	France				1	1		1	4					1			3	5	0	8
15	DRR	DRONERADAR Sp z o.o.	Poland					1			3					1	1		1	5	0	6
16	CAF	CAFA TECH OÜ	Estonia					1			1		1						1	2	0	3
17	FRQ	FREQUENTIS AG	Austria		2			1		2	7		1			1			4	10	0	14
18	OPL	ORANGE POLSKA SPOLKA AKCYJNA	Poland							1	5			1		2			3	6	0	9
19	MOE	MUNICIPALITY OF EGALEO	Greece							3	5			1		4	1		7	7	0	14
20	ORA	ORANGE SA	France					1		1	3								1	4	0	5
			Percentage	0 %	100 %	0 %	19 %	81 %	0 %	19 %	81 %	0 %	13 %	88 %	0 %	67 %	33 %	0 %	30 %	70 %	0 %	

7. PROGRESS OF TECHNICAL WORK AND ACHIEVEMENTS

This section reports on major work performed and achievements obtained for each of the 5G!Drones project objectives during the Reporting Period (M13 – M18). In order to provide context, the progress towards project objectives is recapped from Deliverable D6.2 for each of the objectives, followed by this Reporting Period's contribution.

7.1. Summary and progress towards project objectives

> **Objective 1 "Analysis of the performance requirements of UAV verticals":** 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.

M1 – M12 (from D6.2)

5G!Drones UAV use cases as stated in DoA have been revisited, complemented, and confirmed in terms of both feasibility and market relevance perspective. Within each of the four broad UAV-based Use Case categories identified to benefit from the large-scale deployment of 5G networks, twelve scenarios (including three sub-scenarios) have been identified as candidates to be trialled over the available 5G testing facilities to test and validate 5G KPIs. D1.1 *Use case specifications and requirements* provides a description of each of the use case scenarios detailing hardware and software enabling components for the UAV trial to take place. It also provides information on the 5G network and drone requirements required to deploy the trials as well as lists the application performance requirements and vertical-service-level KPIs that are critical to be measured during the trials.

Further to this an initial analysis of the UAV market, the regulation and legislation to date vs. to come, as well as the role 5G technology could play was also performed. This has been fully documented in D1.4 "UAV business and regulatory ecosystem and the role of 5G". This is used to ensure proper alignment of the whole (development & trial) work towards useful and usable results. This is also in favour to have results widely adopted and generate new business opportunities through provision of newly enabled UAV services.

Objective 1 has been worked out by WP1 mainly through Task 1.1 "Analysis of the UAV business and regulatory ecosystem and the role of 5G technology" and Task 1.2 "Use case assessment and refinement" which have respectively delivered D1.4 and D1.1.

M13 – M18

During the Reporting Period Objective 1 has mainly been addressed through WP1 Task 1.1. "Analysis of the UAV business and regulatory ecosystem and the role of 5G technology", Task 1.4 "System architecture for the support of the vertical use-cases", and Innovation Management Team (IMT) activities.

The IMT team has considered additional topics towards the Objective namely utilising Intelligent Transport Systems (ITS) vehicle-to-everything (V2X) communications solutions for inter-drone communications.

> **Objective 2 "Design and implementation of the 5G!Drones software layer (or system) to execute UAV trial":** 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.

M1 – M12 (from D6.2)

Several significant progress steps have also been reported by key technical deliverables.

- **High-level design of 5G!Drones overall architecture** to support the UAV use cases over a federated, multi-domain 5G infrastructure, as well as to manage successful execution of their trials. This architecture fully documented in D1.3 has been produced by WP1 but most importantly has been shared and agreed by other WPs since made actionable from their side. Indeed the overall 5G!Drones architecture, while stressing structuring environmental concepts (e.g. 5G network slice, MEC as well as UTM & U-Space) and embracing relevant standardisation work, depicts the major building blocks needed to get it realised namely the Portal, the Trial Controller, the Abstraction Layer, the 5G Facility Infrastructure Monitoring, the U-Space entity and the U-Space Adapter. It also presents in detail the cornerstone of the envisaged architecture, the 5G!Drones Trial Controller its components and their interaction , as well as the UAV verticals and the 5G Facilities, in order to enforce the relevant UAV service logic. Last but not least it also stress some of the identified gaps at first supporting 5G Facilities level (i.e. X-Network, 5GEVE, 5GTN and 5GENESIS) and second, enablers level to cover the UAV use case requirements.
- **5G trial Facilities description:** description of 5G Facilities was provided initial on M6 through deliverable D1.2 with insights on each of the 5G trail facilities, namely: the 5GENESIS, Athens 5G site, the 5G-EVE, Sophia Antipolis 5G site, Aalto university X-network, and the University of Oulu 5G Test Network (5GTN). Initial description of 5G facilities was further refined and extended in the context of D1.5 (M12) that extensively describes each of the 5G facilities required to carry out trial experiments in the 5G!Drones adding some of the details which were missing in previous deliverables (e.g. radio and core network capabilities, edge computing technologies supported, interactions with the trial controller) while considering features upgrades as well as security mechanisms in place. Furthermore, the mapping of use case scenarios and facilities. The initial mapping of use-case scenarios and facilities (in D1.2) was advanced and made actionable since now expressed (in D1.5) as a set of functional components that will permit the deployment of a given scenario. These components are first mapped within architecture proper to each scenario deployment, and then categorized into UAV components, UAV operator components, UTM components, and 5G components.
- **Trial controller**: an initial version of the Trial Controller architecture, its mechanisms and APIs has been worked out by WP2 and fully documented in D2.1. This work leverages on overall design of 5G!Drones architecture from D1.3 and further details trial controller, its components (Trial Scenario Execution Engine, Trial Architecture Management Plane, KPI Assessment, Data Gathering) their interaction as well as supporting mechanisms and/or algorithms. Further to this D2.1 also emphasizes on references points derived and that are key towards the definition of the Trial Controller APIs. Apart from paving the way towards the next release of the trial controller architecture, mechanisms and APIs (aka D2.4), D2.1 was also made actionable to other WP and more specifically WP4 to figure components to integrate, test and validate from Trial Controller perspective.

M13 – M18

Objective 2 has mainly been addressed through Tasks 1.4, to be reported in D1.6 which is an evolution of D1.3, at M24, Tasks 2.1, 2.2, and 2.3, to be reported in D2.2 at M23, and Tasks 3.1, 3.2, and 3.3

reported in D3.1. The Task 1.4 activities focus on refining the high-level design of the overall architecture, which governs the Objective 2 software layer, whereas the WP2 Tasks focus on the detailed definition of Trial controller architectural part and its software and hardware development. WP3 Tasks focus on the infrastructure enablers that are accessed through the abstraction layer. The objective has been addressed through achievements in the following technical areas:

- **High-level design of 5G!Drones overall architecture**: During this period, 5G!Drones partners have been working on the final architecture and on the refinements of the technical design and updated specifications of the 5G!Drones platform, from what has been described in D1.3. This shall be documented in D1.6 that will present a global picture of the final architecture. D1.6 shall focus on the refined extensive list of the requirements relative to the final architecture design. It will provide an analysis of the updated 5G!Drones architecture including each for each component key functionalities and development progress over the federated, multi-domain 5G infrastructure. An early version of D1.6 was produced within the reporting period for project internal purposes.
- **Trial controller**: The work achieved during this period regarding the trial controller activities will be reported in D2.2. D2.2 will describe the trial engine, including modules and functions as introduced in D2.1.
- **Infrastucture enablers**: D3.1 describes some 5G!Drones infrastructure enablers needed to cover project's needs, which are not facility specific, and that results from the work of Task 3.1, Task 3.2, and Task 3.3, such as Abstraction Layer, NSD template, MEC capabilities, and security functions.

> **Objective 3 "Design a high-level scenario descriptor language to run and analyse the results of the UAV trials":** Design a high-level (or Northbound) API to allow a UAV vertical to configure a trial and run the test.

M1 – M12 (from D6.2)

This objective in scope of WP2 was mainly covered during the period by worked performed on T2.1 **"Trial execution APIs for verticals and experimenters"** and T2.3 **"Trial architecture management plan"**. Results achieved have been detailed and reflected in D2.1. With focus put on the provision of high-level scenario description languages and APIs, as well as mechanisms to translate scenarios to deployments using the APIs provided by facilities and the 5G!Drones enablers, a Functional Breakdown Structure (FBS) for Web Portals describing all the functions, required to be performed by the experimenter to specify his test was defined. From this FBS a Scenario Description Language was defined, with all the details and information elements, which are required to work with Web Portals 1 and 2, and to define the experiment. Based on this, the prototype APIs were designed. This initial work which has delivered will be continued and further detailed and documented in the context of implementations of the web portals.

M13 – M18

This objective is in scope of WP2 and was mainly covered during the period by work performed in T2.1 "Trial execution APIs for verticals and experimenters" and T2.3 "Trial architecture management plan". The work during the Reporting Period has mainly focused on the design and implementation of the Life Cycle Manager (LCM) and the work was based on the trial process flows the project has worked on during the period.

The activities focus on trial execution management and trial monitoring aspects, while different management interfaces are being designed and provided to cover the project's needs. This Objective has also been addressed in the scope of T2.3, responsible for building the Trial Enforcement component of the Trial Controller.

> **Objective 4 "Design and implementation of 5G!Drones enablers for UAV trials and operations":** 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 uRLLC) and one for the data plane (type eMBB or mMTC). 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.

M1 – M12 (from D6.2)

Objective 4 has been worked out by WP2, WP3, and WP4 following technical progress achieved by WP1 ranging from the Use Cases detailed (D1.1), the High-level design of 5G!Drones overall architecture (i.e. D1.3), initial (M6/D1.2) and refined description of the 5G facilities (M12/D1.5). This has been performed while taking into consideration additional work performed in the context of D1.4. This has framed the work of WP2 and WP3. The former has delivered initial description of Trial Controller seen as one of the core enabler despite coarse-grained. The later has been working on initial list of enablers (see D6.2 WP3 appendices for details form Section 9 to Section 14) under work (specification / development).

Based on information coming from the work performed by WP1, WP2, and WP3, WP4 has specified an initial integration plan which has been reported in D4.1. A 4-phased iterative process of Build-Deploy-Cycles per facility has been devised and the basic steps and involved interactions for each integration activity have been defined. This initial integration plan has been shared and agreed with other WPs and more specifically WP2 and WP4 that will deliver components/enablers to be tested integrated in the context of the test cases to be trialled.

M13 – M18

Objective 4 has been further developed in WP2, WP3, and WP4 following the technical progress achieved by WP1. During the Reporting Period, WP2 continued working mainly on the trial controller and the web portal (both Webportal 1 and 2), while WP3 has been focusing on the design and implementation of the infrastructure enablers, including the ones required to provide end-to-end slicing and MEC capabilities. The abstraction layer, required to allow communication with the different facilities, is also carried out in the scope of WP3.

The main achievements towards this objective are reported in Deliverable D3.1 – Report on infrastructure-level enablers for 5G!Drones (M18; R; PU; OPL).

> **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. 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)

M1 – M12 (from D6.2)

This objective is in scope of two Tasks of WP4 which have either barely started or not started at all, namely T4.2 "Preparation and execution of trials" (M12-M36) and T4.3 "Evaluation of trial results (M20-M36). As such there is no progress to report yet except preliminary discussions in view of 5G KPIs to validate coming from UAV use cases description as stated in D1.1.

M13 – M18

This objective is in scope of two Tasks of WP4 which, namely T4.2 "Preparation and execution of trials" and T4.3 "Evaluation of trial results". The project partners have started working on those Tasks during the period by performing several feasibility tests, in Finland at Oulu 5GTN and Aalto X-Network, as well as in the 5GENESIS Greece facility in Athens. These tests were very useful and allowed the project to identify existing gaps in the approach and plan corrective actions. The tests also enabled to identify the components that do function as intended for the trials and the ones that require further development. The feasibility also enabled the project to collect both application and network data. These data are currently being analysed and the output will be reported during the next period.

> **Objective 6 "Validate UAV KPIs using 5G":** 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..

M1 – M12 (from D6.2)

This objective is in scope of two Tasks of WP4 which have either barely started or not started at all, namely T4.2 "Preparation and execution of trials" (M12-M36) and T4.3 "Evaluation of trial results (M20-M36). As such there is no progress to report yet except preliminary discussions in view of UAV KPIs to validate coming from UAV use cases description as stated in D1.1.

M13 – M18

The objective 6 is also in the scope of Task T4.2 and is being addressed by the feasibility tests that have been run during the Reporting Period. Several UAV KPIs using 5G were measured during these tests, including 5G data speed tests. The 5G data speed tests carried out on indicated upload quality is insufficient for streaming 4K camera or LiDAR data, and the challenges relates to the uplink/downlink fraction used in the available bandwidth. The insufficient uplink capacity has been identified as a typical challenge in to date commercial networks that aim at maximising downlink capacity.

> **Objective 7 "Advanced data analytics tools to visualise and deeply analyse the trial results, and provide feedback to the 5G and UAV ecosystem":** 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 3GPP or ETSI MEC, in order to optimise or update 5G standards for UAV

M1 – M12 (from D6.2)

This objective is mainly in scope of WP2 Task T2.4 "Tools for experiment data analysis and visualization" and WP4 Task T4.3. Due to the fact T4.3 from WP4 has not yet started, the progress comes mainly from WP2 and Task 2.4.

During the period several investigations, leading to some experimentations, of available tools for data aggregation, analysis and visualisation (e.g. Elasticsearch, Logstash, and Kibana) have been performed by partners and a survey was conducted. All results have been delivered and discussed in order to further converge towards selection of the most appropriate data analysis and visualisation tools to cover Use Cases requirements. Integration of those tools was also looked at and further progressed under overall trial architecture perspective (e.g. relation between the trial enforcement module and the data extraction and visualisation/analytics) in view of the refined 5G!Drones architecture.

M13 – M18

Due to the fact Task 4.3 from WP4 has not yet started, the progress towards this Objective mainly comes from WP2 and Task 2.4. During the Reporting Period, 5G!Drones worked on the data collection and analysis tools. In particular, there has been work on the integration of storage, analysis, and visualization tools that were identified during the first period (namely the ELK suite). These tools have been installed and made available to Beneficiaries. In addition, the project has adapted offline data analysis algorithms to online and has integrated them into the selected tools.

> **Objective 8 "**Dissemination, standardisation and exploitation of 5G!Drones Description Dissemination, standardisation and exploitation of all concepts and**" :** Dissemination, standardisation and exploitation of all concepts and technologies developed in the 5G!Drones project. A special focus is given to showcasing components of the project in UAV- and 5G-related events.

M1 – M12 (from D6.2)

Initial plans for what concerns dissemination, showcasing, exploitation and standardisation have been started and reported in D5.1 "Communication, showcasing, dissemination, exploitation plan and standardization roadmap". The project has performed and delivered according the plans despite it has to adapt to situation caused by Covid-19 (some dissemination events were cancelled or went virtual). 5G!Drones has been presented within private and public events on numerous occasions and has had very active online presence through website, social media, and updated newsletters issued. 5G!Drones has been very active at the 5G-PPP Programme through various bodies ranging from Steering Board and Technology Board but also Working Groups of interest for which the project had appointed representatives (see 5G-PPP devoted section for the details in Section 0).

M13 – M18

During the Reporting Period, 5G!Drones consortium has established a complete landscape of the standards Development Organization (SDOs) as well as various associations relevant within 5G!Drones frameworks, including 3GPP, GSMA, GUTMA, ACJA, IEEE, CEPT/ECC, ASTM, ETSI, IETF, BNAE,

Drone REGIM, 5G-PPP (Pre-standardization working group), FAA, SESAR JU, NASA, EUROCAE, EASA, ASD-STAN, ISO, LAANC, and ARC. The work performed during the period is reported in D5.3 – Report on contribution to standardization and international fora.

Partners, in the scope of this Task, have worked on identifying the organizations relevant for 5G!Drones standardisation activities and how they relate to the project's activities. Furthermore, they have worked on establishing a strategy to contribute to these organizations and specify the 5G!Drones representative role in the organization (contributor, attendance).

8. PROGRESS AND ACHIEVEMENTS OF THE WORK PACKAGES

The following sections provide a detailed description of the work carried out in the Work Packages of the project during the Reporting Period. The description starts by listing the Work Package objectives, as found in the Description of Action and, and continues with the main achievements and progress over the reporting period. It details the work carried out per Task, along with the individual Beneficiary contributions to each Task.

8.1. WP1 Use case requirements and system architecture

8.1.1. Progress towards objectives and details for each Task [FRQ]

WP1 Objectives
- Objective 1: **"Analysis of the performance requirements of UAV verticals' applications and business models in 5G"**
- Objective 2: **"Design and implementation of the 5G!Drones software layer (or system) to execute UAV trials"**
- Objective 3: **"Design a high-level scenario descriptor language to run and analyse the results of the UAV trials"**
- Objective 4: **"Design and implementation of 5G!Drones enablers for UAV trial and operations"**.

WP Tasks and interrelations:
- T1.1: Analysis of the UAV business and regulatory ecosystem and the role of 5G technology (M01-M42)
- ~~T1.2: Use case assessment and refinement (M01-M06)~~
- ~~T1.3: Detailed description of 5G facilities and mapping with the vertical use cases (M1-M12)~~
- T1.4: System architecture for the support of the vertical use cases (M1-M24)

Main Progress in the period:
A series of regular WP1 phone conferences has been conducted by FRQ, the WP1 leader, in order to monitor and control the project activities towards achieving the WP1 goals, giving the Task leaders the opportunity to report the progress of work performed during the period. All WP1 partners have been comprehensively exploiting the WP1 phone conferences for ex-change of ideas, for technical and administrative discussions, and for progress reporting. WP1 has already successfully submitted the Deliverables D1.1, D1.2, D1.3, D1.4, and D1.5 in the previous reporting period. With deliverables D1.1, D1.2, and D1.5 the Tasks 1.2 and 1.3. were successfully completed. Ongoing activities in WP1 are the work on D1.6 in Task 1.4 and the preparations for D1.7 in Task 1.1.

The carried out work result are reflected in the 5G!Drones system architecture with two different web-portals, one specialised to the needs of the UAV industry and the second one focused on the 5G infrastructure to be provided and maintained by each ICT-17 facility. This approach maintains integrity of the experimental ICT-17 platforms and further enhances their expandability to a tighter support of vertical industries. This outcome resulted in a revised 5G!Drones architecture, which affected also all the related data flow diagrams, as well as the final architecture of the project to be reported in D1.6.

Significant results
Ongoing work on deliverables:
D1.6 – 5G!Drones system architecture refined design (an early version of D1.6 has been produced for project internal purposes)
D1.7 – Final report on UAV business and regulatory ecosystem and the role of 5G

The WP1 deliverables are significant foundations for the other WPs work and for the technical implementations. WP1 has actively participated in the EAB questions & answers session.

Deviations from Annex I and impact on other Tasks, available resources and planning
There has been no deviation from the expected contributions in WP1.

8.1.2. Task 1.1 Analysis of the UAV business and regulatory ecosystem and the role of 5G technology (M01-M42) [CAF]

Task Objectives:
A basic premise of the 5G!Drones project is that 5G technology will provide the technical means and thus provide new opportunities for the provision of enhanced UAV services. The purpose of this Task is thus to provide a detailed analysis of the current state of the UAV market with a particular focus on the role of 5G technology in it. This analysis will identify key application areas where 5G technology can help provide new or enhanced services, and how each stakeholder in the UAV-service-related value chain (UAV equipment vendors, vendors of telecommunications equipment, network operators, UAV service providers, regulatory bodies), and the society at large, can benefit from these developments. At the same time, this Task will pay particular attention to regulatory aspects, since the related legislation to perform UAV flight operations is currently subject to significant changes and may have impact on both how UAV vertical services should operate (e.g., necessitating UAS Traffic Management modules onboard), and how the 5G!Drones trials will be executed. The activities of this Task and their outcomes, which will be reported in **D1.4**, will provide input to T1.2 for the refinement and detailed descriptions of the target use case scenarios. Before the end of the project, and after the trial results get evaluated, the analyses of this Task will be reassessed, taking into account also the changes in the market, regulatory and technological landscape that will have taken place after the delivery of D1.4. This study will deliver an updated version of D1.4, using insight from the results of the trials to provide recommendations and study market perspectives (deliverable **D1.7**).

Task Activities during the period:

D1.4 was submitted in the previous reporting period, reporting the initial analysis of the UAV and 5G ecosystems, nevertheless relevant activities remain, as there are further developments both in the UAV Business and Regulatory areas. These developments and changes are continuously monitored and will be reported with the submission of Deliverable D1.7 (in M42). For this reason, the accumulation of all material, resources, and references relevant to D1.7 has been organised within a suitable repository structure that WP1 partners are periodically updating. Partners from countries where trials are planned - Finland, France, and Greece - are especially helpful as they ensure a very good overview of local regulations (both in the field of UAVs and radio communication rules). Apart from the separate regulations in Finland, France, and Greece, EU regulation is also thoroughly

monitored for both UAV flights and radio communication equipment. D1.7 will have the same structure as D1.4 with updated content and will further analyse how 5G technology can be used for drone services.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. recurring partner activities, such as participation to teleconferences will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO does not participate in this Task.

2-THA carried out preparation for the annual review, presentation slides overview, and Q&A comments. It attended general review preparation and review itself. THA had further discussion with its Business Lines of interest (e.g. Ercom/Suneris) for possible Use Case (UC) extensions and it did an investigation of further contacts within Thales (e.g. TAV) in this context. THA has been preparing material for D1.7 and it has been following European regulation and its application in France.

3-ALE participated to the 1st year review preparatory and review meetings. ALE has been tracking evolution of European regulation and its application in France with documents and webinar from the French NAA. It has carried out work to find material for D1.7.

4-INV has been analyzing and estimating the impact of the regulations and law development for its products and 5G!Drones project. It analyzed documents: EU 2019 947, EU 2019 945, EASA Opinion No 01-2020 and some other documents shared by CAF. It also did reading and analysis of publication "UK Parliament - Civilian use of the drones". INV is actively tracking the European legislation development for drone market. It participated in the webinar "Drone Regulation Report" organized by DII and participated in webinar organized by Oracle "Enabling 5G New Business", where one of the topics was also devoted to UAV communication utilizing 5G mobile networks. It also attended the Webinar: The New Drone Regulation - an Overview organized by Swiss Federal Office of Civil Aviation.

5-HEP does not participate in this Task.

6-NCSRD, in collaboration with the rest partners involved in Athens Use Case, has performed all the necessary activities towards applying for a clearance to flying at Egaleo Stadium. The process that should be followed has been clarified and in applications were filed. In collaboration with COS, NCSRD has prepared the steps towards applying for installing the necessary equipment at the Egaleo stadium as well as for taking an experimental lisence for the 5G spectrum. NCSRD has contributed in the analysis and the business of the UAV cases planned to taken place in Athens platform. It has contributed in clarifying the regulatory aspects needed for the UAV flight in Athens during the October trials and has contributed in receiving bandwidth licenses for the 5G trials in Athens in October.

7-AU participated to the rehearsal and the review meetings. It has been checking and looking for materials for D1.7 about UAV businesses linked to the scenario they are leading (UAV-based IoT data collection).

8-COS has contributed in the analysis and the business of the UAV cases planned to taken place in Athens platform at the OTE Academy premises. It clarified the regulatory aspects needed for the UAV flight around the OTE Academy premises in Athens during the October trials and it applied and secured trial bandwidth licenses in the 3.5GHz band for the 5G trials in Athens in October.

9-AIR does not participate in this Task.

10-UMS contributed to the preparation for the 1st year review meeting. Otherwise, it has no planned involvement in this Reporting Period outside of expected participation in this Task.

11-INF contributed to the preparation for the annual review, presentation slides overview and Q&A comments. It attended the general review preparation and review preparation internal activities. INF had started internal processes for next steps and D1.7 actions planning. It has performed communication of business and market aspects of the project and D1.4 through 5G!Drones social media channels and website. It has created a repository of locations/files in Teams for D1.7 accumulation of material, resources, and references and contributed to the content.

12-NOK conducted preparation for the annual review, attending general review preparation event and general review. It has researched for UAS & 5G business news from business analysis and announcements, and collected and analysed material for D1.7.

13-RXB made active participation and preparation for 1st year review meeting. It also has contributed to UAV business cases and industry verticals and supported the IMT for presentations.

14-EUR participated to the 1st year review preparatory and the review meetings. It has been tracking the regulation of UAV in France for the trial preparation and has participated to the UC refinement.

15-DRR provided a review of D1.6 ToC and it has monitored EASA U-Space regulation developments.

16-CAF as Task leader it has led preparation of presentation of D1.4 for 1st year review and EAB meetings. CAF made preparations for the 1st year review, namely presentation slides about T1.1 activities. It attended general review preparation and 1st year review. CAF has made significant contributions to IMT work. In addition, it has been organising the material collection workflow for D1.7 and made contributions to the analysis of UAV business cases and regulation part for IMT work.

17-FRQ leads WP1 and conducts the bi-weekly meetings performing preparation, distribution, and tracking of agenda, Minutes of Meeting, and Action Points. It made preparations for the annual review regarding WP1, participated in 1st year review preparation, and presented slides about WP1 achievements during the review.

18-OPL participated in the first year review preparations. It has made a review of business ecosystem for further contributions to collecting material for D1.7 and for updating of target business model vision.

19-MOE does not participate in this Task.

20-ORA does not participate in this Task.

8.1.3. Task 1.2 Use case assessment and refinement (M01-M06) [UMS]

The Task has ended.

8.1.4. Task 1.3 Detailed description of 5G facilities and mapping with the vertical use cases (M1-M12) [UO]

The Task has ended.

8.1.5. Task 1.4 System architecture for the support of the vertical use cases (M1-M24) [ORA]

Task Objectives:

This Task will provide the overall system architecture design (i) to support the selected use cases over a federated, multi-domain 5G infrastructure and (ii) to execute large-scale UAV trials. It will identify and design at a high level the architectural components to provide the necessary infrastructure support for the selected use cases (5G!Drones enablers), which will be elaborated in WP3. Furthermore, it will define the underlying 5G architecture on top of which the vertical services will be deployed. This includes all the necessary 5G system components, as well as the specific 5G!Drones enablers. At the same time, it will provide a high-level design of the management plane for the execution of the trials, which will be the basis for the detailed design and implementation of the 5G!Drones trial controller (WP2). T1.4 will deliver an initial architecture design (**D1.3**) at the end of M08, marking partially **MS2** (due M12) of the project. An updated version of the architecture (**D1.6**) will be delivered at M24 based on feedback from implementation and integration activities of WP2-WP4.

Task Activities during the period:

D1.3 has been submitted in the previous reporting period. Advances towards D1.6: NCSRD has been working on the deliverable and the responsibilities for all sections of the document have been set up. NCSRD circulated a draft of D1.6 to all partners of Task 1.4 with the target to create a first draft of the document in M18, which will be followed by the document review and refinement process. The submission date of D1.6 will be M24. The architectural discussions continued within WP1 and other Work Packages, as the final architecture will be based on feedback from implementation and integration activities in WP2-WP4. A dedicated security chapter in D1.6 will address the questions raised by the EC. The security requirements will be relevant for the implementation work in WP3.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO During the period UO has produced slides and contributed to the first-year review preparations of WP1. It also actively contributed to the review process. UO also stared considering received review comments of WP1 and their impact on the Oulu use cases. Moreover, UO revisited the use cases planned to be trialled at the 5GTN facility in Oulu in preparation for the feasibility tests that were conducted at the end of August in Oulu. UO has participated in the revision discussions of the overall architecture. It has contributed to an internal early version of D1.6, to sections 3.1 and 3.6.1.

2-THA actively participated to the 1st year review. It has contributed to D1.6 Table of Contents (ToC) creation and contributed to architectural work with focus on some of the aspects (e.g. Security despite not uniquely). THA has further participated to the discussions regarding the revision of the architecture.

3-ALE has been reviewing and commenting proposed D1.6 ToC. It has contributed to document D1.6 ToC as well as to section 3.6.2 regarding the updates on 5G!Drones UAV Service Enablers. An update with respect to the status, detailed description, and current progress for each of the enablers was provided to this document. Besides, information regarding new enablers that were not defined in document D1.3, was also included in the document.

4-INV has reviewed and commented the proposed D1.6 ToC - 5G!Drones system architecture refined design. It made contributions to D1.6: following NCSRD request, INVOLI analysed the high level description picture and gave comments on it.

5-HEP does not partake the Task 1.4.

6-NCSRD has prepared and released the first ToC of D1.6, which has released to the consortium, asking for comments and revisions. Upon receiving various comments and improvements, NCSRD has released a full draft of the ToC, which is used for starting to draft the document. NCSRD has contributed also to the smooth integration of 5G!Drones solution with existing experimentation platforms, like 5GENESIS, which resulted in introducing two web portals in the revised 5G!Drones architecture, keeping portal 1 to be common across platforms, while portal 2 to be platform specific. Moreover, NCSRD is leading the revised architecture activities of the 5G!Drones project and it is the editor of D1.6. An early release of D1.6 has been scheduled for November 2020.

7-AU has worked on identifying the revisions of the overall architecture based on the work conducted in both WP2 and WP3. It has participated to the discussion of the overall architecture. AU has also been evaluating the overall architecture against the achieved work in the trial controller architecture, where AU is leading WP2. It has been preparing inputs for the deliverable D1.6 related to the sections "Functional requirements of the trial controller" and "Functional requirements of the web portal", both assigned to it.

8-COS has contributed to early draft of Deliverable D1.6 for Sections 2.1, 2.2, 4.1.4, and 4.2.4.

9-AIR has updated the architecture of a subset of their mission critical technical enabler to leverage lifecycle manager developed within WP2. It has provided the security requirements relative to the use case 'monitoring wildfire' they lead (cross activity WP1/WP3).

10-UMS has had little planned involvement in this Task outside of expected participation. It has provided small amounts of inputs to early version of D1.6.

11-INF participated in WP1 review preparation. It has done an internal process for exploiting D1.3 content for posting material. INF has commented and reviewed the proposed D1.6 ToC and D1.6 initial content. It has monitored and analysed T1.4 activities for communicating the results through social media and website, and linking them to T1.1 (business impact).

12-NOK has analyzed and kept many workshop meetings with partners to research and analysis 5G!Drones project architecture. It updated the trial process flow material with other partners, a task is partly done within this Task as it will have impact to D1.6.

13-RXB has commented on D1.6 initial structure and content and contributed to the early draft of D1.6 on Sections 2.2.8, 2.2.9, 3.5.2.3, 3.5.5, and 3.5.6. It has held multilateral calls with partners to organise and coordinate project activities and multilateral collaborations with partners to discuss aspects related to U-Space, architecture and UTM.

14-EUR with many partners has conducted discussion and proposed an architecture that integrates 5G and U-Space. A paper including the contribution has been submitted to IEEE Vehicular Magazine. This architecture has been also presented in one of WP1 meeting. EUR has also worked on the refinement of the 5G!Drones architecture describing the integration of U-Space in 5G, which has been published in IEEE Vehicular Technology Magazine.

15-DRR has reviewed D1.6 ToC and provided comments to D1.6 proposal. It has updated requirements preparations (RTM files for D1.6).

16-CAF has been reviewing and commenting proposed D1.6 ToC and it has contributed to document D1.6 ToC and to the sections: 2.3, 3.5.5, 3.5.6 and 3.6.2. CAF is conducting ongoing analysis of UAV businesses, regulation, and 5G role to supporting feasibility tests and collecting materials for D1.7.

17-FRQ is leading WP1 and conducting the bi-weekly meetings performing preparation, distribution and tracking of agenda, Minutes of Meeting, and Action Points. In addition, it has made contributions to the early draft of deliverable D1.6.

18-OPL participated in first year review preparation. It made a review and analysis of the latest changes in 3GPP standardisation and their impact on UAV ecosystem, preparations for contributions to D1.6.

19-MOE has conducted an analysis together with NCSRD and COS on the architecture of 5GENESIS facility and Use Case (UC4Sc1). MOE has contributed in the analysis and the business of the UAV cases planned to taken place in Athens platform. It has also contributed in applying bandwidth licenses for the 5G physical feasibility tests in Egaleo in October.

20-ORA is the leader of the Task. It participated in review preparatory meeting and the review itself. It has been reviewing D1.6 structure and content.

8.2. WP2 Trial controller

8.2.1. Progress towards objectives and details for each Task

WP2 Objectives
This WP will work towards the following high-level project objectives:

- Objective 2: **"Design and implementation of the 5G!Drones software layer (or system) to execute UAV trials"**
- Objective 3: **"Design a high-level scenario descriptor language to run and analyze the results of the UAV trials"**
- Objective 7: **"Advanced data analytics tools to visualize and deeply analyze the trial results, and provide feedback to the 5G and UAV ecosystem"**

WP Tasks and interrelations:
- Task 2.1: Trial execution APIs for verticals and experimenters (M3-M30)
- Task 2.2 Trial scenario execution engine (M3-M30)
- Task 2.3: Trial architecture management plane (M6-M30)
- Task 2.4: Tools for experiment data analysis and visualization (M3-M30)

Main Progress in the period:
WP2 has been conducting bi-weekly meetings during the period from M13 to M18 to organise and monitor the activities of the Work Package. Each meeting covers the activities of all WP2 Tasks. An important work carried out during this period is the revision of the workflow diagram of the trials. This diagram expands on the earlier version reported in the deliverable D2.1 and specifies the different modules of the trial controller involved in the preparation and the execution of the trials. This workflow sorts out the functionalities of the different modules and constitutes a reference basis to develop them. In parallel, partners have also started the implementation work of the trial controller modules. These modules are webportal 1 (UAV related webportal), webportal 2 (facility related webportal), life cycle manager, trial enforcement and test automation, KPI component, and U-Space adapter. The implementation work of the trial controller has advanced and some modules have already been demonstrated.

In order to establish a clear plan to finalize, deliver, and integrate the different modules of the work package, WP2 has also worked on definition of a release plan covering the period until M24. This plan provides a timely basis to be considered for the release and the integration of the modules of the trial controller.

The D2.2 "Initial implementation of the Trial Engine" is the software delivery following the architecture work done by the project. The ToC for D2.2 report was proposed and agreed by partners. In this document all the partners developing the modules of Trial Engine can report their work. Recently we have decided also to add a chapter for Best Practices for software development, which is important to know and follow since the beginning.

Significant results
Definition of a more mature workflow diagram involving the different modules of the trial controller and sorting out their functionalities. Some modules of the trial controller are being developed. These include:

- Webportals 2;
- Light implementation of the LCM module (available in 5G!Drones Gitlab);
- First implementation of trial enforcement (available in 5G!Drones Gitlab);
- Implementation of the Data Collector Tool;
- Interfaces to the KPI component allowing the partners to provide KPI data to ElasticSearch KPI store, to further analize these KPIs, and get current active KPI providers;
- Interfaces to the U-Space adapter used for flight operations; and
- Interfaces to the U-Space adapter used collect and expose telemetry data.

Definition of a release planning for the different modules of the trial controller covering the period until M24

Deviations from Annex I and impact on other Tasks, available resources and planning
There has been no deviation from planned activity.

8.2.2. Task 2.1 Trial execution APIs for verticals and experimenters (M3-M30) [INV]

Task Objectives:
This Task will provide a high-level language and API for describing and executing trial scenarios. This language will allow the composition of UAV services, the definition of the KPIs to monitor, the specific requirements of the service in terms of 5G functionality (e.g., number and types of slices), and the selection of a mapping between service components and facilities where these should be deployed and executed. Moreover, it will allow to specify the trial duration and infrastructure resources to be leased per facility/region and per service component, using an abstracted view of the underlying facility infrastructure. Receiving early feedback from WP1, the activities of T2.1 will begin at M03 by creating an API model which will be representing all the entities that are relevant with the execution of the experiments (scenario, service component, KPI, network capability, physical/virtual compute/network/storage resource abstraction, etc.). The API model will be expressed following the OpenAPI Specification using a yaml or json syntax, which will facilitate the development of RESTful services for trial execution.

Task Activities during the period:

The Web Portals are the main delivery item in T2.1 and development has started in the beginning of November. First, the mock-ups for login, basic dashboard and flight planning were presented. Based on them, we have started front-end interface work.

The second important item to mention during the Reporting Period is the collaboration of partners from all Tasks of Work Package 2 on defining the flight planning and flight execution flows. This was an iterative process, involving many meetings, during which Partners shared the ideas and points of view and finally Task 2.1 produced the final version, which is product of consensus. As part of this process, the requirements for each module of the Trial Engine, which is the main interest of T2.1, including the Web Portals, have been finalised.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO has been studying the requirements for best approach to viable deployment of APIs during the Reporting Period. It has been testing some software installations (ONAP, Openbaton, and 5GTANGO). UO has developed the schedule for WP2 related modules and their dependencies for 5GTN implementation. It is also following up and adapting the implementation schedule based on WP2 components' refining in WP2 common activities. Web portal 2 basic functionality has been implemented on OSM server for further integration and API development is ongoing.

Deviation and corrective action:
During the period UO experienced an unforeseeable risk of having to change the WP2 participating personnel due to individuals leaving to work for industry. This event has caused delays in continuation of API development work, which has been compensated by putting extra resources to work on the Task. By the end of November, UO has caught up with activities.

2-THA has participated to discussions related to trial engine. It has done investigation of enablers from WP2 to put back into perspective of enablers in scope of WP3 in order to stay aligned and anticipate any of the dependencies, which could apply. Similarly, this has been done for what concerns the API. This is also reflected in the context of the project Enablers' excel file addressed in WP3 and which encompasses also WP2 enablers. THA has participated to discussions and meeting regarding Trial engine and the Webportals. It has contributed to the design of the trial controller.

3-ALE does not partake the WP2.

4-INV leads the work related to D2.2 "Initial implementation of the Trial Engine". It has discussed with different partners the scope of work and according to PMT suggestion; it proposed the ToC for document reporting the work progress. INV proposed the schedule for activities leading to delivery of D2.2. It has also taken an active role in defining the work for Web Portal 1 and discussed with AU required virtual server resources for Web Portal 1 and Dashboard. INV is in touch with partners to track the work progress and it has introduced a new chapter describing the "best practices" for software development. Internally INV started preparations for Web Portal 1 work and has had discussion with DRR about Web Portal functions. It conducted an analysis of APIs for mission planning delivered by Frequentis. INV prepared the slides for 1st Yearly Review representing the T2.1 activities.

5-HEP does not partake in the Task 2.1.

6-NCSRD contributed in the APIs integration of the experiment execution engine with the LCM, towards executing the steps of the experiment according to the test descriptor. NCSRD contributed in presenting the Open5GENESIS solution, as a good example for the purpose and objectives of Trial Controller. It has contributed in the overall design of the trial controller, in the relation between the different components of the trial controller, emphasizing in the lifecycle of an experiment, and in the functionalities that the exposed APIs should provide to the experimenter.

7-AU as the WP leader has been organizing and managing the bi-weekly meetings. It is monitoring the activity of the Task. AU has been preparing and presenting the progress status of the work package in the preparatory the 1st year review meeting. It has been working on the development of a web portal (Webportal 2) allowing to describe the network part of the trial and performing different enhancement on the developed web portal for describing UAV part of the trial (Webportal 1). AU prepared and managed the slot reserved to WP2 in the virtual face to face meeting of October. It has also been peparing the release planning of the Task (until the end of Y2) and discussing with the partners on Covid-19 related risks linked to the activities of the Task. AU has been preparing and presenting the developed web portal of AU in bi-weekly meeting of October 8th 2020 and performing different enhancements on the developed web portal. In particular, AU is working on the implementation of functionalities allowing to manage the set of VNFs, the UAVs, and the users (from the web portal).

8-COS does not partake in WP2.

9-AIR has continued working on life cycle manager adapting their mission critical technical enabler for supporting external orchestration with no specificity for mission critical application. AIR has started the development of new APIs allowing building added value applications on top of the mission critical collaboration platform. This is particularly interesting in the framework of 5G!Drones for any application that could process real-time video from drones.

10-UMS has had no planned involvement in this period outside of expected participation in this Task apart from reviewing and providing feedback to Web Portal 1 requirements traceability matrix (RTM) file.

11-INF does not partake in Task 2.1.

12-NOK contributed in over 10 meetings related to trial process sequency research and design. The meeting series started on June 5th and was divided to 1) planning, 2) execution, and 3) the post-processing parts. The meeting series was an active joint collaboration with participation from, for example, AU, AIR, CAF, EUR, DDR, INV, NCSRD, UO, RXB and NOK. NOK has further participated and co-led with INV and DDR the planning part of trial process flow development. Many partners (AU, AIR, CAF, FRQ, RXB, EUR, NCSRD, ...) were involved to this work.

13-RXB has participated in LCM discussion with NOK, FRQ, DRR, INV, UMS and other partners involved. It has led the activities related to Trial Validator and made active contributions towards U-Space Adapter. It participated in process flow discussion of trial controller – execution phase and done an implementation of draft KPI API. It has conducted multilateral collaboration and support in WP2 T2.1 related activities and activities related to Trial Validator and execution APIs.

14-EUR has proposed a refinement of the Trial architecture, and particularly the role of Webportal 2. It has done implementation of Webportal2, where a first version was pushed to 5G!Drones Gitlab repository in September. EUR has participated to the refinement of the role of the Webportal 1. It has made a development of an application that tracks the drones' flight using the 5G-EVE facility.

15-DRR has continued U-Space adapter protocol development. It has participated in discussions with other partners on Web portal designed functionality (support for mission planning, usage of coverage map in mission planning) and made an analysis of integration and functionalities of U-Space Adapter. Further, DRR has been reviewing and consulting the process flow related to trial enforcement. It took part in the preparation and review of functional requirements for Web Portal (Webportal1) and Facility Web Portal (Webportal2). A review of web portal requirements is captured in RTM.

16-CAF made an analysis and contribution to Web portal and U-Space Adapter architecture. It has participated to the Webportal1 Taskforce: having discussions with INV about Webportal1 and made an analysis of APIs functions for Webportal 1. CAF has participated and supported trial process flow development.

17-FRQ has done KPI component specification analysis, documentation, and internal clarification. It has made an implementation of draft KPI API, and work on design and coordination on network coverage API. FRQ has participated in trial process flow development, especially KPI related parts.

18-OPL does not partake in WP2.

19-MOE does not partake in Task 2.1.

20-ORA had no planned activity on this Task between June and August. After, it has been working on the preparation of interfaces for measuring network capability, linked to its contributions in WP3.

8.2.3. Task 2.2 Trial scenario execution engine (M3-M30) [EUR]

Task Objectives:
Requests for the execution of trial scenarios that are received over the northbound API of the trial controller need to be translated to an actual UAV service deployment on top of one or more trial sites, and the appropriate functionality should be in place to manage the execution of the trial. This is the purpose of T2.2. The trial execution engine needs to interface with the different facilities that will be used in the project using APIs exposed by the facilities, as well as the interfaces of the enablers that will be designed and implemented in WP3. Regarding the latter, particularly important is the work in T3.3, which provides an infrastructure abstraction offering the trial controller a unified view of the resources and the capabilities available across facilities. The execution engine is responsible for extracting the requirements of each UAV trial in terms of 5G (and other) features and (i) establishing end-to-end network slices with the required performance, security and isolation characteristics using the APIs provided by the slicing enablers (see T3.1), (ii) if necessary, onboarding and instantiating application components at edge data centers by interfacing with Mobile Edge Application Orchestrators (see T3.2), (iii) configuring and launching UAV-service and connectivity-related components onboard the UAVs. The trial scenario execution engine thus manages the full "lifecycle" of a trial, from deployment to termination and result collection

Task Activities during the period:
Task 2.2 activities have been divided into three main sub-tasks: Webportal 2, LCM, and Validator. During this period, the activities regarding Webportal 2 have been finalized. Three Webportal 2 implementations have been released. The Webportal 2 of EUR is available in the project Gitlab. The activities on LCM also have made a lot of advances. The workflow definition of the trial creation and trial finalisation have been finalised. In addition, the requirement elicitation work of LCM has practically ended. The implementation of the LCM has started. Note that a light implementation of LCM has been released and is available in the 5G!Drones Gitlab. This version implements the LCM of a Network Slice. Finally, the work on the validator has initiated, and discussion with the different facility owners has started to define the requirement and objectives of the validator.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO: Between June and August UO had no activity other than following T2.2 work. Between September and October the trial engine implementation is ongoing and the implementation timeline plan has been created and revised. In the trial engine the first version of trial translator, trial validator verification, and life-cycle manager trial enforcement and KPI monitoring have been implemented for 5GTN. Review of trial process flow baseline has been started for UO owned Use Cases.

Deviation and corrective action:
Due to the change of WP2 personnel In June not sufficient effort has been reported in this activity between June and August. New personnel and extra personnel resources have been catching up with activities and by the end of November UO has practically caught up with activities.

2-THA has been following Task 2.2 progress and participated to discussions. It has also participated to discussions and meeting regarding flight planning and execution. THA has participated to the design of the LCM.

3-ALE does not partake in WP2.

4-INV is not partaking Task 2.2. Nevertheless, INV has actively participated in several meetings organised by NOK for definition of the trial process flow (flight preparation and flight execution), with special focus on Life Cycle Manager role. Diagrams were presented later to all partners. It has further participated in number of the sessions dedicated to messages flow definition for flight planning and execution.

5-HEP is not partaking Task 2.2.

6-NCSRD contributed in the relation of the trial execution engine with the rest components of the Trial Controller and their relation with the LCM. NCSRD proposed a specific relation between the trial controller engine and the experiment execution component, as being part of the LCM. Relation with the abstraction layer was also contributed by NCSRD. It made contribution in the flow diagram of the execution engine with the trial enforcement and the LCM and contribution in the relation to the various enablers with the trial controller architecture.

7-AU as the WP leader has been organizing and managing the bi-weekly meetings and monitoring the activity of the Task. It prepared and presented the progress status of the work package in the preparatory meeting and the 1st year review meeting. AU has been working on the development of a web portal (Webportal 2) allowing to describe the network part of the scenario. This also related to T2.1. It has been also working on the development of a trial translator allowing to produce a network slice template adapted to Aalto facility starting from the description provided from Webportal 2. AU has further participated to the LCM work force discussion and discussing and explaining the process of performing trials using X-Network. It has updated the workflow diagram following the discussed process. AU prepared and managed the slot reserved to WP2 in the virtual face to face meeting of October. It has been preparing the release planning of the Task (until the end of Y2) and discussing with the partners on Covid-19 related risks linked to the activities of the Task. AU has been preparing a data base schema linking the different repositories (UAV repository, trial repository, VNF repository and facility repository). The schema has been presented in the bi-weekly meeting of October 22nd 2020. AU is working on the implementation of an interface allowing to check if trial can be accommodated by its facility. This interface will be used by the trial validator module. AU has been

discussing and working internally on potential environments that can be used to develop more sophisticated LCM allowing to express policies that can be enforced on the top of the facilities.

8-COS does not partake WP2.

9-AIR does not partake Task 2.2.

10-UMS has done preparation work for 'Scope of Mission Planning' discussion. It has initiated work on UAV repository by preparing the RTM.

11-INF does not partake Task 2.2.

12-NOK did lead LCM development design and integration analysis together with other LCM members and DDR. There were over 10 meetings related to trial process sequency research and design. The meeting series started 5th of Jun and did divided to 1. planning, 2. execution and 3. the post-processing parts. There has been active participation to meeting series from, for example, AU, AIR, CAF, EUR, DDR, INV, NCSRD, UO, REX, and NOK. NOK participated and co-led with INV and DDR the execution part of trial process flow development. NOK continued to design requirements and implementation for the LCM, which has an active Task force.

13-RXB has been working on the Trial Validator and contributing to Workforce on U-Space Adapter. It has had an active participation in LCM calls and it leads activities related to Trial Validator.

14-EUR is the leader of the activity of the Task. It has updated on the status of the Task in each WP2 meeting. It has done work on the refinement of the trial engine architecture. EUR has proposed a more clean architecture, where the role of the LCM and the abstraction layer have been clearly identified. It participated to the definition of the functions of the LCM and made implementation of a light version of LCM. EUR provided slides for the WPL for the review meeting. EUR has finalised the Webportal 2 implementation, which is available in 5G!Drones Gitlab.

15-DRR work on Web portal has been analysis of integration and functionalities of U-Space Adapter. It has contributed in process flow discussion of trial controller – execution phase. DRR made a review of LCM flow with NCSRD and reviewed and updated flows of preparation and execution phase after AU and UO remarks. DRR made a generic trial process flow analysis and design (facilitation of series of meetings, documenting in flow diagrams). DRR made preparation of functional requirements for Trial Validator in the form of RTM based on the process flow diagrams and contributed in Trial Validator discussion. It made a review of LCM requirements captured in RTM file and made a review of Trial Repository's state flow diagram prepared by INV. DRR facilitated functional requirements gathering in RTMs. It had LCM interfaces discussion with LCM team. DRR updated interface information (identification of interrogating modules) in available RTMs. And took part in Trial execution phase diagram review and discussion.

16-CAF has been participating in all Trial Life Cycle Manager meetings and contributed to LCM Taskforce work. It has done work with FRQ for 5G!Drones integration with UTM system. CAF participated in the sessions of LCM development meetings and in the Trial Validator design discussions.

17-FRQ did coordination and contribution to Workforce Trial Validator and to Workforce U-space Adapter. FRQ worked with Drone Operators (CAF, DRR, and HEP) for integration with UTM system. It has done work on implementation of U-Space adapter, API documentation for U-Space adapter, and UTM system integration work with multiple partners.

18-OPL does not partake WP2

19-MOE does not partake Task 2.2.

20-ORA does not partake Task 2.2.

8.2.4. Task 2.3 Trial architecture management plan (M6-M30) [NCSRD]

Task Objectives:

The activities in this Task will focus on trial execution monitoring and management aspects. Different management interfaces will be provided to cover the needs of the different roles (verticals and experimenters, facility owners). In particular, T2.3 will design APIs for runtime monitoring of a trial and the collection of results. This interface is used by verticals/experimenters. This management component also uses the APIs provided by the 5G facilities and 5G!Drones enablers (WP3). The verticals will also be provided with a management interface to control the UAV applications at the vertical-service level and retrieve application-level KPIs, as the latter have been defined in the scenario description. Finally, the trial architecture management plan will provide interfaces to facility owners to enable the monitoring of the infrastructure during the execution of a trial and the collection of 5G KPIs. It should be noted that different facilities may have different mechanisms and interfaces to monitor their infrastructures, and there will be trial scenarios which will be spanning across different facility domains. The purpose of this Task is to unify these interfaces providing a common entry point for monitoring and management. This will also reduce the complexity of the data analysis and visualization mechanisms of T4.2, since the latter will not have to deal with the particularities of each underlying facility and each heterogeneous UAV service.

Task Activities during the period:

Task 2.3 focuses its activities on trial execution management though the design and implementation of different management interfaces. Consequently, responsibility of the Task is to build the Trial Enforcement component. During this last period, Task 2.3 participated in activities regarding the assessment and refinement of the Trial Enforcement component architecture as well as its connection to the overall architecture of the Trial Engine and the 5G!Drones platform. Additionally, it actively participated in the creation of the trials workflow during the trials preparation and execution.

Furthermore, the development of the Trial Enforcement module begun and a first implementation is already available, with a first stable release schedule to be completed during the next quarter of the project. Finally, Testing Automation submodule was introduced and Task's activities focused on its development and integration with the main module, in addition to the creation of an API parser around the test plan executor solution.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO had no activity on this Task from June to August. Between September and November the KPI and trial repositories development has started. The work for adoption of other trial repositories for 5GTN has also started.

2-THA has had discussions regarding KPIs collection, storage, and analysis. It has participated to discussions related to life cycle manager and security requirements.

3-ALE does not partake WP2.

4-INV is participating and giving inputs in the discussion how KPIs are collected, stored and analysed. It is discussing with partners on the role and processes flow for Trial Translator, Trial Validator, and Life Cycle Manager. Part of work for Security Work Group can be attributed to this Task, particularly the definition of the security requirements regarding communication between Trial Engine components and facility.

5-HEP had no specific planned involvement in this Task during the Reporting Period.

6-NCSRD contributed by presenting an enabling technology for building the trial architecture management plane, which is based on an open-source project. NCSRD proposed a solution that supports the full automation of the experiment execution and the reception of the respective measurements and it presented an initial demo of the proposed solution. NCSRD initiated many items on clarifying the relation of the Trial execution management plane with the rest components of the trial controller and the LCM, as well as the abstraction layer. It has been leading the activities related to the design and development of the trial architecture management plane, clarifying the functionalities of the trial architecture management plane as trial enforcement component, and clarifying the relation of the trial enforcement with the data analytics and monitoring module.

7-AU has been organizing and managing the bi-weekly meetings and monitoring the activity of the Task. It prepared and presented the progress status of the Work Package in the preparatory meeting and in the 1st year review meeting. AU is working on the development of interfaces allowing to manage its facility and working on the development of automation tools for managing its facility. This is also linked to AU work in WP3. AU prepared and managed the slot reserved to WP2 in the virtual face to face meeting of October and has been preparing the release planning of the Task (until the end of Y2). It has discussed with the partners on Covid-19 related risks linked to the activities of the Task.

8-COS does not partake in WP2.

9-AIR does not partake in Task 2.3.

10-UMS had no specific planned involvement in this Task during the Reporting Period.

11-INF does not partake in Task 2.3.

12-NOK had over 10 meetings related to trial process sequency research and design. The meeting series started June 5th and was divided to 1) planning, 2) execution, and 3) the post-processing parts. NOK further analysed OpenTap usage for project as proposed by NCSRD. NOK also has Trial enforcement part planned in internal work and has had LCM related workshop with several partners.

13-RXB does not partake Task 2.3.

14-EUR provided a new architecture of the 5G!Drones trial engine, including the management and Life cycle of a trial. EUR has participated to the discussion on the role of LCM and its interaction with the 5G-EVE facility.

15-DRR has been consulting on the KPI monitoring implementation (functionalities and operation). It has created the LCM initial version of functional requirements list (RTF file) .

16-CAF provided inputs on how KPIs should be measured and analysed. It also participated in Trial architecture Management plane discussions and preparations for meetings.

17-FRQ carried out coordination of KPI API with partners regarding additional specific interfaces for network facilities. Between September and November it has had no specific planned involvement in the Task.

18-OPL does not partake WP2.

19-MOE Contributed in the flow diagram of the execution engine with the trial enforcement of the UC4Sc1 and in the relation to the various enablers with the trial controller architecture regarding the UC4Sc1. MOE participated in trial architecture management plane discussions and preparations for meetings.

20-ORA does not partake Task 2.3.

8.2.5. Task 2.4 Tools for experiment data analysis and visualization (M3-M30) [FRQ]

Task Objectives:

The goal of this Task is to provide sophisticated mechanisms for the management and analysis of the data that will be generated during the trials. These mechanisms will be applied in WP4. This Task will face important challenges. First, very large volumes of experimental data will be generated during the trials; these data pertain to both the UAV-service level (e.g., video traces, sensor readings, etc.) and the 5G facility level (e.g., packet-level measurements, signal coverage reports, latency measurements, etc.). Second, these data are often unstructured, have multiple dimensions, and involve multiple KPIs to measure. The expected challenges pertain particularly to the management, analysis, and the visualization of the experimental data and call for (i) big data management techniques, (ii) the application of data analytics and/or machine learning techniques for the analysis of trial results, (iii) development of visualization tools which will be used both at trial execution time and for the post-trial evaluation of the results.

The work in this Task place efforts on data analysis and the intuitive representation of trials results. This feature is becoming essential to process and understand the volumes of data generated by automated trial systems. This Task will use and extend open-source tools (such as Elasticsearch, Logstash, Kibana, collectively known as the ELK stack [ELK18]) for real-time actionable insights on any type of unstructured data. Notably, partners in 5G!Drones already have significant experience applying this solution and plan to extend these tools with new features, such as new visualisation plugins relevant to 5G parameters and advanced statistical data analysis, correlation techniques, and machine learning algorithms. The algorithms, mechanisms and tools developed in T2.4 will be reported in **D2.3**, while the related software will be released in **D2.6**.

Task Activities during the period:

Task 2.4 focuses on data analysis and visualisation. In terms of data analysis, an initial implementation of the KPI component is conducted. It provides REST API to provide KPI data to ElasticSearch KPI store, to further analyse KPIs, and to get current active KPI providers. The interfaces will be exposed to the partners. In parallel, facility owners have been working on preparing modules allowing to capture the KPIs. In addition, a Data Collector Tool has been implemented to retrive data from target nodes and store them in ElasticSearch. Furthermore, data visualisation has also been demonstrated using Kibana.

In order to efficiently organise and track the progress of the U-Space adapter module, WP2 partners have decided to include the report progress of this module as part of Task 2.4. Indeed, U-Space and U-Space adapter are not mentioned in the DoA as part of WP2, and constitue the contribution of the project to enable the synergy between U-Space and telecommunications domains. The U-Space adapter is modeled as a set of interfaces to the Webportal 1, trial engine, and the KPI component. U-

Space interfaces for flight operations and telemetry data have already been demonstrated.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO conducted visualisation testing for simultaneous localization and mapping (SLAM) utilising Octomapping and T265 based optical flow measurement and inertial measurement unit (IMU) based tracking. Integration of T265 tracking for position reference in the UAV's Pixhawk based Flight Control Unit. UO did further testing and implementation of the deep learning-based image segmentation, and machine vision for object detection and classification. UO has also conducted work on iimplementation and testing related to virtual reality visualisation, spatial information representation and data streaming. It has designed interfaces for virtual reality visualisation improved to include dynamic object loading.

2-THA has led data analysis Taskforce. It has done implementation of a mechanism for anomaly detection in 5G networks. THA did integration of the mechanism to be used with 5G!Drones portal. THA did work on data analysis for anomaly detection and integration of data analysis tool to web portal data visualisation tool.

3-ALE does not partake WP2.

4-INV has made contribution details to analytics part – how data is sent and stored. It has given the feedback and comments about pre-test results and report from X-Network and 5GTN. INV was involved in discussion regarding the experiment execution messages flow for KPIs collection. It has conducted review, feedback, and comments about pre-test results and report from 5GENESIS feasibility tests.

5-HEP has done preparation and implementation of sensors data collection for 5GTN feasibility tests. It made a sensor data visualisation implementation (for Lidar SLAM). HEP has done visualisation testing of lidar SLAM on a system with smaller upload speed requirements compared to the one used at 5GTN tests.

6-NCSRD contributed by providing details on how the integration between the data management plane and the monitoring tool should be performed in order the collection of the data to be performed in an automatic way during the execution of the experiment. Discussion on synchronisation issues and timestamps during the data collection was raised by NCSRD. A proposal made to be used the GPS clock. NCSRD has been contributing on the way that the captured data will be stored for analysis and visualization, contributing on the timings of the experiment in terms of synchronization, and contributing related to the know-how and the lessons learnt from 5GENESIS project.

7-AU as WP leader has been organizing and managing the bi-weekly meetings and monitoring and coordinating the activity of the Task. It prepared and presented the progress status of the work package in the preparatory and the 1st year review meeting. AU has been working on the development of interfaces allowing to get and collect data monitored from its facility. This is also linked to its contributions in WP3. AU prepared and managed the slot reserved to WP2 in the virtual face to face meeting of October and has been preparing the release planning of the Task (until the end of Y2). It has been discussing with the partners on Covid-19 related risks linked to the activities of the Task.

8-COS does not partake WP2.

9-AIR does not partake Task 2.4.

10-UMS has had no planned involvement in this Reporting Period in this Task apart from providing input on data management processes at UAV-service level.

11-INF has participated in dedicated T2.4 - Analytics Taskforce activities. It has made contribution details to analytics Taskforce and potential business exploitation of specific metrics that have been pointed out. INF partook review preparation internal activities. It has been monitoring and analysing T2.4 activities from a business perspective, communicating the results through social media and website, linking T2.4 activities to T1.1 and T5.1.

12-NOK has continued to develop a system to collect MEM/CPU health data from system devices and visualise it in ELK stack. It has coordinated with FRQ on upcoming deliverable D2.3. NOK has been finalizing an ELK-stack pipeline from raw data to user interface (UI) visualisation and contribution code to project partners.

13-RXB contributed to Trial validator architecture and sequence flow, LCM discussions, and KPIs. Between September and November it has had no planned activity in the Task.

14-EUR provided inputs for the KPIs and how they are measured and formatted by the 5G-EVE Sophia Antipolis site. EUR has had participation to the discussions on the visualisation tool and it has made a presentation of the KPI collection in 5G-EVE facility.

15-DRR has made a review and provided comments to the ToC of D2.3. It has made a review of LCM flow – capturing measurements phase, update to process flows (Draw.io), discussions, and alignment. DRR made a review of U-Space related KPI's according to CONOPS 3.

16-CAF made contributions to experiment data analysis and visualisation options (GIS solutions for 2D and 3D analysis). It has analysed and tested experiments' results analysing and visualisation tools related to UC4 feasibility tests in Athens in October 2020.

17-FRQ has been conducting implementation of KPI component. It has made Inspection of D2.3 ToC and has been coordinating with NOK on deliverable D2.3 contents. FRQ has done coordination with partners on data analysis tasks and tools, made an architecture of KPI Component, and done initial implementation of KPI Component (REST API for partners to provide KPI data to ElasticSearch KPI store, to allow further analysis of KPIs; REST API to get current active KPI provider). FRQ has exposed KPI Component for first integration tests with partners.

18-OPL does not partake WP2.

19-MOE does not partake Task 2.4.

20-ORA does not partake Task 2.4.

8.3. WP3 Enabling mechanisms and tools to support UAV use cases

8.3.1. Progress towards objectives and details for each Task

WP Objectives:

WP3 aims to accomplish Objective 4: **"Design and implementation of 5G!Drones enablers for UAV trials and operations."**

Based on the outcome of T1.3, which will identify which enabling mechanisms are necessary for the support of the use cases defined in T1.2 and for the execution of the respective trials, this WP, which will be carried out in parallel with WP2, has the following sub-objectives:

- Design and implementation of mechanisms for end-to-end orchestration, management and security of coexisting UAV slices, with a particular focus on scalability and performance isolation.
- Development of the necessary components for MEC support.
- Implementation of software tools and APIs for facility infrastructure abstraction and to enable the federation of 5G facilities.

WP Tasks and interrelations:

WP Tasks and interrelations: Breakdown structure of WP3 reflects the structuration of the work according the 5 thematic areas in scope. As such it is made of the following 4 Tasks:

- T3.1: Scalable end-to-end slice orchestration, management and security mechanisms (M3-M32)
- T3.2: MEC capabilities for the support of 5G!Drones trials (M3-M32)
- T3.3: Infrastructure abstraction and federation of 5G facilities (M3-M32)
- T3.4: Development of UAV use case service components (M3-M33)

Main Progress in the period:

During this period, WP3 has mainly addressed the challenges for network slicing to support emerging UAV-related use cases, in particular slice provisioning, performance isolation, resource sharing at the RAN, core, etc., and end-to-end slices (across multiple domains), providing scalable slice management. WP3 has also addressed network slicing security extensions and relevant integration with the selected trial facilities. To cope with specific security requirements, software defined security (SD-Sec) and security as a service (SECaaS) have be promoted. The WP has also started working on the missing components for slicing support in the selected 5G facilities (identified in T1.3) and the architecture design provided by T1.4, as well as on the components for end-to-end secure slice deployment and orchestration, with the support for managing slice components across administrative domains.

Regarding MEC activities, WP3 has been working on service mobility management, considering UAV and MEC constraints where the partners have provided several contributions. Among these contributions, we can cite two on service migration among edge when following drones mobility, and two on the path planning, taking into account MEC availability. In addition, T3.2 contributes to a dedicated section in the D3.1. Partners have provided contributions on MEC service mobility, MEC deployment types, and MEC and NS.

The abstraction layer task has been tackled by identifying which interfaces are required by the trial controller to run a trial on top of a specific facility, the mapping of the facility interfaces to unified interfaces, designing and implementing the abstraction layer, and finally the continuous delivery and integration of the abstraction layer. During this Reporting Period, the WP has also focused on the abstraction of network slicing management interfaces, and a survey about the status and implementation details of the interfaces in each facility has been performed.

Significant results

Regarding slicing activities: The WP has proposed two different implementations for a 5G platform capable of demonstrating slicing capabilities.

Regarding MEC activities: Two contributions showing service migration among edge when following drones mobility, and two on path planning, taking into account MEC availability.

Submission of Deliverable D3.1 that is the first WP deliverable describing the 5G!Drones enablers.

Deviations from Annex I and impact on other Tasks, available resources and planning
The Task 3.4 is behind schedule compared to what is planned in the direction of work.

Reasoning for failing to achieve critical objectives and/or not being on schedule
This is due to a change in ALE's staff but also very strongly to the pandemic we are experiencing, which affects all activities relating to UAVs. Indeed, these activities generally require on-site work which is not possible remotely. Nevertheless, during the Reporting Period work resumed to a good start and the Task is on the right track.

8.3.2. Task 3.1 Scalable end-to-end slice orchestration, management and security mechanisms (M3-M32) [OPL]

Task Objectives:
Task T3.1 will address challenges for network slicing to support emerging UAV-related use cases. It should be noted that the successful execution of the targeted use case trials depends on the capabilities of the underlying facilities to maintain different types of services (uRLLC, mMTC, eMBB), including the provision of performance isolation and resource sharing at the RAN, core, transport and compute levels. Following the identification of missing components for slicing support in the selected 5G facilities (T1.3) and the architecture design provided by T1.4, this Task will provide the slicing-related enablers.

In particular, it will develop components for end-to-end secure slice deployment and orchestration, with the support for managing slice components across administrative domains. This is necessary for the cases where the functionality of an end-to-end slice spans across facilities (e.g., one facility is providing RAN and MEC functionality, while UAV control functions are split between the trial site and the vertical's premises; UAVs are restricted to a single facility due to regulatory requirements, while core network components and other functions of the UAV slice are executed as virtual instances at another trial site/facility). Activities in this Task will be in close synergy with T3.3, where the necessary infrastructure abstractions will be developed to facilitate federation and multi-domain operation

The selected 5G!Drones use cases have as a typical feature the *coexistence of multiple network slices* with different performance requirements for the provision of a *single drone service*. For example, for a public safety scenario, apart from operation of UTM modules, which require a uRLLC slice to meet the strict timing and reliability requirements for safe and secure flight operations, video has to be streamed from the drones necessitating the deployment of an eMBB slice to support it. Taking into consideration that

- multiple slices for other services/"tenants" would be deployed simultaneously over the shared 5G infrastructure, and
- end-to-end slices may cross administrative domains,

raises significant concerns regarding *scalable slice management*.

Furthermore, critical services such as UTM and public safety related have important *security and performance isolation* requirements. For UAV services in general, *safety is linked with security*. For example, without appropriate protection mechanisms at various levels, a malicious actor might aim to disrupt the operation of UTM or tamper with the control of a UAV, bringing significant risks. Security aspects in network slicing are generally overlooked. T3.1 will put particular focus in this direction,

studying network slicing security extensions and integrating them with the selected trial facilities. T3.1 will enable each of the network slices needed to achieve the UC trials to be adequately secured. To cope with specific security requirements from each of the network slices, software defined security (SD-Sec) and security as a service (SECaas) will be promoted. The advanced slicing mechanisms that will be contributed by this Task will be reported in **D3.1**, while the software components that will be implemented will be released with the whole 5G!Drones Enablers Software Suite (**D3.3**).

Task Activities during the period:

Most T3.1 partners have put effort related to the Deliverable D3.1. The overall editor of the document is OPL, but also the responsibilities for all sections of the document have been assigned. In the meantime, to achieve the primary goals of D3.1, the efforts to identify the missing components and mechanisms regarding network slicing in the facilities provided by partners have been undertaken. To achieve synchronisation of partners activities, cyclic technical presentations regarding T3.1 have been organised. The T3.1 contributions to D3.1 includes research related to RAN slicing (mostly EUR, THA), network slicing security extensions (mostly THA), scalability of network slicing management (OPL, DRR) as well as necessary abstractions of interfaces (AU) needed for conduction of 5G!Drones trials. The enablers proposed by T3.1 are derived from progress achieved by Tasks T1.3 and T1.4. The preliminary summary of work has been delivered in M12 within the first D3.1 draft, prepared by OPL. The document was distributed to the partners for the internal review and to allow for further refinement. The work on identifying slicing enablers has been continued since, and final version of D3.1 has now been delivered at M18 as planned.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO has been installing and configuring infrastructure orchestration and management related components, such as OpenStack, OSM, NextEPC, and DevStack to run as 5GTN edge servers. UO has also been studying generic ETSI and 3GPP slicing related specification status and specifications, and how 5G slicing architecture can be implemented in 5GTN in alignment with 5G!Drones technical architecture. UO has carried out facility implementation of slicing capable system, part of which involved Installation of Open Source MANO and Openstack. Further facility implementation includes configuring Openstack as Virtual Infrastructure Manager for Open Source MANO and virtualising EPC with the help of OpenStack. This is essential for creating images of core for slicing purposes. UO is also working on 5G Core implementation and it has installed and configured the NextEPC. Virtualised NextEPC has been made available. UO has contributed its assigned parts in Deliverable D3.1 and it has refined the faclility enablers' documentation, including a timeline.

Deviation and proposed corrective action:
During the period UO has changed most of the WP3 personnel due to individuals' unexpected departure to work for the industry. This change of personnel has resulted in delays with development of slice orchestration and management. UO has involved additional personnel to speed up work.

2-THA leads the WP. It has made organisation of bi-weekly telcos and organisation of meetings for technical presentations. THA made a comparison on the slicing capabilities of two platforms: EmPower and OAI. It has installedand configured OAI at THA premises and performed extensive research activities on slicing mechanisms. THA has had an active participation for what concerns Security topics and Security Taskforce. THA provided an implementation of a slicing platform.

3-ALE does not partake in Task 3.1.

4-INV does not partake in Task 3.1.

5-HEP does not partake in Task 3.1.

6-NCSRD continued the development of the slicing capability at the NDV domain of the infrastructure. NCSRD investigates different open source projects of the 5G-CORE, such as Free5GS, Open5GC, OAI 5G Core, to expand the slicing capabilities at the core part as well. This activity is highly innovative and still ongoing. NCSRD also examined integration of Policy Aspects in the slice deployment. It has made further developments in the KATANA slice manager made towards supporting new versions of Openstack for the resource allocation at the NFV domain. Improvements are made for incorporating security policies in the slice manager. This is ongoing work. NCSRD tested Ericsson APEX integration for policy and security enforcement.

7-AU has been enhancing the core network with capabilities for selecting network slices based on UE information. It has made an automation of core network installation procedure and compatibility test of the core with several RAN softwares. AU has done implementation of an API for network slice feasibility check, implementation of an API for VNFs (i.e., UAV applications) on-boarding, implementation of an API for VNFs resources scaling, and implementation of a DNS service used for the steering user plane traffic towards UAV applications. AU made contribution to D3.1 regarding network slicing enablers.

8-COS does not partake WP3.

9-AIR does not partake WP3.

10-UMS has had no planned involvement in this Reporting Period apart from reviewing and providing inputs to security requirements excel as UC2Sc2 leaders.

11-INF does not partake WP3.

12-NOK does not partake Task 3.1.

13-RXB does not partake Task 3.1.

14-EUR has done introduction and evaluation of a new network slicing mechanisms for 5G NR. It has made an implementation of a LORA slice on top of 5G-EVE SA facility. EUR has made contribution on 5G RAN slicing, and contribution to the Deliverable D3.1 section on Network Slicing.

15-DRR has made contribution on task assignment definition – abstracted interfaces for MEC / slice / KPI and integration of abstraction layer. It made definition of multilateration based A2D spoofing proof. DRR made a review of relation of T2.2 and T3.3 API and contributed to D3.1 preparation workshop.

16-CAF initiated and led Security Taskforce for mapping security requirements. It organised Security Taskforce teleconferences and work for mapping security requirements. CAF provided inputs for Security Requirements table as UC1Sc3, UC2Sc3, Uc3Sc1 leader.

17-FRQ has had coordination with partners regarding mobile network-related coverage data - in preparation of Athens 5GENESIS feasibility tests. Otherwise it has had very limited activity in the Task during the Reporting Period.

18-OPL is the Task leader. It has done preparation of the Task input to the WP3 presentation for the first project review and participated to both preparatory and the actual review meeting. OPL has coordinated activities of the Task. It has done identification/validation of 5G network mechanisms-

related gaps in 5G!Drones testbeds. OPL had the editorship of D3.1 (T3.1 area). It made T3.1 scope-related contributions for D3.1 and it has coordinated contributions and editing of D3.1.

19-MOE does not partake in Task 3.1.

20-ORA does not partake in Task 3.1.

8.3.3. Task 3.2 MEC capabilities for the support of 5G!Drones trials (M3-M32) [EUR]

Task Objectives:

Edge computing comes with the promise of low latency, and this is critical for the delay-sensitive components that many of the 5G!Drones use case scenarios involve. This Task will focus on the integration of Multi-access Edge Computing in the 5G!Drones architecture and in the trial facilities. As described in Section 1.3, the ICT-17 and other facilities where the use cases will be trialled feature to some extent MEC features. However, these capabilities are heterogeneous. Therefore, following the requirements analysis of T1.2, this Task will ensure that a common subset of MEC capabilities necessary for the support of the defined use cases is present at all facilities that will be used in the trials, and will fill potential gaps by developing the missing components critical MEC components.

Building on existing MEC components provided by the partners, T3.2 will create the necessary support for the inclusion of MEC application instances and related network and compute resources into an end-to-end UAV slice. However, an overview of the current status of the standards in slicing and edge computing reveals that *slicing support for MEC is still at a very early stage*. Given that 5G!Drones makes heavy use of slicing in conjunction with edge computing, it is necessary to extend current MEC implementations for slice awareness so that the appropriate level of (performance and other) isolation among coexisting slices is also enforced at the MEC level. This Task will thus provide interface extensions and mechanisms for improved slicing awareness, resource isolation and security in a multitenant MEC environment for new UAV vertical use cases.

Finally, the research activities of this Task will address the challenges of UAV mobility by introducing a *mobility management component*, which will ensure that UAV service components that are deployed at the edge are appropriately migrated across edge clouds following UAV mobility in order to maintain the latency constraints of the respective slices. The contributions of this Task will be reported in deliverable **D3.1**, and the related software components will be released with the 5G!Drones Enablers Software Suite (**D3.3**).

Task Activities during the period:

During this Reporting Period, Task 3.2 activities have focused on service mobility management, considering UAV and MEC constraints. Several contributions have been provided by the partners: two on showing service migration among edge when following drones mobility, and two on the path planning, taking into account MEC availability. In addition, Task 3.2 contributed to a dedicated section in the D3.1. Partners have provided contributions on MEC service mobility, MEC deployment types, and MEC and NS.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO has been installing Nokia Cloud Infrastructure for Realtime Applications and the latest version of vMEC Platform software into 5GTN edge server to enable 5G!Drones project applications installation on the edge. UO allocated and configured edge server space for Oulu Use Case feasibility tests carried out in August. UO has installed the Nokia Virtual Multi-Access Edge Computing platform

on single node server. It is running on top of OpenStack environment. Internal configuration and connectivity configuration to RAN and core network (EPC) is ongoing to enable local breakout (S1-LBO) between RAN and EPC traffic. The vMEC refinement and upgrading implementation plan has been created as 5G!Drones vMEC enabler. Also, application instantiation is under study. UO has contributed to MEC documentation reported in D3.1, including mobility management and service migration. UO is also continuing studying 5G slicing and EDGE/MEC architecture.

2-THA led the WP and organised bi-weekly teleconferences, and technical presentations. It made a presentation of its research activities regarding mobility management for MEC and has continued its research activities on MEC. THA participated to Mobility Management activities by providing a Connectivity and coverage metric characterisation system and a drone trajectory planning algorithm.

3-ALE does not partake in Task 3.2.

4-INV does not partake in Task 3.2.

5-HEP does not partake in Task 3.2.

6-NCSRD contributed in the Athens feasibility flights with the all-in-one 5G system of NCSRD, which supports an edge computing node attached to the core with low latency due to this topology. NCSRD closely collaborates with COS on interconnecting their network with optical link in order to connect NCSRD core network with COS Nokia 5G NR, which will be further enabled with local breakout (LBO) for realising a MEC solution with the appropriate 5G signaling and interfaces. For the support of Athens trials of Y2 NCSRD provided at the Egaleo stadium the portable edge computing solution. The portable edge computing solution is an all-in-one NSA 5G deployment, which provides low latency slice on spot. NCSRD, together with COS, works on realising an LBO ETSI MEC solution. Part of this work was used in Athens 5G feasibility tests.

7-AU did an implementation of the first version of the mobility manager for the Follow me edge cloud platform and an implementation of a web UI (WUI) for the Follow me edge cloud platform. AU conducted an investigation of the possible solutions for a proof-of-concept (PoC) demo. It also did research work on MEC-aware flight planning for UAVs. AU made an implementation of an API that allows the relocation of a service from one Edge host to another. It also made a feasibility test of live service migration for the virtual flight controller. AU made a deployment and integration of the UAV simulator with the virtual flight controller for PoC purposes. Finally, AU made contribution to D3.1 regarding MEC enablers for mobility management.

8-COS does not partake WP3.

9-AIR does not partake WP3.

10-UMS had no planned activity on the Task from June to August. Between September and November UMS presented its role, current, and future work on assisting the 5G facilities in understanding the MEC requirements for UAV operators.

11-INF does not partake WP3.

12-NOK had no planned activity on the Task from June to August. Between September and November NOK did keep workshops with UO related to security, mobility, and UO facility MEC framework.

13-RXB does not partake in Task 3.2.

14-EUR is the leader of the Task. It carried out organization of the meetings, conducting discussion and coordinating the contributions of partners. EUR proposed a new MEC-aware flight planification method. It did an implementation of a MEC service to ease the deployment of LORA service. EUR did preparation of slides on Task's activities for preparatory and the actual review meeting. EUR is the editor of the Deliverable D3.1 MEC part and it has contributed to D3.1 MEC sections.

15-DRR had no planned activity on the Task from June to August. Between September and November DRR held discussions with RXB on CARS (Common Altitude Reference Service) implementation on MEC.

16-CAF conducted research about MEC capabilities and functions to support MEC based command and control (C2) and video analytics solutions for UAVs. It made contributions to D3.1 MEC and UAV enablers section and MEC solutions' developments for supporting feasibility tests.

17-FRQ did contribution to the technical discussions on test preparation and interface specification preparation for Athens trial. Otherwise, it did not have significant planned activity during the Reporting Period.

18-OPL participated in 1st year review preparatory meeting. It has the editorship of D3.1 (T3.2 area). It made preparation of T3.2 scope-related contributions for D3.1, and has had discussions with T3.2 leader for coordination.

19-MOE does not partake in Task 3.2.

20-ORA does not partake in Task 3.2.

8.3.4. Task 3.3 Infrastructure abstraction and federation of 5G facilities (M3-M32) [AU]

Task Objectives:

Given that 5G!Drones will trial services over heterogeneous 5G facilities, T3.3 is focused on providing a unified interface to expose facility capabilities and to deploy functions there. This interface will provide a single abstraction for network (e.g., RAN) and compute resources (e.g., those provided from a central or MEC datacenter). The API will be accessed by the trial controller to deploy and manage components of the vertical service and to orchestrate the execution of a trial. The abstraction layer that will be provided by this activity will in turn rely on the 5G facility interfaces. From a software design perspective, it can be seen as a plugin framework, where for each facility a plugin will be implemented, thus contributing to the system's extensibility.

Furthermore, this Task will ensure the necessary level of connectivity across facilities and, in turn, among the components of a vertical service deployed at different sites, as well as between the trial controller and the management and orchestration components of each facility. This activity involves all relevant authentication, authorization and access control issues (AAA), and will further enable features such as the interconnection of a partner site to a facility and the dynamic relocation of service components at trial runtime. It shall be noted that these AAA issues are relevant with access to the management planes of facilities and, although having implications to the slicing security issues studied in T3.1, are distinctly different. The activities of this Task will contribute towards achieving multi-domain orchestration of UAV slices, a topic also related with T3.1.

As a final note, since ICT-17 (and other complementary infrastructures that will be used by the project) will be still evolving during the course of 5G!Drones, this can significantly impact the activities in this Task. We will adopt an incremental design and development approach, which will follow closely the output of Task T1.3 (detailed description of 5G facilities). The abstraction and federation interfaces

and mechanisms provided in this Task will be reported in **D3.1** and the produced software will also be released as part of the 5G!Drones Enablers Software Suite in **D3.3**.

Task Activities during the period:

During the period starting at M13 and ending at M18, the Task efforts were mainly dedicated to implementation work. Two implementations that allow the abstraction of network slicing management interfaces were released. The first implementation provided by EUR is in the form of a monolithic application (i.e., requests router, services lookup, and parsers running as a single application) that allows the abstraction of network slicing interfaces. For the time being, this implementation provides an abstraction for the 5G-EVE facility only.

The second implementation provided by AU is compliant to the previously reported microservice-based architecture and it is mainly based on open-source tools for implementing the requests router and service lookup components. This implementation comes with a dummy facility parser that allows the emulation of real trial facilities. The abstraction layer with emulated parsers is already deployed at AU premises which would allow to speed up the development process of the trial controller by testing the different requests sent by the trial controller. Moreover, the released dummy parser can be used as a living implementation that the involved partners can use to add and remove abstracted interfaces and as a template for their facilities parsers. In this regard, UO has presented the first version of the 5GTN parser which is based on the released dummy parser.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO has been studying API abstraction of the 5GTN. It has implemented the abstraction layer (creation of dummy parser for 5GTN), based on RESTful APIs. This parser translates the requests coming from upper layer to the 5G facility specific requests. Full implementation of the parser resumes after the OSM north bound interface for the parser is ready. UO has planned the schedule for WP3 related modules to be developed by University of Oulu. UO has also contributed to the facility enabler documentation updating.

2-THA, 3-ALE, 4-INV, and 5-HEP do not partake in Task 3.3.

6-NCSRD contributed in the interfacing of the experimentation execution component with the abstraction layer. it raised discussions on the necessity for a common abstraction layer across the different platforms. It further contributed to the various discussion and presentations on the relation of abstraction layer with LCM. NCSRD provided some corrections in the released figures, related to the relevance of the abstraction layer to the experiment architecture management plane.

7-AU is the leader of T3.3. It made preparation of a presentation for the review meeting. AU made a deployment of the open-source API Gateway Kong and development of X-network facility parser. It presented T3.3 activities in the virtual F2F meeting. AU made an implementation and release of a dummy facility parser and the microservices-based abstraction layer (i.e., API gateway and parsers lookup). It gave a presentation of a live demo for network slicing abstracted interfaces using the released abstraction layer and dummy facility parser. It also made contribution to D3.1 regarding abstraction layer and abstracted interfaces.

8-COS and *9-AIR* do not partake in WP3.

10-UMS has had no planned activity in this Task during the Reporting Period.

11-INF does not partake in WP3.

12-NOK and *13-RXB* do not partake in Task 3.3.

14-EUR made a proposition of an architecture of the abstraction layer. It made an implementation of the abstraction layer, and the first version of the implementation is available in Gitlab of the project. It also made a presentation of the implementation to the partners.

15-DRR has been consulting adaptation and abstraction capabilities from the integration with trial controller perspective (e.g. data formats for KPI measurements from the facilities). Between September and November it has not had planned activity for the Task.

16-CAF has had no planned activity for the Task during the Reporting Period.

17-FRQ made contribution to the overall architecture with respect to discussion on specific Plugins for each facility and research on flight information management system (FIMS) for integration with UTM systems with focus on KPI items in regard to Athens trials. Between September and November it has had no planned activity on the Task.

18-OPL does not partake in Task 3.3

19-MOE provided support for Athens trials of Y2. MOE with NCSRD and COS provided at the Egaleo stadium "Stavros Mavrothalassitis" the portable edge computing solution. MOE and NCSRD together with COS work on realising a LBO ETSI MEC solution. Part of this work was used in Egaleo 5G feasibility tests. After the tests MOE had no planned involvement in this Reporting period outside of expected participation in this Task.

20-ORA has had no planned activity for the Task during the Reporting Period.

8.3.5. Task 3.4 Development of UAV use case service components (M3-M33) [ALE]

Task Objectives:
Based on the detailed specification of the use cases of T1.2, the goal of this Task is to enhance the existing UAV software or develop new software to support the use cases. This pertains both to onboard units and to software to be run remotely (e.g., as virtual instances on edge or remote clouds), and includes both control functionality and application level one. With the completion of the activities of this Task, all *target use case scenarios will be fully implemented*. Also, in another line of activities in this Task, the necessary software and hardware components for the integration of 5G technology on UAVs will be provided (e.g., installation and integration of UE equipment onboard). Deliverable **D3.2** is dedicated to the description of the activities of this Task, while the full software suite including all use case scenarios to be trialed is delivered in **D3.4**

Task Activities during the period:

The Task has been setting up tools for monitoring and keeping track of the progress regarding the development of UAV-service Enablers. The Task has established an excel sheet with all the identified enablers by partner. In order for partners to present the progress about enabler's development, current status and their activities so far, the Task has set up a calendar for technical presentations from the partners, slotted from October 2020 to January 2021.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences

and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO did mobile remote-control station related development for UAV monitoring and control. It carried out testing and commanding a remote operated UAV in ROS-Gazebo simulation environment. Further software integration and testing of the Intel RealSense D435, T265 and Ouster OS1-16 LiDAR data fusion for SLAM and navigation was done. Testing of reference localisation sensor continued. UO continued work connecting real drone control and virtual reality visualisation and UI. Integration and interface implementation of large cable drone to test facility started. Virtual reality visualisation and user interface ability to define drone path was completed. UO conducted high precision reference point cloud for botanical garden test facility.

2-THA has had no planned activity in this Task between June and August. After that, THA has participated to the definition of security requirements.

3-ALE as leader of this Task, one of its functions is to monitor and to keep an eye on the development and implementation of the UAV service enablers by each of the concerned parted. In this way, and during the period M13 to M18, ALE has defined a set of tools to allow partners to report the progress regarding the development and implementation. A set of documents were defined whose purpose was to acquire relevant and detailed information of each of them (enabler description, type, current status, dependencies, expected release dates, etc), extending then the initial description defined in D1.3. These documents replace those previously proposed (use case oriented) by new ones (partner oriented) and gather new information such as expected release dates for the set of enablers. Besides, these documents allowed to identify new enablers that were not defined in D1.3 but need to be included in the final solution of UAV service enablers. It was the case of ORA (France) who provided two algorithms (trajectory optimisation and UAV location) that will be implemented and used as enablers for two use cases and were not identified before. In M16, ALE proposed a calendar of technical presentations in order for partners to present their work. These presentations allow partners to more concretely present the progress as well as to show results, exchange and discuss them with other partners. Besides this management Task regarding T3.4, ALE has focused on the design and development of its own enablers (our enablers were defined in D1.3: Alerion GCS, Data processing, Sensor Streaming and the Hydradrone), defined for our use case: UC3Sc1Sub-Scenario 3. ALE is currently working in the hardware design of the Hydradrone. No activities for this Task during holidays (M15).

4-INV created the list of security requirements and their classification for UC1Sc3 (as an example for all other scenarios). It participated in meetings to discuss with CAF, THA, and ORA aspects related to security requirements. INV has been filling the enablers table and discussion with THA about components that can be provided by INV. It has been reading the documents and presentations, commenting and giving feedback for other T3.x streams. INV has provided an update about status of INV's components, which can be utilised in 5G!Drones project. It did definition of security requirements – part of Security Work Group related to UAV software, services and hardware.

5-HEP has made development and implementation of Hepta's GCS & data presentation for Oulu feasibility tests. It has been testing the implementation of Hepta's GCS on Edge server, configuring drone with 5G connectivity, and testing tether power delivery for drone.

6-NCSRD does not partake in Task 3.4.

7-AU has made development of an IoT gateway that will be used on top of its drones to collect data while flying. This development work goes towards the realisation of the use case scenario US3Sc2 led by AU. Furthermore, AU has developed drivers allowing the gateway to automatically recognise the mounted IoT sensors.

8-COS and *9-AIR* do not partake in WP3.

10-UMS has made preparation work for Athens feasibility tests. It also has made development of UMS UAV service enablers, presented the status of UMS UAV service enablers, and prepared a simulation testbed for trials at 5GENESIS.

11-INF does not partake WP3.

12-NOK started development of a UWB based positioning system in NOK premises as UO premises were closed due to Covid-19 during summer. NOK has done preparation work for Oulu pre-trials. NOK has continued design for DJI Matric 5G measurement payload container and continued 5G modem integration for Nokia Drone.

13-RXB actively contributed to KPIs to be captured. It has contributed and led the efforts towards U-Space initiative and led the initiative and efforts towards U-Space adapter and relevant KPIs. RXB held discussions and work with partners on how and what U-Space services should be included in the project scope. The discussions resulted in an excel list mapping SESAR's Technical Baseline 3 U-Space services with the Use Cases in 5G!drones. RXB did further work on matching KPI's from WP1 with functional requirements and enablers for the scenarios to be able to perform scenarios according for the use case scenarios in both the radio, U-Space, and UAV domains.

14-EUR proposed a telemetry service at MEC. Otherwise it has had no planned activities in this Task during the Reporting Period.

15-DRR carried out development of the U-Space enablers to be delivered by DRR (Telemetry, mission prioritization, CDDLC, dFPL), designing APIs and integration frameworks, and preparation for integration for Athens feasibility tests. DRR did work on API for U-Space integration: dFPL, telemetry, and 5G specific KPI. DRR is working on telemetry presentation, preparation of final version (T3.x U-Space enabler info DRR.pptx) and provided a progress report on it.

16-CAF has made development and adaptation of CAFA CUP platform for feasibility tests in Athens and in Finland. It also made development of CAFA Video Analyzer for the same purposes. CAF has also made development of hardware components for CAFA Drone Delivery service (UC1Sc3) and for attaching 5G device onboard a drone as well as development of software components for CAFA C2 and 3D mapping.

17-FRQ has conducted an evaluation of options to simulate large number of drones together with partners: CAF, RXB, and DRR. Otherwise, it has had no other planned activity for the Reporting Period.

18-OPL is not partaking the Task 3.4.

19- MOE has had no planned activities on this Task during the Reporting Period.

20-ORA has made simulation of trajectory optimisation and UAV location. It has been also working on defining an algorithm for UAV localisation based on two base stations.

8.4. WP4 Integration and trial validation

8.4.1. Progress towards objectives and details for each Task [UMS]

WP4 Objectives
- Objective 5: **"Validate 5G KPIs that demonstrate execution of UAV use cases"**
- Objective 6: **"Validate UAV KPIs using 5G"**
- Objective 7: **"Advanced data analytics tools to visualise and deeply analyse the trial results, and provide <u>feedback to the 5G and UAV ecosystem"</u>**

To this end, the following specific objectives will be pursued:
- Integration of the developments of WP2 (trial controller) and WP3 (5G!Drones enablers) towards a full 5G!Drones architecture on top of the selected 5G trial facilities.
- Detailed design of trials.
- Execution of trials for the 5G!Drones use cases on the selected trial sites.
- Validation of the vertical service and 5G related KPIs.
- Evaluation of the performance of the use cases.

Identification of necessary enhancements in the used 5G facilities, and the 5G system in general and provision of recommendations.

WP Tasks and interrelations:
- T4.1: Software integration and 5G!Drones architecture validation (M6-M36) [DRR]
- T4.2: Preparation and execution of trials (M12-M42) [CAF]
- T4.3: Evaluation of trial results (M20-M42) [COS]

Description of work

This is the work package where most of the efforts of the project will be put. It involves all aspects that have to do with the execution of trials. T4.1 is responsible for the integration of the software and hardware components that will be developed in WP2 and WP3, leading to a fully functional 5G!Drones trial architecture on top of the selected 5G facilities. Task T4.2 is where the use case scenarios, defined in detail in T1.2, will be trialled, after a careful design of a trial plan and a preparation phase. T4.3 will use advanced data analysis tools produced in T2.4 to evaluate the results of the trials from the perspectives of both the UAV industry and the 5G system. These results will be fed back to T1.1 to re-evaluate the role of 5G technology in the UAV ecosystem and provide recommendations to the appropriate bodies and stakeholders.

Main Progress in the period:

Despite the disruptions that have resulted due to Covid-19 restrictions, WP4 has continued to make progress and build on top of existing work within the current reporting period. Within T4.1, partners have collaborated effectively to set out the integration steps necessary to integrate the modules and enablers developed within WP2 and WP3 respectively. This includes working collaboratively with WP2 module owners to prepare Requirement Traceability Matrices and working collaboratively with WP3 enablers process flows. In addition, system process flows have been created for a generic 5G!Drones trial to further outline the manner in which the 5G!Drones components interact with each other. Initial integration work has also been carried out between facility infrastructures and UTM systems. Finally, work on D4.2 has been initiated with a draft ToC as well as setting out an initial release plan.

T4.2 was officially kicked-off at the end of the previous Reporting Period and has conducted multiple feasibility tests at the different trial facilities under the challenges imposed by Covid-19 restrictions. The aim of the feasibility tests is to conduct test flights using partners' existing capabilities and disseminate the learnings to WP2, WP3, and T4.1 to assist in development and integration. The feasibility tests conducted so far include:

1. Remote and physical feasibility tests conducted at 5GENESIS facility in Greece in June and October respectively.

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2. Feasibility tests conducted using a proprietary simulation testbed developed by UMS at 5GENESIS in November.
3. Physical feasibility tests conducted at 5GTN and X-Network in Finland in August.

In addition, work has now commenced on preparing for feasibility tests at 5G-EVE trial facility in France. As per recommendations made in the 1st year review, the Task activities have also reviewed some simulation/emulation options as contingency measures and e.g. UMS is developing a simulator in this context.

Significant results
T4.1:
1. RTMs created in collaboration with WP2 module owners.
2. System process flow of a generic 5G!Drones trial created.
3. Initial release plan created.
4. Central code repository set up together with methodology associated.
5. D4.2 draft ToC created.
T4.2:
1. Remote and physical feasibility tests conducted at 5GENESIS, 5GTN, and X-Network.

Deviations from Annex I and impact on other Tasks, available resources and planning
The physical feasibility tests on 5G-EVE SA have been further delayed since autumn due to Covid-19 restrictions. Planning for the tests are underway and target is to have the tests within one-month notice of restrictions' lifting.

8.4.2. Task 4.1 Software integration and 5G!Drones architecture validation (M6-M36) [DRR]

Task Objectives:
The role of T4.1 is to deliver *a fully-fledged trial system* including all the necessary components at the UAV service and the infrastructure levels for the execution of the selected trials over 5G facilities. It will *integrate the 5G!Drones trial controller and 5G!Drones enablers, including UAV-service-related software and hardware*. Given the *size and complexity* of the project, with lots of heterogeneous components that are to be implemented and integrated with existing ones in a manner compatible with the trial facilities, a detailed *integration plan* will be created early in the course of the Task, which will drive all integration activities in the project. This plan will define the integration and testing procedures and environment (including development and testing methodologies, tools, interfaces, and validation criteria) which will manage how the software and/or hardware modules that will be progressively delivered by WP2 and WP3 are *incrementally deployed and tested in the trial facilities*. Following the plan, the following activities will take place within this Task:
- Incremental deployment and unit tests in a laboratory environment.
- Deployment and individual component testing on the 5G facilities.
- Functional tests for the validation of the 5G!Drones architecture.
- Integration and testing of the UAV hardware in the target ICT-17 facilities and other supporting 5G facilities.
- Functional tests of the selected scenarios over the selected facilities.

This Task will work in close synergy with WP2 and WP3, providing continuous feedback from the integration activities for the refinement of the designed trial architecture and enablers. The integration plan will be reported in **D4.1** at M07 and refined in **D4.2** at M26.

Task Activities during the period:
For the purpose of integration planning, it is crucial to gather and align planning of all necessary contributions from WP2 and WP3. These include all facilities' deployment roadmaps, UAV and facility specific enablers (applications, tools, etc), and Trial Controller solution delivery roadmap. Thus, Task

4.1 has put a lot of effort in trials' system flows and processes definition. For this purpose, Task 4.1 defined the documentation containing requirements for the solution: systems' process flow diagrams, and Requirements Traceability Matrixes (RTMs). Mentioned RTMs would also provide the traceability matrix for testing. Finally, RTMs would document:

- solution's requirements based on aligned process flows,
- interfaces between components, and
- test coverage for those requirements.

This activity is performed together with WP2 and WP3 partners. Initial draft version of D4.2 document was also prepared, which would update the testing and integration approach methodology provided in D4.1 as well as the release plan and implementation status. Release plans based on the deployment and availability plans to be provided by all contributing parties from WP2 and WP3, which will reflect the implementation plan for functionalities captured in RTMs.

Central code repository for future deployment and integration was also set up, including methodology for maintaining and contributing the content. Initial contributions from some partners were published. During the Athens feasibility tests initial integrations of the facility infrastructure with UTM systems of FRQ and DRR, for the purposes of collecting of telemetry data, were successfully performed.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO Contribution and results:
UO has been preparing for the feasibility tests that were conducted in Oulu 5GTN coverage area at the end of August. UO participated in multiple dedicated teleconferences in coordinating required equipment, permits, preparation of facility and edge server for CAF and HEP to be able to install their software. UO has created the integration and release plan for 5GTN modules developed under Work Packages 2 and 3. The plan is monitored and updated regularly, and execution of the plan is ongoing. Moreover, UO has contributed in WP4 common 5G!Drones release planning. UO integration and release plan is to be connected to common 5G!Drones release plan.

2-THA contributed and participated in WP4 meetings and ongoing discussions related to 5G!Drones architecture and the slicing mechanisms of different platforms (for uplink and downlink scenarios). Different components have been considered such as the network slice Life Cycle Manager and the creation of different isolated slices. THA was actively working on OpenAirInterface and srsLTE (especially on the RAN slicing mechanisms and 5G scheduling) to integrate it into a local 5G platform and have a clear vision to propose a solution for data analysis and slice security. In addition to the technical contributions on MEC and RAN slicing, THA has also delivered guidelines for integrating the main WP4 contributions in the use case demonstrations (or testbeds). THA contributed and participated actively in WP4 meetings and ongoing discussions related to the 5G!Drones architecture, the slicing mechanisms of different platforms (for uplink and downlink scenarios), and trials execution planning. Different components have been considered such as the network slice LCM and the creation of different isolated slices. In addition to the technical contributions on MEC and RAN slicing, THA has also delivered guidelines for integrating the main WP4 contributions in the use case demonstrations (or testbeds).

3-ALE has investigated feasibility test for the scenario UC3Sc1 Sub-Scenario 3. ALE did not participate this time to feasibility tests due to the lack of readiness with respect to some of the components that take part of our scenario (Hydradrone). However, ALE closely followed what happened during the feasibility tests, especially those at OULU University since our scenario will be trialled in that place.

4-INV has done work understanding how the integration and testing for D2.2 "Initial implementation of Trial Engine" should be done to be compliant with the D4.1. It prepared the skeleton for reporting the integration and testing for D2.2. INV has been working on initial version of Requirements Traceability Matrix for Webportal 1, Facility Web Portal. It has been reviewing and commenting RTM for Trial Validator, Life Cycle Manager, and Trial Enforcement.

5-HEP has participated in Integration work with FRQ. It has been doing planning work and preparations for FRQ and UMS integration.

6-NCSRD has coordinated the activities towards the 2nd feasibility trial in Athens for drone assisted radio coverage assessment. NCSRD has integrated in collaboration with UMS, CAF, HEP, FRQ, and DRR, the necessary components needed for the field trial test. It has collaborated with CAF for installing at NCSRD Edge computing the FCC module and collaborated with HEP for installing at NCSRD Edge computing the respective FCC module. It has installed on 5G mobile phones the necessary measurement software and collaborated with FRQ and UMS for sending telemetry to their UTM systems.

7-AU did integration of the web portal developed as part of WP2, with the UAV flight controller developed as part of WP3. It has made contribution to the meetings organised by NOK and DRR for establishing the workflow diagram, discussing and providing information on what interfaces are provided by X-Network facility, and updating the workflow diagram following the interfaces supported by its facility. AU has done integration of the developed platform for network slicing (as part of T3.1) with the gNB of the University (a commercial gNB already deployed at the University). AU also did integration of the web portal developed as part of WP2 with the flight controller developed as part of WP3.

8-COS has provided support for the design and planning of the 2nd feasibility trials in Athens scheduled for October 2020 for drone assisted radio coverage assessment. It planned the OTE Academy integration efforts, prepared the edge cloud to host CAF C2 application and Video Streaming Application. COS made an analysis of the D4.2 ToC.

9-AIR: Although 5G-EVE platform is still blocked due to Covid-19 situation, AIR has multiplied integrations of Mission Critical Services on significant environments with regards to 5G!Drones that will de-risk future integration on experimental platform. It has defined a new strategy and new developments started in order to find Covid free tests allowing to limit people presence on site and automating deployments and tests to reduce traveling personnel.

10-UMS as WP leader has done preparation and leading bi-weekly meetings, and preparation for 1st year review meeting. It has done UTM integration with UMS platform, developing the process flow for UC2Sc2, providing feedback to D4.2 ToC, and Engaging in discussions regarding release plan. UMS did preparation as WP4 leader for virtual F2F meeting.

11-INF has made initial comments and planning of D4.2 ToC, comment on D4.2, and preparations for 1st year review. INF has been monitoring and analysing T4.1 activities from a business perspective, communicating the results through social media and website, linking T4.1 activities to T4.2, T1.1 and T5.1.

12-NOK contributed to over 10 meetings related to trial process sequency research and design. The meeting series started June 5th and were divided to 1) planning, 2) execution, and 3) the post-processing parts. There has been actively participation to meeting series from, for example, AU, AIR, CAF, EUR, DDR, INV, NCSRD, UO, RXB and NOK. These meeting NOK organised together with DRR as these pre-steps are crucial for system integration and test planning. In addition, NOK started to design for life cycle manager integration and testing.

13-RXB does not partake in Task 4.1, Nevertheless it has contributed to the Task activity in conjunction with other Tasks as follows.
- Cross WP2/WP3/WP4 package workshop – end-to-end process flow.
- Work on API for U-Space integration: dFPL, telemetry, 5G specific KPI.
- Active participation in calls between UMS, and other partners in negotiating the WP4 related conflicts.
- Active involvement in discussing and planning the simulation platform for testing and trials.
- Active contribution and support in activities related to integration and validation.
- Active contribution to sequence diagram and architecture.
- Multilateral calls with partners to support integration and planning.

14-EUR made proposal of an intergation plan for Webportal2, LCM, and Abstraction layer. It did preparation and test of the 5G-EVE components to be used by the UC. EUR has participated to the integration time plane and contributed to the integration plane.

Deviation and corrective action:
EUR has been highly impacted by the Covid restrictions, which delayed the tests on 5G-EVE facility. EUR is continuing working on preparing the components for the trials (Webportal, LCM, Abstraction layer, Slice Orchestrator).

15-DRR is the Task leader. It has made preparations of presentation for first year review. It has held Trial preparation discussion and made functional tests preparation based on use cases – discussion with OPL. It has contributed to cross WP2/WP3/WP4 package workshop – end-to-end process flow review. It had managed the project GitLab repository (registration, rules/structure review, etc). DRR has updated RTM tables – preparation of the functionalities lists for LCM and U-Space Adapter. It has done work on API for U-Space integration: dFPL, telemetry, 5G specific KPI. It made a review of the EC yearly review report with preparation of comments/feedback to the Period 1 review (U-Space perspective). DRR made a mid-holiday status update regarding T4.1 activities and WP4 related conclusions from EU report (benchamarking, real 5G networks usage, massive tests, detailed planning). It reviewed the finished feasibility tests results from the integration aspects' perspective. DRR has made preparation of status updates of T4.1 (presentations). It has been designing UTM integration part with FRQ, based on U-Space regulation requirments in the field of telemetry and flight planning. It has further made RTM development, D4.2 planning, release planning workshop agenda preparation, release planning workshop/brainstorming, and preparation/discussion with RXB/UMS on release plan (drivers, frequency).

16-CAF did preparations for 1st year review meeting regarding WP4 activities. It has participated in WP2, WP3, and WP4 cross-WPs meeting, and in integration with FRQ systems. CAF made UTM integration for CAFA C2 platform. It has been developing the process flow and integration plan for UC1Sc3, UC2Sc3, and UC3Sc1.

17-FRQ made a prototype implementation with ground control station for Athens feasibility tests. It made integrations with Drone Partners (DRR, CAF, and HEP) for Athens trials. FRQ has done UTM integration work with multiple partners based on U-Space regulation requirements for telemetry, flight planning, and notifications. It has worked for visualisation of U-Space data in UTM system.

18-OPL has been monitoring the Task activities and has had discussion of OPL comments to initial documents. OPL has worked on validation of adaptability of the OPL distributed slice management laboratory solution to the requirements of UAV use cases. It has participated in discussions dedicated to description of information flow between architectural entities during the life-cycle of test scenarios. It has also held discussions with D4.2 leader about OPL contributions to the deliverable.

19-MOE has participated to specific telcos dedicated to the Athens fesibility tests site. It made contributions to the definition of the components for the feasibility trial and has supported the planned activities for the Athens demonstration (UC4Sc1 in 5GENESIS Athens) in Egaleo stadium from 19th to 20th October, 2020.

20-ORA did not has any planned activity in this Task during the Reporting Period.

8.4.3. Task 4.2 Preparation and execution of trials (M12-M42) [CAF]

Task Objectives:
In this Task, the scenarios defined in T1.2 will be trialled over the 5G!Drones architecture which integrates the different 5G trial facilities. The activities of this Task are split in two phases:

- **Preparation phase:** Following an evaluation of the evolution and status of the available ICT-17 and other 5G facilities to which use cases have been mapped in T1.3, and the requirements of the use cases, as identified in T1.2, a detailed *trial plan* will be drafted for all use cases, including the 5G facilities for the execution of the trials, the interconnection of the trial sites, the KPIs to extract and the partners responsible for managing the trials. The trial plan will include *experiments of varying scales*, ranging from *small-scale, single-site trials* focusing on studying particular use case features which do not necessitate extensive deployments and lots of resources to *large-scale showcasing events*. The preparation phase also includes full *functional tests* of the selected scenarios over the selected facilities and preparations for showcasing trials. A critical aspect of trial preparation is planning the timing of trials: *Trial scheduling* should take into account the availability of facilities (and the amount of resources thereof for the execution of experiments) and the expected trial duration.

- **Trial plan execution and collection of trial results:** This is the main phase of the experiments, where the trial plan is executed. The orchestration of this activity and the collection of its results will take place using the interface of the trial controller. We remark that depending on the decisions that will be taken during the specification of the trial plan, multiple trials may take place simultaneously, potentially on top of a shared facility. Trials will commence after the delivery of the trial plan, marking **MS3** (M26).

An activity that will take place in parallel with trial execution is *trial demonstration*. Part of the trials specified in the trial plan will be on live showcasing events. For example, the plan will include showcasing the use case scenario that demonstrates enhanced connectivity during crowded events at the trial facility of the Municipality of Egaleo (municipal stadium). This is linked with specific communication and dissemination activities of WP5 and has as its focus not only to demonstrate the UAV-related use case scenarios, but also to demonstrate the operation and capabilities of the overall trial architecture and experimental methodologies. The trial plan (deliverable **D4.3**) will be delivered in M26. The trial results will be directly channelled to T4.3 as they become available.

Task Activities during the period:
Under Task 4.2, the main focus in the M13-M18 period was to conduct feasibility tests. The purpose of the feasibility tests was to test the existing technical solutions to the extent possible and gather important information and inputs for D4.3 Trials planning. In Preparation phase project partners conducted the following feasibility tests:

1. In June at 5GENESIS facility in Greece UC4 Connectivity remote feasibility tests.
2. In August at X-Network in Finland UC1Sc3 Drone delivery physical feasibility tests.
3. In August at 5GTN network in Finland UC3Sc1 Infrastructure inspection physical feasibility tests.
4. In October at 5GENESIS facility in Greece UC4 Connectivity physical feasibility tests.

5. In November work has now commenced on preparing for feasibility tests at 5G-EVE trial facility in France.

Each feasibility test was preceded by about 1.5 months of planning and preparation so that the tests would be of maximum benefit for the project. After each test, the results were analysed and discussed, and a report was prepared and presented to all project partners. The findings collected from each feasibility test were used to plan subsequent feasibility tests, which ensured continuous development of the planning and execution of feasibility tests.

In summary, feasibility tests were critical for the 5G!Drones project because they provided the necessary inputs for WP2, WP3,WP4, and WP5 continue development and exploitation activities. As all Work Packages of the project constantly need practical feedback, it is planned to carry out pre-trials in the Preparation phase in the first half of 2021 before starting the Phase 2-Trials.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are described next. Regular partner activities, such as participation to teleconferences and face-to-face meetings will not be reported independently as they are considered the default a Beneficiary partaking a Task would do.

1-UO feasibility tests for Use Cases to be trialled in Oulu were prepared for and conducted. Feasibility tests were conducted during over two days where UO provided all of the needed 5G communications equipment. Work was carried out to enable feasibility tests in UO 5GTN environment by setting up edge server for trial purposes. Moreover, testing of some software installations (ONAP, Openbaton and 5GTANGO) were done. UO has contributed in the 5GTN physical feasibility tests analysis and lessons learned documentation and has disseminated some of the findings in a 5G-PPP event. Actions have been initiated to ensure appropriate 5GTN coverage in areas where heavy drones may be trialled without extensive SORA documentation.

2-THA has contributed actively in Task 4.2 in order to enrich the ongoing discussions for identifying clearly the trials and creating a direct link between WP3 requirements and WP4 activities. Furthermore, THA has contributed to discussions for the execution and preparation of demonstrations and KPIs related to different use-cases. On the other hand, THA pushes discussions for upcoming demonstrations and testbeds.

3-ALE participated to preparatory meetings for feasibility test. It has been taking into consideration the feedback from the feasibility tests.

4-INV participated to a number of preparatory meetings for the feasibility tests. It has been reviewing, commenting, and providing feedback on the feasibility test reports from X-Network and 5GTN. INV has also analysed and commented on the 5GENESIS Athens feasibility tests' results.

5-HEP applied and acquired an exemption license from the Finnish Transport and Communications Agency (Traficom) for using 5G phone onboard of drone in Finland for the feasibility tests. It made preparations for Oulu 5GTN feasibility tests held on 27-28 August. HEP performed real flight tests on 27-28 August in Oulu during testing integration with 5G phones. It has participated in 5GENESIS UC4Sc1 telcos and it has been configuring a drone for UC4Sc1, fabricating mockup antenna, preparing dummy payload, and testing hardware setup. It arranged logistics and support for UC4Sc1 and took part of 5GENESIS Athens feasibility tests.

6-NCSRD has proceeded with the MOE for all the necessary preparations at the Egaleo Stadium for the execution of the 5GENESIS feasibility tests. It has done preparation of the Egaleo Stadium field trial with the necessary cabling and equipment and made an acknowledgement of the trial to the national radio regulator. NCSRD collaborated with COS for integrating the Nokia 5G NR with NCSRD Core to be used for UC4 validation. It led the preparations of the tests setup for the Athens Trial 2nd

feasibility trial in the Municipality of Egaleo primarily and for the COS Academy secondly. It communicated with the respective ministries for receiving the necessary bandwidth licenses for the trials and prepared all the necessary 5G equipment on site at the stadium of the municipality of Egaleo.

7-AU applied and acquired a license from Traficom for controlling drones using 5G network of Aalto University. It performed several hours of real flights and test of the network quality in different locations around the campus of the university. AU conducted preparation for Finland feasibility test which was held on August 24th, 2020. It participated and contributed to the dedicated meetings to Finland feasibility test by discussing and providing information on what its facility can support during this period. AU has been supporting CAF for applying to the license for controlling CAF drones using Aalto 5G network by providing information on its network and approving the requests received from Traficom. It has provided CAF access to a windows server, to two 5G phones, and coordinating with their technical team for installing the required software. AU has also performed several hours of outdoor trials to test the platform it developed for the use case scenario AU is leading (UAV-based IoT data collection). It performed outdoor tests of the quality of the network after integrating the developed platform for network slicing with the gNB of the University.

8-COS did installation and configuration of the MEC node at OTE Academy site to support Local Break Out Capabilities for the UC4 use case. It did integration of the MEC node with the NOKIA Airscale 5G BTS (NSA). COS integrated the Nokia 5G NR with NCSRD Core to be used for UC4 validation. It supported the demo setup for the Athens Trial 2nd feasibility tests, both in the Municipality of Egaleo and in OTE Academy. COS integrated the C2 and Streaming Server application with the COS LBO node for the execution of the 3rd day's trials and did Athens trials 3rd day preparation (OTE academy, 21 Oct 2020).

9-AIR has set up discussions with UC2Sc1 partners in order to prepare future feasibility tests that will be conducted as soon as Covid-19 situation allows it and comparable to what was already done in Finland for different use cases. AIR has started the preparation of technical feasibility tests on 5G-EVE platform, which are unfortunately postponed due to Covid-19 situation in France.

10-UMS as WP leader carried out preparation, leading WP4 bi-weekly meetings, and preparation for 1st year review meeting. UMS also conducted remote feasibility tests for UC4Sc1. It participated in dedicated telcos for Athens physical feasibility tests and conducted tests with simulation testbed at 5GENESIS. UMS did preparation as WP4 leader for the project's virtual F2F meeting and it has.

11-INF has initiated internal processes for monitoring and analysing performed trials activities as communication and business liaison of WP4. It made Athens initial trial video publishing, monitored and reported initial Athens and Finland trials, and reviewed and did final editing of feasibility tests reports (for communication/publishing). INF has been analysing T4.2 activities from a business perspective, communicating the results through social media and website, linking T4.2 activities to T4.1, T4.3, T1.1 and T5.1. INF partook in Athens trials (Egaleo stadium and Cosmote academy, 19-21 Oct 2020) and attended, communicated and reported Athens trials. It has been reviewing and done final editing of feasibility tests reports and corresponding videos editing (for communication/publishing).

12-NOK prepared and conducted internal feasibility tests for Use Case 3 in Oulu Nokia premises. This was done due to Covid-19 restrictions. A report was created from feasibility tests. NOK did follow other feasibility tests in UO. NOK created and presented material of the Nokia's feasibility tests during August 27-28th, 2020 in Nokia premises for project partners. It also analyzed and participated to Athen's and Eurocom's trials planning and presentations.

13-RXB has had interactions for all feasibility tests and leading the efforts towards flight planning, safety assessment and trial coordination. RXB has had an active role in trial planning and execution

for X-Network, 5GTN, and 5GENESIS Athens tests, and active role in planning, coordination and execution of EUR 5G-EVE trials, an active role in trial data analysis and results publishing, and an active role in discussions related to simulation platform for trial execution.

14-EUR field test are delayed due to the Covid-19 restrictions. EUR has worked to test the 5G-EVE platform using its own drones. It has also done preparation of the 5G-EVE facility to run 5G!Drones UCs.

Deviation and corrective action:
Due to the Covid-19 situation EUR was not able to host and start the trial feasibility tests.

15-DRR took part in trial preparation discussion. It did functional tests preparation based on use cases. It has reviewed the finished feasibility tests results from the integration aspects perspective and participated in resulting conclusions and brainstorming work. DRR has done Athens use case preparation. It partook in telemetry integration design – discussions on integration with FRQ systems. It did FRQ DRR Telemetry integration for Athens use case along with software development and integration tests.

16-CAF did preparations and participated in Athens feasibility tests in June 2020. CAF applied and acquired a license from Traficom for using drones with onboard 5G smartphones in Finland. It performed real flights and tests using C2 software worked in NCSRD server for preparing for Athens remote feasibility tests. CAF participated and contributed to the dedicated meetings on Finland feasibility tests in June and August 2020. CAF prepared for Aalto feasibility test and led these tests which were held on 24 August 2020. CAF did preparation for UO feasibility tests and led these tests which were held on 27-28 August 2020. CAF has collected feedback and compiled reports and analyses of Finland feasibility tests (conducted in August 2020). It integrated the C2 and Video Streaming Server applications for Athens physical feasibility tests in October 19-21, 2020. CAF made preparations for Athens physical feasibility tests in October 2020 (trials planning and prepared Hardware and software components) and conducted Athens physical feasibility tests in October 2020 with NCSRD, HEP, INF, MOE, COS, and RXB. CAF has collected feedback and compiled reports and analyses of Athens feasibility tests (conducted in October 2020).

17-FRQ made contributions to overall preparations and coordination for Athens feasibility tests. It had active participation in preparation calls, did UTM telemetry integration for Athens trials with multiple partners, and remotely supported the Athens feasibility tests.

18-OPL has been monitoring the Task activities. It has held discussion with CAF of OPL comments to initial documents. OPL has made analysis and comments to the test site feasibility testing. OPL participated in feasibility tests preparations and debriefing sessions. It made a review of the trial reports and prepared remarks on it.

Deviation and proposed action:
Due to the Covid-19 situation and related ban of travels, OPL was unable to participate physically in field trials, no remedy possible at the moment.

19-MOE contributed on the initial performing trials with drone emulation (as a response to Covid crisis). It did Athens feasibility tests preparation (Egaleo stadium, 19-20 Oct 2020), and organised, attended, and reported Athens feasibility tests.

Deviation and corrective action:
Due to Covid-19 situation physical feasibility tests were postponed to October.

20-ORA has conducted uplink interferences measuring methodology testing and it has been preparing for interference measurement tests during the Reporting Period.

8.5. WP5 Dissemination, standardization and exploitation

8.5.1. Progress towards objectives and details for each Task

WP Objectives

This WP contributes towards the following high-level project Objectives

- Objective 8: **"Dissemination, standardization and exploitation of 5G!Drones"**

For these to be attained, the following specific objectives will be pursued within this WP:

- Communicate project outcomes to a wide audience
- Showcase the activities and results of the project in large events
- Disseminate results to industrial and academic communities, as well as standardization and regulatory bodies
- Cross-fertilize within 5G-PPP and beyond
- Exploit the results of the project by various means: Improve 5G facilities, provide recommendations for the 5G system, improve UAV products to take full advantage of the 5G potential, etc.
- Produce and manage intellectual property and perform activities towards commercialization.

WP Tasks and interrelations:

- T5.1: Communication activities (M1-M42)
- T5.2: Standardization, exploitation and IPR management (M1-M42)
- T5.3: Showcasing and dissemination activities (M1-M42)

Main Progress in the period:

WP5 is running in conformance with the plans developed in D5.1 released at M6:

- 5G!Drones Social media channels and Website is up and running.
- Social Media channels and Website are constantly updated with latest project news, papers, presentations, articles, trials and events.
- The «News» section of the website is regularly updated with news and more detailed content (compared to the shorter social media posts).
- Statistical Dashboards are produced on a monthly basis for 5G!Drones Website, Twitter, LinkedIn, Facebook and Instagram.
- All Public submitted deliverables are available for downloading at the 5G!Drones website.
- 5G!Drones members have established a complete landscape of the standards Development Organization (SDOs) as well as various associations relevant within 5G!Drones.
- 5G!Drones partners are contributing to or are following various standardisation activities that are reported in D5.3.
- 5G!Drones partners have exposed their strategy to contribute to or go on contributing to SDOs and organisation in the next period.
- 5G!Drones partners are involved in various dissemination activities that are carefully stored for being reported in D5.2 scheduled on M23.

Significant results

Deliverable D5.1 – Communication, showcasing, dissemination and exploitation plan and standardization roadmap was submitted on M6 of the project. 5G!Drones has been very active in presentations at various events of 5G and UAV fora.

Deliverable D5.3 - Report on contribution to standardization and international fora – 1st Version has beeb released at M18 and will be updated in the next version so called D5.4 and scheduled M42.

Deviations from Annex I and impact on other Tasks, available resources and planning

With the Amendment 2 of the project NOK shifted additional seven PMs to WP5.

8.5.2. Task 5.1 Communication activities (M1-M42) [INF]

Task Objectives:
The main objective of this Task is to devise and deploy a sound communication strategy plan, required to make the project achieve maximum visibility and to maximize the impact within the business and scientific communities, so to guarantee a fast dissemination and adoption of the project outputs. Planned activities will be monitored throughout the project lifetime and periodically amended, so to ensure long-term effectiveness and attainability. Communication activities will target related markets and industries with the objective of fully exploiting the novel business opportunities that are raised from related market activities and business functions. To this Task belong activities such as setup of a public website, file sharing and collaboration tool, keep social channels/networks updated, and communicate project achievements to the broadest possible audience through events, conferences, etc. This Task will also rely on facilities offered at 5G PPP programme level to communicate (e.g. 5G PPP newsletter).

Task Activities during the period:
Task 5.1 keeps up coordinating effectively the 5G!Drones communication activities while running, updating, and monitoring the 5G!Drones communication channels namely the 5G!Drones website (**www.5gdrones.eu**) and social media channels (in Twitter, LinkedIn, Facebook, Instagram, YouTube) with activities, news, posts focused on project activities/achievements/results as well as resharing public articles related to 5G, drones and 5G!Drones use cases for raising general public awareness. Quarterly newsletters are published on time (**https://5gdrones.eu/newsletter/**), leaflets, posters (**https://5gdrones.eu/wp-content/uploads/2020/06/5GDrones-Leaftlet-DL6.pdf**) and stickers are constantly used to supplement the performed communication activities. As per the 5G!Drones communication plan/strategy (D5.1), all channels are intensively used on a regular basis for communicating project's activities and achievements to the project's audience and the general public.

In specifics, during the Reporting Period (June 2020 – early November 2020) the following communication activities have been performed:
- 5G!Drones "Communication and Dissemination" web pages updated with 40+ activities
- 50+ posts added in the 5G!Drones website "News" page
- 1880+ website visitors
- 8000+ website hits
- 250+ new posts published in social media channels
- 1125+ Total Followers in LinkedIn, Twitter, Facebook and Instagram (June 2019 - Oct 2020)
- 283 New Followers in social media channels (June-Oct 2020), +33% increase in 5 months
- 53 Total Subscribers in 5G!Drones YouTube channel
- 2 new videos released in YouTube 5G!Drones channel
- 2 Newsletter issues published (Issues 4 and 5)
- 1 Newsletter issue under editing (Issue 6)
- 4 public documents related to 5G!Drones performed trials released
- 25 monthly statistical dashboards released (internally)
- 50+ leaflets distributed during trials (limited number of participants allowed due to Covid-19 restrictions)
- 50+ stickers distributed during trials (limited number of participants allowed due to Covid-19 restrictions)

In parallel, monitoring mechanisms for evaluating the channels performance are used on a monthly basis (Monthly Data Studio Statistical dashboards are issued for the website and social media channels, refer to Section 8.5.1.1 for more details on the Reporting Period statistical dashboards). Also tracking processes are maintained (in the MS Teams repository) that allow all partners to formally document their performed activities which are then used as communication content for the 5G!Drones communication channels.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are:

1-UO had no reported effort during between June and September due to Covid-19. During the rest of the Reporting Period UO attended as an invited speaker and a participant in 5G-PPP workshop "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" on 14 October, 2020. UO also participated and brought forth 5G!Drones relevant topics in the Traficom 5GMomentum event: Connectivity for Drones Forum on 2 Nov, 2020.

Deviation and proposed corrective action:
Due to Covid-19 all planned communication activities were between June and September.

2-THA has had internal communication of work and results of the project to Research & Technology as well as Business communities of concern. Otherwise, it has had no planned activity on this Task during the Reporting Period except following work and advising whenever needed.

3-ALE has had no planned activity in this Task during the Reporting Period.

4-INV has reviewed draft article "The EU Funded 5G!Drones Research Project Is Testing, Validating, and Defining KPIs for the Future of the Drone Industry" for Commercial UAV News and had related correspondence with the journalist on the matter. It has done social media publication and follow-up. INV has had various exchanges on the participation to Commercial UAV Europe Amsterdam and it conducted a review of 5G!Drones newsletter Issue 5 and 6.

5-HEP does not partake in WP5.

6-NCSRD participated in 6G Flagship white papers on 6G business, reporting the drone vertical perspective. NCSRD as 5G!Drones partner co-organised with 5GENESIS project the workshop "5G Trials in Europe" granted also the support of the 5G-IA/5G-PPP. NCSRD communicated this workshop at EC as well: **https://cordis.europa.eu/article/id/422451-5g-trials-in-europe-online-workshop-on-14-october-2020/fr**. NCSRD communicated the second 5G feasibility trials in Athens via the NCSRD social media channels and its newsletter
-   **https://www.youtube.com/watch?v=Shtk6azFwNk**
-   **https://mailchi.mp/3e9ed2da4eba/newsletter-iit-ncsrdemokritos-august-october-2020**.
NCSRD communicated via its YOUTUBE channel the 5G!Drones presentation in "5G Trials Workshop" **https://www.youtube.com/watch?v=yCpf8GH7KxI**.

7-AU: In order to promote the activities of 5G!Drones, AU has updated its web site and promoted the feasibility test conducted at X-Network trial site of the university on 24th August 2020. In 2 November 2020, AU performed an internal presentation to the research units of its department to promote the activities and the achievements of 5G!Drones.

8-COS had no planned activity on the Task between June and September. During the rest of the Reporting Period COS prepared and participated in the Commercial UAV News Interview Q&A article and prepared and issued the 5G!Drones article to be published in the Greek Telecom National Regulation Authority (EETT) magazine.

9-AIR has done supervision of the Task as WP leader. It started division level communication plan initiative to promote drone usage for mission critical services. AIR made an internal presentation of 5G!Drones first year result at engineering manager staff. It has also had involvement in 5G-PPP project brochure for 2021 issue.

10-UMS has had no planned involvement in this Reporting Period in this Task.

11-INF as the Task leader coordinated T5.1 activities. It has been running the project website and News section (updates, content creation, news, posts, uploads), running all social media accounts (Twitter, LinkedIn, Facebook, Instagram, YouTube) - updates, posts, reply to comments, developing of monthly statistical dashboards for monitoring the performance of web site and social media (June, July, August), maintaining in Teams the communication activities repository, editing and releasing newsletter issue No 4 (March-May) at the middle of June, No 5 (June-August) at the middle of Sep, and No 6 (Sept-Nov) (to be released 1st half of December). INF has also communicated 5G-PPP newsletter and newsflash and tagged 5G-PPP in all our communication activities. It has prepared annual (Y1) statistical dashboards of all communication channels (M1-M12), reviewed preparation internal activities, prepared T5.1 reporting and presentation slides for Y1 review, produced review and its preparation of T5.1 presentation. INF has been monitoring all running Tasks of the project for reporting and communicating activities and results. It prepared a Special statistical dashboards development for D6.3 (June 2020 - October 2020 period) and attended Athens feasibility tests, distributing communication material (leaflets and stickers), creating content (photos, videos), and communicating performed activities over website and social media.

12-NOK has had only minor effort, mostly following and shared project related information inside NOK and other social channels. It has produced sharing material for Nokia article related to UAV and UAS.

13-RXB has made active communication on website and social media, active contributions with presentations in several conferences and international forums, contribution to D5.3, and participated in WP5 planning call and 1st year review meeting preparation calls. It has edited photos and videos for Finland feasibility tests and coordinated with CAF for publishing the video. RXB has communicated 5G!Drones activities on LinkedIn and Twitter on several occasions during this period.

14-EUR has had no planned involvement in this Reporting Period in this Task.

15-DRR does not partake in WP5.

16-CAF has done communication activities on CAF website regarding June 2020 remote feasibility tests in Athens. It made media planning for feasibility tests in Aalto and Oulu in August 2020 and it has communicated activities (video recording, taking photos and editing photos and videos and publishing) regarding Feasibility tests in August 2020 in AU and UO. CAF has compiled photos and edited videos and figures and text for news about Finland Feasibility tests (conducted in August 2020) and communicated Finland feasibility tests (August 2020) on website and LinkedIn. It has also compiled photos and edited videos and figures and text for news about Athens Feasibility tests (conducted in October 2020), and communicated Athens feasibility tests (October 2020) on website and LinkedIn.

17-FRQ made a review of 5G!Drones Newsletter Issue #5. It has made updates about 5G!Drones project on social media and preparation & Interview with Commercial UAV News.

18-OPL and *19-MOE* do not partake in Task 5.1.

20-ORA has had no planned involvement in this Reporting Period in this Task.

8.5.3.   Task 5.2 Standardisation, exploitation and IPR management (M1-M42) [AIR]

Task Objectives:

This Task is mainly focusing on three activities:

- Contribution to standards bodies,
- IPR management, and
- Commercialisation activities

First, this Task will contribute to various standardization bodies. The contributions to standardization will ensure that the research outcome of 5G!Drones will obtain broader recognition and also its results are utilized by a wide industry community. The consortium members have long history of standardization experience in various standardization bodies including ITU-T, IETF, IRTF, ETSI and 3GPP. For instance, **AIR, ORA, NOK, and THA** are contributing to ITU-T, IETF ETSI and 3GPP working groups. These partners will disseminate the results of 5G!Drones within these standards development bodies and support the translation of key results into potential recommendations. Partners representing the UAV ecosystem will be contributing to UAV-relevant standards bodies (e.g., ISO/TC 20/SC 16 Unmanned aircraft Systems, NASA's Unmanned Aircraft System (UAS) Traffic Management (UTM) ecosystem, EUROCAE Working Groups on Unmanned Aircraft Systems (UAS), and RTCA). **AU and UO** will also determine standardization opportunities for the findings of the 5G!Drones project and launch pre-standardization research groups, study groups and/or working groups in the areas of the project under IEEE Standards Association and IEEE IoT Community. Standards' relevant results of the project will be also promoted within the IEEE Conference on Standards for Communications and Networking, founded by **AU**. **FRQ** is a member of several relevant international fora, which focus on bringing industry, research and end-users together. Examples are the PSCE (Public Safety Communications Europe), the EENA (European Emergency Number Association), the British APCO, and the TCCA Tetra and Critical Communications Association. In several of these fora, **FRQ** is providing an official role such as chairing a workgroup. In addition, the active involvement of consortium members in the standardization process will bring their knowledge of standardization to the project and make the consortium aware of any standardization results that can be applied to the project. WP Leaders will monitor the respective R&D activities in 5G!Drones and stimulate the standardization of their outcomes. This Task involves a continuous awareness of possible standardization opportunities and development within relevant standards identified during proposal preparation. This Task will also take advantage of the 5G-PPP Pre-standardization Working Groups active at 5G IA level and so liaise with it.

Second, this Task will be focusing on management of IPRs. Intellectual property (IP) management is important to safeguard investment from the partners but also to maximize commercial exploitation the potential of the resources invested in the project. ***IPR will be protected by an agreement, in alignment with the policies and context for EU funded projects***, that specifies how and under which conditions partners get access to existing and created IP owned and generated by other partners and specifies the conditions of access to such IP in the case of exploitation beyond the scope and duration of the project. The agreement will cover specification and handling of the types of intellectual properties, mechanisms to identify and to brand them and definition of the roles of the partners and the individual usage rights of the intellectual properties. A Consortium Agreement (CA) based on the EICTA (European Information, Communications and Consumer Electronics Technology Industry Association) model will be signed between all partners before the start of the project, specifying among other things the internal organization of the consortium reflecting rules for dissemination, internal disputes settlement and IPR arrangements.

Third, this Task will be also focusing on the exploitation of project results. It will be focusing on three primary goals:

- **Sustainability.** The project's efforts will be made sustainable in the immediate term beyond the project's lifetime. This will ensure that exploitation of the project's results can be made

smoothly towards the end of the project and will continue after the project's funding period ends.

- **Exploitation of results.** The project's results, particularly those that fulfill the objectives as described in Section 1.1, will be directly exploited by the consortium and individual partners.
- **Long-term viability.** Long-term exploitation of objectives will be explicitly considered in view of the market. For this purpose, this Task will be focusing on the creation of both partner-level and consortium-level exploitation plans. Moreover, it will include an impact assessment that prioritizes the highest-impact exploitation methods. Based on these results, post-project business plans will be generated. In addition, this Task will organize workshops inviting a range of target stakeholders that will provide feedback and assist in exploiting the project results in the best possible way.

Task Activities during the period:

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

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

These activities have been reported in D5.3 issued end of M18.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are as follows.

1-UO had no reported effort between June and September ETSI SmartBAN standaridisation activities during the period were carried out using project external resources. After September, UO continued its contributions on ETSI SmartBAN#23 standardisation on Oct 15, 2020. It also submitted a patent application "METHOD FOR ESTABLISHING RELAY CONNECTIVITY IN ETSI SMARTBAN" for the European Patent Office on Nov 4, 2020. UO also provided contributions to D5.3 regarding SmartBAN standardisation.

2-THA has followed standardization activities of RAN2 and RAN3 Working Groups and it follows closely the evolution of standardization. It has studied on enhancement of RAN slicing for NR.

3-ALE had no planned activity in the Task between June and September. After September, it made a contribution for D5.3: Chapter about BNAE and Drone REGIM.

4-INV has introduced new INV members to ACJA work. It participated to ACJA monthly general assembly meetings and Work Task 2 "Supplemental Data Service Provider (SDSP) to Mobile Network Operators (MNOs)" meetings. INV has been reviewing and commenting documents submitted by ACJA: TS 22.125 "Unmanned Aerial System (UAS) support in 3GPP" 3GPP liaison statement. It has participated in ASTM standards working committee on the topic of SSDPs (supplemental service data providers) – once per week; preparation of the same as co-lead of the working group and participated in Remote ID activities, including on the development of drone trackers based on ASTM standard. INV participated in AVISTRAT-CH meetings to work out the new strategy for Swiss aviation industry

including drone requirements. INV has made contribution for D5.3 – writing the chapter about GUTMA, contributing to chapters about ACJA and ASTM, and giving the future plans of INV's involvement in these organisations. It has reviewed and made corrections to consolidated D5.3 document. Finally, INV attended RTCA Webinar: Modernizing the NAS.

5-HEP does not partake in WP5.

6-NCSRD does not partake in Task 5.2.

7-AU had no planned activity in the Task between June and September. After September it has been contributing to the deliverable D5.3, reviewing it and checking if there are suitable standards groups on UAVs within IEEE Standards Association.

8-COS has had no planned involvement in this Reporting Period in this Task.

9-AIR is the Task leader. It has contributed to 5G-PPP SDO Impact Survey Technical Support and to SA6 FP-UAS discussions. AIR has initiated D5.3 as main editor for reporting standardisation activities of 5G!Drones consortium during this first period from M1 to M18. AIR has contributed to 5G-PPP 6G and B5G survey completion, to discussions within 3GPP, and it is establishing a bridge between the project's IMT and 3GPP. AIR was main editor for D5.3 for reporting standardisation activities of 5G!Drones consortium during this first period from M1 to M18.

10-UMS has had no planned involvement in this Reporting Period in this Task.

11-INF is not partaking in Task 5.2.

12-NOK has participated in Remote ID activities. It has workshopped with NOK CEPT/ECC SE21 delegate related for Drone usage at TRP measurements and observed "Service performance measurement methods over 5G experimental networks White paper – ICT-19 performance KPIs" 5G-PPP TMV TF creation. NOK kept internal standard workshop related to SA REL17, ACJA WT1/WT3, NR UAV Rel 18. It contributed to several chapters in D5.3.

13-RXB has had active participation in ASTM F38 committee as a voting member and contributed to meetings and ballots and attended meetings. It has active involvement with agencies such as NASA, SESAR JU, and EUROCONTROL. RXB has contributed to ACJA MOPS and its discussions – multiple meetings with GUTMA & GSMA members.

14-EUR has made preparation of a contribution based on MEC LORA for ETSI MEC group. It contributed to the deliverable D5.3 on MEC standardisation.

15-DRR does not partake in WP5.

16- CAF has contributed to 5G-PPP Security WG whitepaper and contributed to 5G-PPP Automotive WG regarding standardisation topic – How to use V2X protocols for D2D (drone-to-drone) positions and direction sharing. It has been analysing and preparing standardisation activities overview for IMT meetings.

17-FRQ does not partake in Task 5.2.

18-OPL has provided support for AIR in preparation of documents for the project review. It had no planned effort on the Task between September and November.

19-MOE does not partake in Task 5.2.

20-ORA has made contribution to standardisation progress sections (3GPP, CEPT, GSMA, ACJA, and IETF) in the corresponding Deliverable D5.3.

8.5.4. Task 5.3 Showcasing and dissemination activities (M1-M42) [RXB]

Task Objectives:

During the runtime of this Task, the consortium partners will establish a showcasing and dissemination plan for presentation of the project results to stakeholders and public. First, we plan to set up an initial plan for showcasing and dissemination. The plan will be refined at M18. Results that seem to be relevant for the European industry will be advertised and made public for a deeper analysis of their commercial and sociological potential. Designated "public use" results will be shared with the public and made open source wherever it is possible. All partners will contribute to a frequent update of the project's dissemination channels: Website (to come online in M03), community forming platforms (Facebook, Twitter, YouTube, blogs), scientific publications, open access publications, conferences, topic-related community, open-source software, general media publications, exhibitions, etc.

The consortium partners will participate in large showcasing events related to both UAV (i.e. Amsterdam Drone Week, UAS TAAC Conference etc.) and 5G (i.e. 5G Summits, MWC etc.) to demonstrate the results of the project and the acquired 5G knowhow. Moreover, 5G!Drones targets publication in selected and high-impact journals and magazines on communications/networking (e.g. IEEE Communication Magazine, IEEE JSAC, IEEE Network, IEEE Internet of Things), and reputed international conferences (e.g. Globecom, ICC, WCNC, Infocom, EuCNC) as well as vertical-oriented publications (Journal of Unmanned Aerial Systems, International Journal of Intelligent Unmanned Systems). Finally, this Task will be focusing on organization, presentation and participation in the organization of events (e.g., panels, targeted workshops, workshops co-located with relevant conferences, special sessions) and participation in these same kind of sessions as keynote speakers, panelists, etc.

Furthermore, 5G!Drones will take advantage of 5G-PPP Programme to liaise and disseminate results to 5G-PPP or 5G-IA Working Groups of interest among which, (already mentioned) Pre-standardization, Architecture WG and Security WG.

Task Activities during the period:

During this Reporting Period, various partners participated and contributed to dissemination activities. One of the major activities to highlight was the "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" organized by NCSRD, as a part of the 5G-PPP workshop. During this workshop, UO also participated as a presenter and highlighted the work done by 5G!Drones project consortium. Besides this workshop, partners from ALE and RXB presented about 5G!Drones project. An international article dedicated to 5G!Drones project was published by Commercial UAV News[1] featuring various partners from the consortium. Partners from NOK, RXB, COS, FRQ, CAF, and UMS were featured in the said article.

NCSRD and COS have led the contributions towards IGI Global book titled "5G Networks and Advancements in Computing, Electronics, and Electrical Engineering" and chapter title "5G and Unmanned Aerial Vehicle (UAV) Use Cases: Analysis of the Ecosystem, Architecture and Applications". Partners from INV and RXB are also contributing to the efforts towards the book. There were also a number of research papers published by various partners during this period of the project.

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[1] **https://www.commercialuavnews.com/europe/5g-drones-is-putting-the-pieces-of-the-drone-ecosystem-together-to-make-sure-they-fit-and-can-deliver-value-to-stakeholders?fbclid=IwAR1_FZiG1PnCesS0ZmA5CImei_KcIFftPxOPeHY3tRbEW-obqketTKY15OE**

The discussions related to dissemination activities in InterDrone 2020 and Commercial UAV News conference are ongoing and RXB is leading the efforts by coordinating closely with the respective organisers.

The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are:

1-UO had no reported effort between June and September. During the rest of the Reporting Period UO attended the 5G-PPP SB virtual meeting and as an invited speaker in 5G-PPP workshop "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" on 14 Oct, 2020.

Deviation and corrective action:
5G-PPP SB telco meeting was not attended due to both main member and deputy being not available at the time. The project's Technical Manager, Pascal Bisson (THA) attended the meeting in UO's stead.

2-THA made a presentation of 5G!Drones to additional contacts at Business Level interested. It made a presentation of 5G!Drones to additional research lab within SIX GBU (i.e. ThereSIS/AI6). THA participated in 5G-PPP SB meeting in July in UO's stead.

3-ALE had no planned activity on the Task between June and September. It made a presentation of the 5G!Drones project during ALE keynote in the ICUAS 2020 conference and a presentation of the work of the UC3Sc1 Sub-Scenario 3 during a Hydreos conference.

4-INV had no planned activity on the Task between June and September. It has put info about 5G!Drones into updated commercial presentations and offers. INV has presented the project to private stakeholders, including Drone Industry Association Switzerland members.

5-HEP does not partake in WP5.

6-NCSRD did preparation of a paper reporting the NCSRD 5G-enabled drone setup to be submitted in a special issue related to 5G. It has had collaboration with COS for submitting a book chapter proposal related to 5G and Drones industry architectural integration. It edited the book chapter related to 5GDrones research advances. It prepared two research papers related to 5G-enabled drones.

7-AU has been working on three scientific papers related to 5G!Drones. The papers have been published in IEEE Transactions on Wireless Communications, IEEE Network Magazine, and IEEE Global Communication Conference 2020. It is also working on other scientific papers related to 5G!Drones activities. AU has been preparing the camera ready of an accepted paper to Globecom 2020.

8-COS had no planned activity on the Task between June and September. It has made an IGI Global book chapter preparation, "5G and Unmanned Aerial Vehicle (UAV) Use Cases: Analysis of the Ecosystem, Architecture and Applications," for the upcoming book, "5G Networks and Advancements in Computing, Electronics, and Electrical Engineering" together with NCSRD.

9-AIR is making supervision of the Task as WP leader. It is also acting as a liaison to 5GPPP Pre standardization WG. AIR has contributed to discussions within ACJA.

10-UMS had no planned activity on the Task between June and September. After, it reviewed and provided feedback on draft Commercial UAV News article and promoted the article posted by Commercial UAV News on 5G!Drones project within UMS's social media handles.

11-INF is maintaining in Teams the dissemination activities repository and excel tracking file. It is communicating dissemination activities via website and social media channels. INF is monitoring SME WG activities: contributing to the new SME web page and SMEs brochure, info on upcoming 5G-PPP activities, reporting to 5G!Drones consortium, preparing annual reporting on SME WG participation, and contributing to the new SME planning for Horizon Europe and SNS association structure. INF contributed to the co-organization of 5G online workshop among NCSRD partner, 5GENESIS project and 5G!Drones (14 Oct 2020). INF edited/prepared the 5G-PPP 5G!Drones brochure for future phase 3 projects publication and submitted it to 5G-PPP BSCW repository.

12-NOK had no planned activity on the Task between June and September. After, NOK contributed to Commercial UAV News with other partners, see:
https://www.commercialuavnews.com/europe/5g-drones-is-putting-the-pieces-of-the-drone-ecosystem-together-to-make-sure-they-fit-and-can-deliver-value-to-stakeholders.

13-RXB leads the efforts towards T5.3. It engages in active and ongoing discussions with organisers of InterDrone and Commercial UAV Expo (Amsterdam Drone Week) for possible dissemination activities. RXB lead the coordination with international journalist to publish dedicated international article about 5G!Drones project. It has had multiple collaborative calls with organizers of Commercial UAV expo to decide and discuss collaborative activities related to 5GDrones project. RXB contributed to the IEEE Vehicular Technology Magazine publication and coordinated with several partners from the consortium. It has been coordinating with InterDrone organisers for InterDrone 2020 exhibition. In the end, 5G!Drones participation as a project was cancelled, but RXB will participate as a member of the project.

14-EUR has submitted two papers on the activities we are conducting in WP1 and WP3. One paper on the architecture integrating U-Space and 5G to IEEE Vehicular Magazine, and another to IEEE Globecom on MEC-aware flight planification. The two papers have been accepted during this period. The first one is on the 5G!Drones architecture involving several partners of the project. We conducted the writing and submission process. It has been accepted in IEEE Vehicular Technology Magazine. The second one is on T3.2 topic. It has been accepted in IEEE Globecom 2020. A paper has been submitted to IEEE/IFIP IM 2021 on 5G RAN Slicing.

15-DRR does not partake WP5.

16-CAF did preparation and presentation of 5G!Drones project feasibility tests results to 5G-PPP Automotive Working Group. It has participated in 5G-PPP 5G-Automotive WG bi-weekly meetings and introduced 5G!Drones project main activities to it.

17-FRQ has made an informal presentation of the 5G!Drones project at ESA/Telco - Project RPAS-HAPS. It also reviewed and provided feedback on draft Commercial UAV News article.

18-OPL presented conference papers at IAIA 2020/5G-PINE, ICC 2020, IFIP Network 2020, and NetSoft 2020. OPL had no planned effort on this Task between September and November.

19-MOE has been updating and communicating dissemination activities via website (www.aigaleo.gr) and social media channels of MOE regarding the feasibility tests in Egaleo stadium in 19 & 20 October 2020.

20-ORA does not partake in Task 5.3.

8.5.1. Exhaustive list of dissemination and exploitation activities performed between M13 and M18

This subsection describes the dissemination and exploitation actions carried out during the Reporting Period. Social media dashboards are only available up until the end of October 2020 at the submission of this deliverable. An exhaustive description of standardisation activities is reported in Deliverable D5.3 with delivery due in M18.

8.5.1.1. Social Media

The 5G!Drones project tracks its social media impact on a monthly basis. The project social media links have been defined in Deliverable D5.1. In the following, an overview of the various social media channels is shown during the period from June 2020 to October 2020 (reporting also November is not feasible as its statistics will be available only after the submission of this Deliverable). The overviews are in a form of dashboard reports. They are live data updated regularly. The Website, Twitter, Facebook, LinkedIn, and Instagram use statistics are illustrated in Figure 2, Figure 3, Figure 4, Figure 5, and Figure 6, respectively.

The 5G!Drones project has established its official website available at **www.5gdrones.eu,** serving as a portal where informative details and relevant 5G and drone data are published, sustaining the ICT-19 project's scope across multiple vertical industries. The Website dashboard data regarding Figure 2 can be found at **https://datastudio.google.com/reporting/d5560db2-9828-4b4a-b104-d75f5bc84241**.
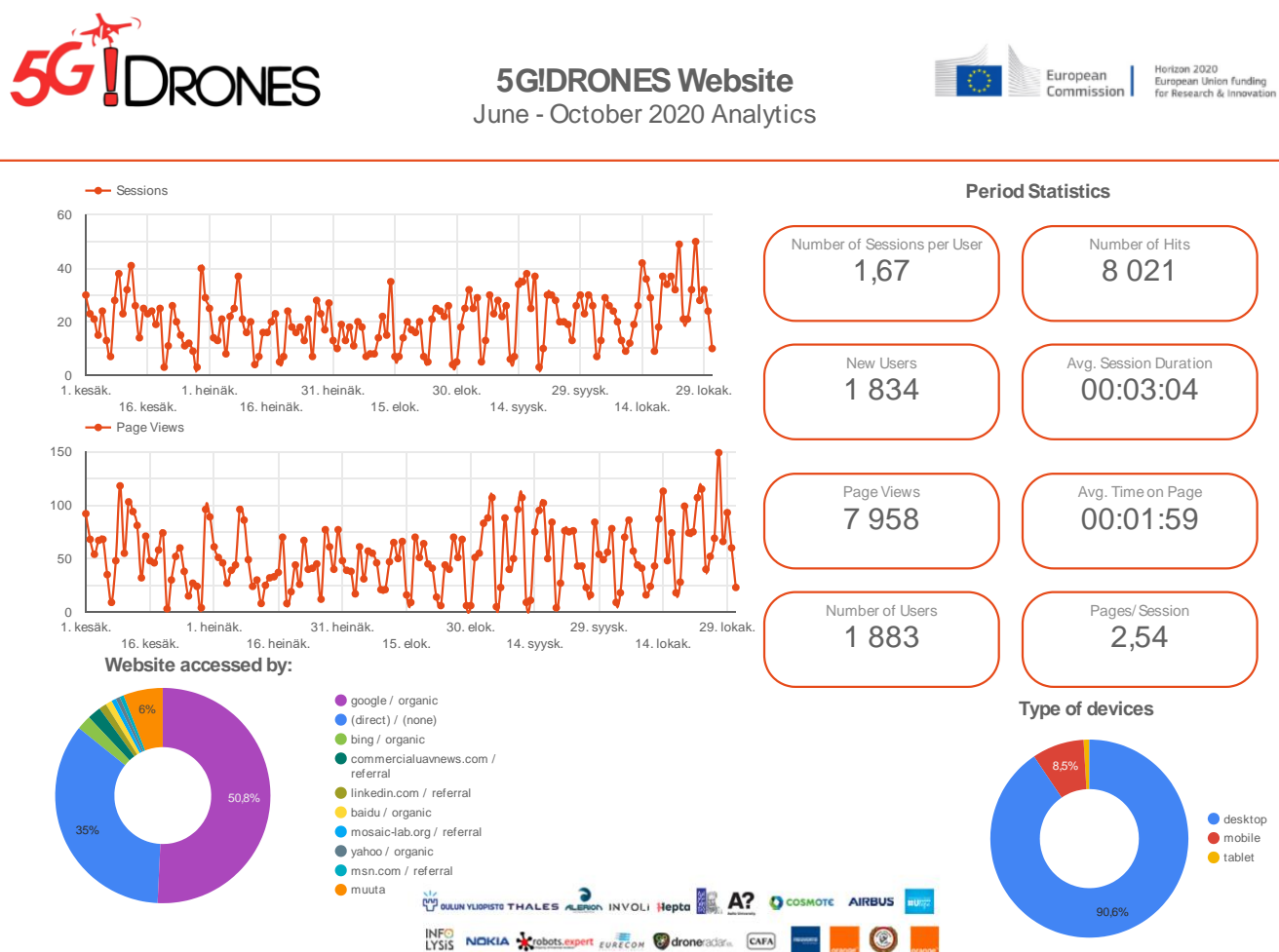
Figure 2: 5G!Drones Website Statistics/Dashboards, June 2020 – October 2020.

5G!Drones is present in all popular social media networks. In specific, the following 5G!Drones social media accounts are open and have been actively used since the beginning of May 2019: Twitter, LinkedIn, Facebook, Instagram, and YouTube and their access links are the following:

Twitter:	**https://twitter.com/5gdrones**
LinkedIn:	**https://www.linkedin.com/in/5gdrones/**
Facebook:	**www.facebook.com/5gdrones**
Instagram:	**https://www.instagram.com/5gdrones_project/**
YouTube:	**https://www.youtube.com/channel/hPj4gQ5P5go7Fer6NJxGOQ**

5G!Drones social media posts are oriented towards promoting the project's news as well as the dissemination activities in which the partners participate. Dissemination activities cover a wide spectrum of events, publications, presentations, workshops, demonstrations, call for papers and other relative activities communicated via the social media accounts. The Twitter dashboard data regarding Figure 3 can be found at **https://datastudio.google.com/reporting/936ac777-145c-442b-a9e5-a1c4a380a5db**.
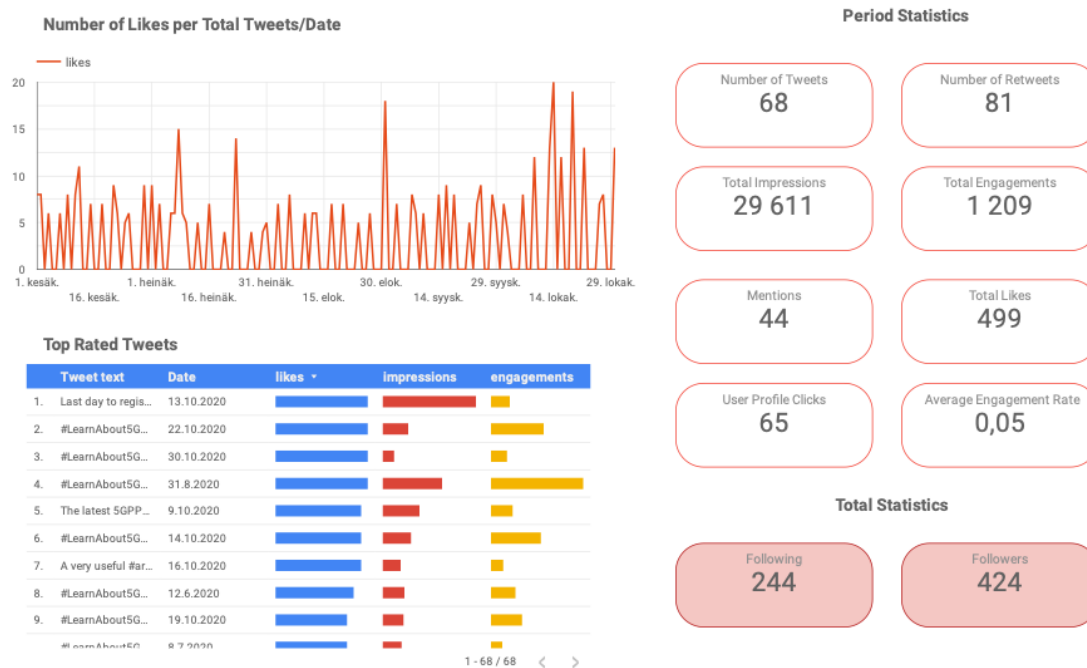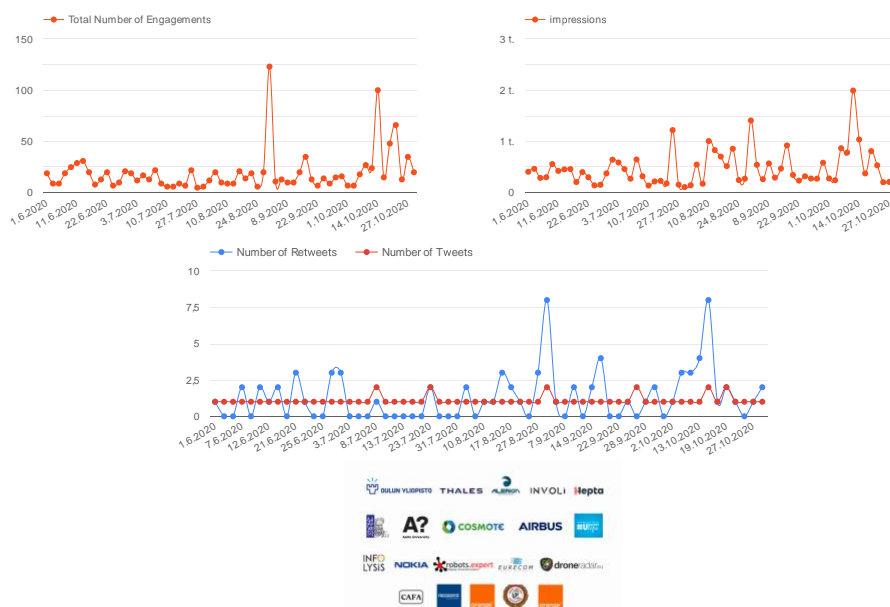
**Figure 3: 5G!Drones Twitter Statistics/Dashboards, June 2020 – October 2020.**

In the 5G!Drones Facebook profile page users can find the latest 5G!Drones posts, get informed on the latest news of the project and send an immediate message to the 5G!Drones team. The Facebook dashboard data regarding Figure 4 can be found at **https://datastudio.google.com/reporting/92c2f190-e577-4efe-9f63-110bf83b9eb3**.

5G!DRONES Facebook Dashboard
June - October 2020 Statistics

Page views

Period Statistics

Posts	Page Views
61	209
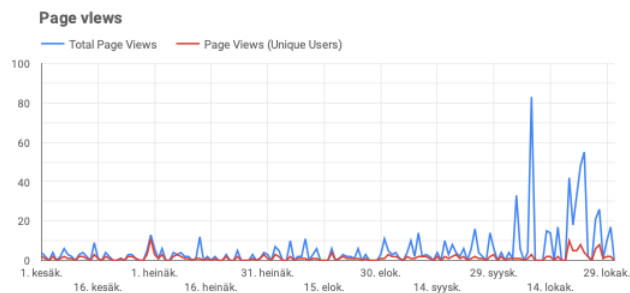
Engagements	Total Reach
987	6 009
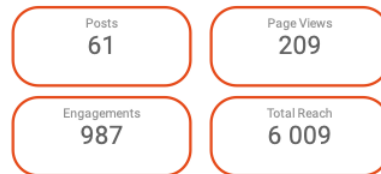
Top Rated Dates in Activity

	Date	Engagements	Reach	Total Page Views ▾
1.	9.10.2020	9	28	83
2.	23.10.2020	27	171	55
3.	22.10.2020	70	390	48
4.	19.10.2020	168	951	42
5.	5.10.2020	1	9	33
6.	21.10.2020	26	174	33
7.	27.10.2020	30	70	26
8.	26.10.2020	21	69	21
9.	20.10.2020	53	474	18

1 - 100 / 153

Total Statistics

Total People Likes	Total Reach
140	14 789

Page Followers	Posts
148	217

5G!DRONES Facebook Dashboard
June - October 2020 Statistics

People Reached per Date

Post Engagements (Likes, Shares, Comments) per Date

Page Likes and Unlikes per Date
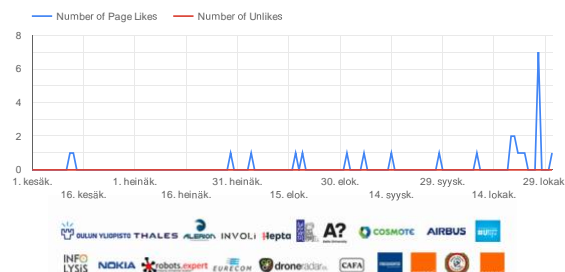
Figure 4: 5G!Drones Facebook Statistics/Dashboards, June 2020 – October 2020.

There is a short bio of the project including its objectives and quantitative details in the official 5G!Drones LinkedIn profile. The audience can easily check the latest project posts and communicate

directly with the 5G!Drones team in case of any queries. The Linkedin dashboard data regarding Figure 5 can be found at **https://datastudio.google.com/reporting/c7be4954-2a54-4dad-8a0a-918076d61eca**.
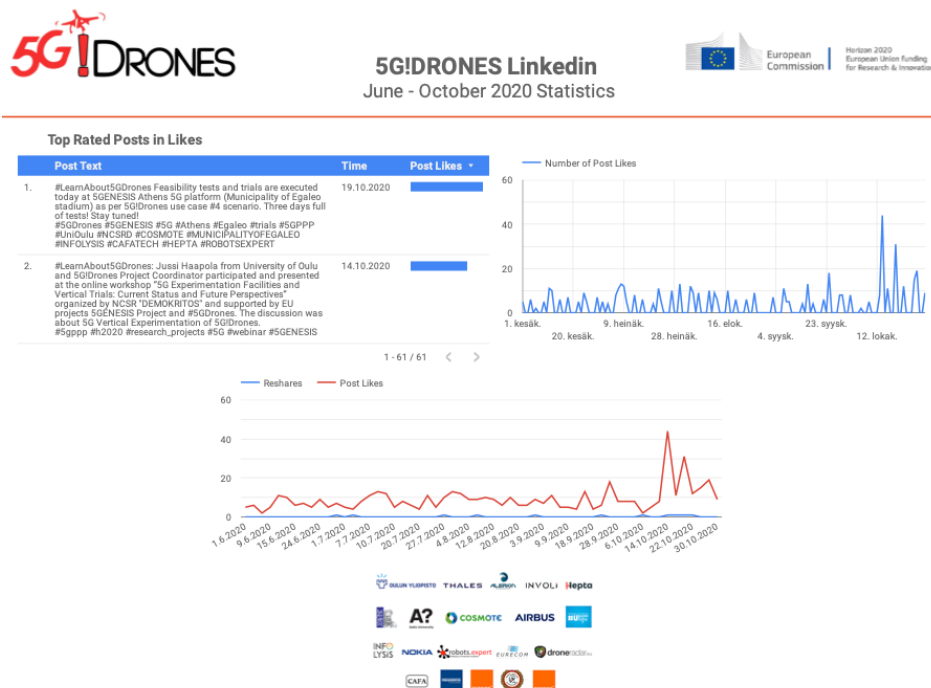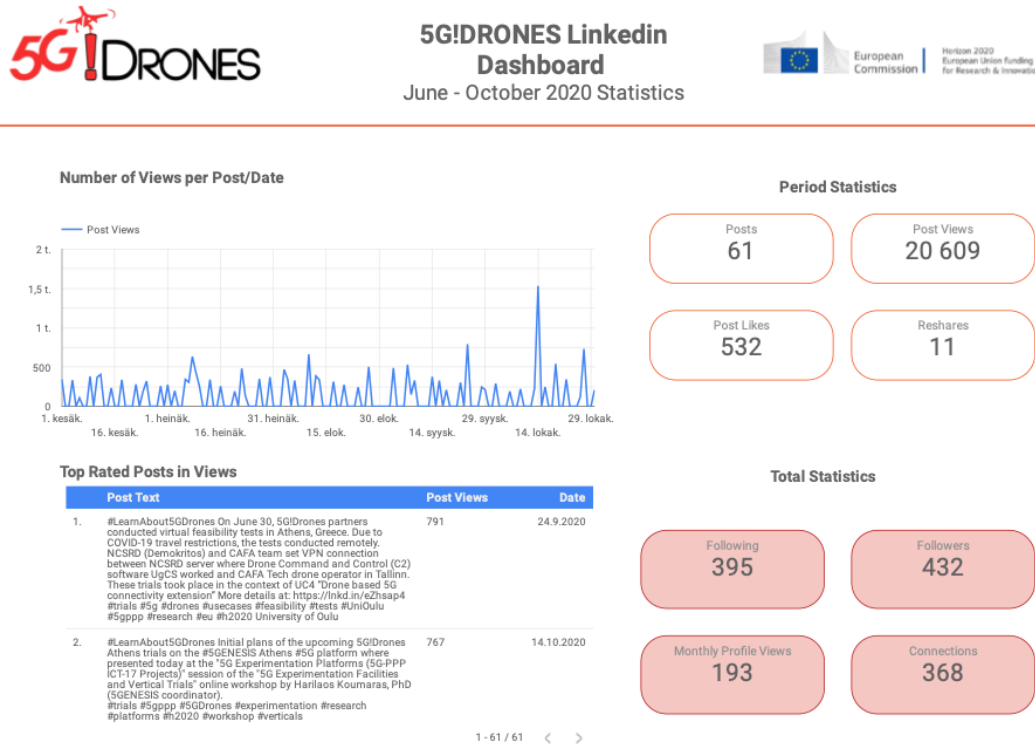
**Figure 5: 5G!Drones Linkedin Statistics/Dashboards, June 2020 – October 2020.**

In the official 5G!Drones Instagram profile and posts/pictures, users can be also redirected to the official 5G!Drones website when clicking on the relevant link included in the profile page. The Instagram dashboard data regarding Figure 6 can be found at **https://datastudio.google.com/reporting/8d5f7b8b-0b02-4ffe-b41f-2332ca9b1e36**.
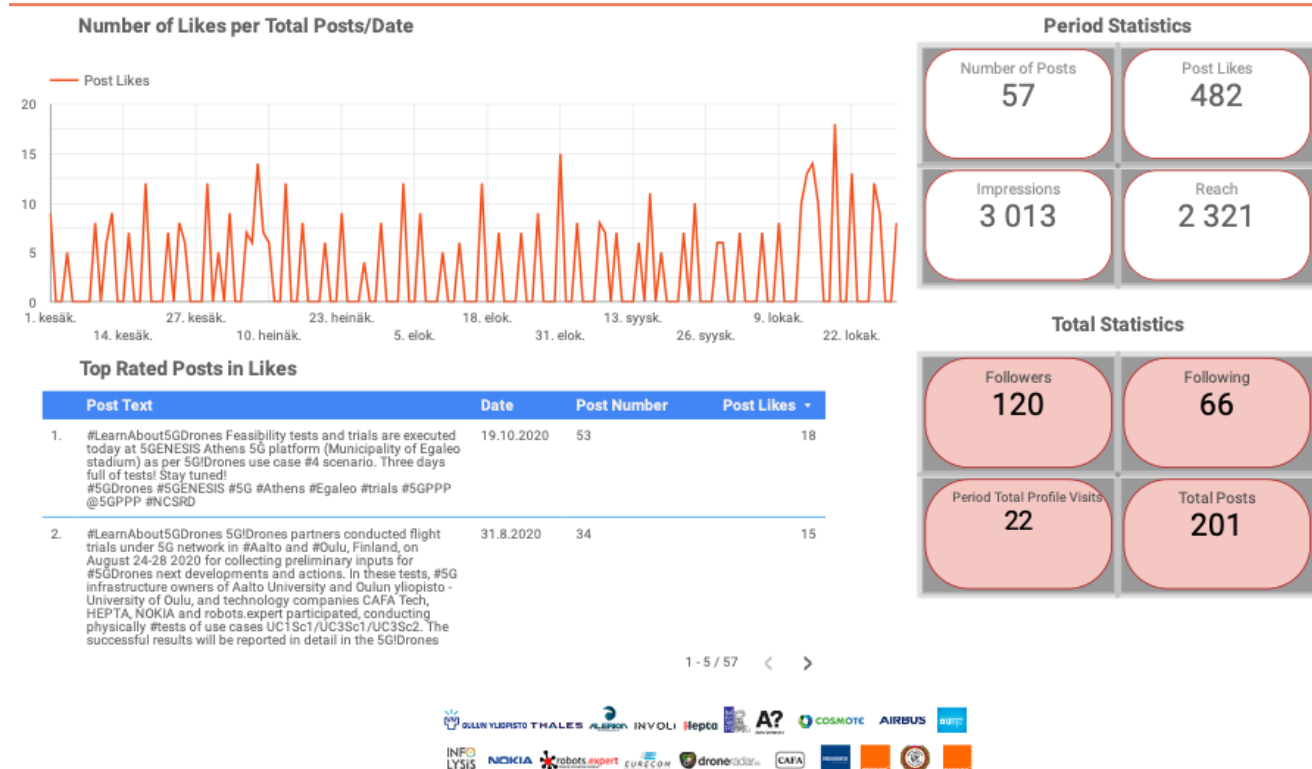
Figure 6: 5G!Drones Instagram Statistics/Dashboards, June 2020 – October 2020.

The project also published newsletters. During the Reporting Period (M13 – M18), two newsletters have been published and one is almost ready to be released. They are available on the project website at **https://5gdrones.eu/newsletter/**.

8.5.1.2. Dissemination and exploitation activities

The specific WP5 dissemination and exploitation activities during the Reporting Period (M13 – M18) are listed in more detail in Table 6. The table describes the authors and Partners involved, the title of the activity, the target of the activity, and a brief description of the activity. It needs to be noted the Table 6 does not list some of the planned activities as the Covid-19 pandemic has caused events to be cancelled, postponed, changed as virtual events, or changed form in such a fashion that dissemination and exploitation is not feasible.

Table 6: 5G!Drones table of dissemination and exploitation activities

#	Authors / Partners	Activity Title	Target (Event, Location, Date)	Description
1	Trials	Athens trials 4	Athens trials, 30 June2020 (NCSRD, CAFA Tech, COSMOTE and Unmanned Life)	On June 30, 2020 5G!Drones partners NCSRD (located in Athens, Greece), CAFA Tech (located in Tallinn, Estonia), COSMOTE (located in Athens, Greece) and Unmanned Life (located in Brussels, Belgium) conducted virtual feasibility tests related to 5G!Drones Use Case 4 "Drone based 5G connectivity extension" scenario. Due to COVID-19 travel restrictions the tests were conducted remotely.
2	Orange Poland and DroneRadar	5G-UASP: 5G-based multi-provider UAV platform architecture	IEEE Conference on Network Softwarization, 29 June – 3 July 2020 (Virtual Conference)	A 5GDRONES Project related conference paper entitled 5G UASPP: 5G-based multi-provider UAV platform architecture", has been accepted at IEEE Conference on Network Softwarization, 29 June – 3 July 2020 (Virtual Conference). Read the paper at: https://5gdrones.eu/wp-content/uploads/2020/05/Multi-provider.pdf
3	Orange Poland and DroneRadar	On 5G support of cross-border UAV operations	Workshop on Integrating UAVs into 5G and Beyond in IEEE International Conference on Communications, 7-11 June 2020 (Virtual Conference)	A 5GDRONES Project related conference paper entitled "On 5G support of cross-border UAV operations" has been accepted at Workshop on Integrating UAVs into 5G and Beyond in IEEE International Conference on Communications, 7-11 June 2020 (Virtual Conference) . Read the paper at: https://5gdrones.eu/wp-content/uploads/2020/05/Cross-border.pdf
4	Article - Interview	The EU Funded 5G!Drones Research Project Is Testing, Validating, and Defining KPIs for the Future of the Drone Industry	Involi, DroneRadar and Robots.Expert partners interviewed by Danielle Gagne, Commercial UAV News Editorial Analyst	"The EU Funded 5G!Drones Research Project Is Testing, Validating, and Defining KPIs for the Future of the Drone Industry", Involi, DroneRadar and Robots.Expert partners interviewed by Danielle Gagne, Commercial UAV News Editorial Analyst: https://www.commercialuavnews.com/infrastructure/5g-drones-is-testing-kpi-s-for-the-drone-industry

5	Article	A Service-Based Architecture for enabling UAV enhanced Network Services	Connectivity Technology blog	"A Service-Based Architecture for enabling UAV enhanced Network Services", Connectivity Technology blog, featuring the 5G!Drones journal paper "A Service-Based Architecture for enabling UAV enhanced Network Services": https://www.connectivity.technology/2020/08/a-service-based-architecture-for.html?m=1
6	Orange Poland	A new approach to 5G and MEC integration	5th Workshop on "5G – Putting Intelligence to the Network Edge" (5G-PINE 2020) in AIAI 2020, 16th International Conference on Artificial Intelligence Applications and Innovations, 5–7 June, 2020 (Virtual Conference)	A 5GDRONES Project related conference paper entitled "A new approach to 5G and MEC integration" has been accepted at 5th Workshop on "5G – Putting Intelligence to the Network Edge" (5G-PINE 2020) in AIAI 2020, 16th International Conference on Artificial Intelligence Applications and Innovations, 5–7 June, 2020 (Virtual Conference) . Read the paper at: https://5gdrones.eu/wp-content/uploads/2020/05/5G-MEC.pdf
7	Aalto University	Spectrum Sharing for Secrecy Performance Enhancement in D2D-Enabled UAV Networks	IEEE Network Magazine	A 5GDRONES Project journal paper entitled "Spectrum Sharing for Secrecy Performance Enhancement in D2D-Enabled UAV Networks" has been accepted in IEEE Network Magazine. Read the paper at: https://5gdrones.eu/wp-content/uploads/2020/05/Spectrum-Sharing-for-Secrecy-Performance-Enhancement-in-D2D-Enabled-UAV-Networks.pdf
8	Aalto University	Energy-aware Collision Avoidance stochastic Optimizer for a UAVs set	IEEE IWCMC	A 5GDRONES conference paper entitled "Energy-aware Collision Avoidance stochastic Optimizer for a UAVs set" has been accepted in IEEE IWCMC (Virtual Event) in 15-19/06/2020. Read the paper online at: https://5gdrones.eu/wp-content/uploads/2020/05/Energy-aware-Collision-Avoidance-stochastic-Optimizer-for-a-UAVs-set.pdf
9	Aalto University	UAV Communication Strategies in the Next Generation of Mobile Networks	IEEE IWCMC	A 5GDRONES conference paper entitled "UAV Communication Strategies in the Next Generation of Mobile Networks" has been accepted in IEEE IWCMC (Virtual Event) in 15-19/06/2020. Read the paper online at https://5gdrones.eu/wp-content/uploads/2020/05/UAV-

				Communication-Strategies-in-the-Next-Generation-of-Mobile-Networks.pdf
10	Orange Poland	Integration of U-Space and 5GS for UAV services	IFIP Networking 2020 – Workshop on Network Slicing 2020, 22-25/06/20	A 5GDRONES Project journal paper entitled "Integration of U-Space and 5GS for UAV services" has been accepted in IFIP Networking 2020 – Workshop on Network Slicing 2020, 22-25/06/20.
11	Robots Expert, Gokul Krishna Srinivasan	Challenges & Benefits of 5G in Urban Air Mobility	IEEE AERIAL COMMUNICATIONS IN 5G AND BEYOND NETWORKS (AERCOMM) WORKSHOP	Invited keynote speech highlighting the 5GDrones project use cases, current status and challenges
12	Eurecom	On extending ETSI MEC to support LoRa for efficient IoT application deployment at the edge	IEEE Communications Standards Magazine	A 5G!Drones paper entitled "On extending ETSI MEC to support LoRa for efficient IoT application deployment at the edge" was accepted at the IEEE Communications Standards Magazine. You may read the paper at https://5gdrones.eu/wp-content/uploads/2020/06/MEC-LORA-paper.pdf
13	Nokia	"5G Benefits for Unmanned Moving Objects"	PrintoCent Webinar Series 2020, 8 June 2020	#LearnAbout5GDrones Juha Hannula (Nokia), 5G!Drones partner, presented "5G Benefits for Unmanned Moving Objects" at PrintoCent Webinar Series 2020, 8 June 2020. More information available at https://www.printocent.net/tapahtumat/1st_webinar_session/ Link to presentation available at: https://youtu.be/0p2kVADx0WU
14	Robots Expert, Gokul Krishna Srinivasan	"What does it take to fly the PX4 stack on a certified aircraft?"	Presentation at PX4 summit, 7 July 2020	Gokul Srinivasan from Robots.Expert had the opportunity to present "What does it take to fly the PX4 stack on a certified aircraft?" at the PX4 Developer Summit 2020 where the 5G!Drones project was also introduced to the PX4 community and industry professionals. The presentation is available at https://www.youtube.com/watch?v=TfNa

				puzs5KQ&list=PLYy2pGCdhu7x1BpFcPsLY72D6z3AUdZWf&index=8&t=0s
15	Gokul Srinivasan	Standards and Policies	ASTM Internation F38 (Unmanned Aircraft Systems) and F39(Aircraft Systems) committees	Gokul Srinivasan from Robots.Expert will represent 5GDRONES Project in the ASTM Internation F38 (Unmanned Aircraft Systems) and F39(Aircraft Systems) committees concerning Standards and Policies
16	Gokul Srinivasan	Talk about UAS and UAM industry - 5G!Drones	InterDrone podcast, 5 August 2020	Gokul Srinivasan from Robots.Expert had the opportunity of participating on the InterDrone podcast on 5/08/2020, representing 5GDRONES Project, where he talked about the UAS and UAM industry. Video available at https://interdrone.com/interdrone-podcast/episode-50-the-uas-vc-funding-model-may-be-broken-how-do-we-avoid-a-bubble-with-gokul-srinivasan/
17	Dr. Harilaos Koumaras (NCSRD)	Webinar Presentation - "MNO OPENNESS: THE NEXT BUSINESS OPPORTUNITY"	6G Research Visions Webinar Series, 16 Sept 2020	The second webinar of the 6G Research Visions Webinar Series, organised by 6G-Flagship of the University of Oulu, will take place on 16th of September. Dr. Harilaos Koumaras from NCSRD, 5G!Drones partner, participates and presents in this webinar which will address the essential choices for developing preferred business of 6G in the age of platforms, ecosystems, and empowerment. The registration form is available at https://www.6gchannel.com/portfolio-posts/6g-research-visions-webinar-series-essential-choices-for-developing-preferred-business-of-6g-in-the-age-of-platforms-ecosystems-and-empowerment/?fbclid=IwAR0Mnr5bJnhHPIXYS6CPXJguICXEhE6AyjhtUIvia3y8KqOKtLiSiiwjWIA VIDEO available at https://www.youtube.com/watch?v=4ebFm1qdgC0&feature=youtu.be

18	Trials x2	Flight trials in Aalto and Oulu, Finland	Flight trials in Aalto and Oulu, Finland, August 24-28 2020	5G!Drones partners conducted flight trials under 5G network in Aalto and Oulu, Finland, on August 24-28 2020 for collecting preliminary inputs for 5G!Drones next developments and actions. In these tests, 5G infrastructure owners of Aalto University and Oulun yliopisto - University of Oulu, and technology companies CAFA Tech, HEPTA, NOKIA participated, conducting physically tests of use cases 1Sc1/3Sc1/3Sc2.
19	5G-PPP white paper	Empowering Vertical Industries through 5G Networks - Current Status and Future Trends	White paper by 5G-PPP, 21 5G-PPP Phase II and Phase III R&I projects and the 5G-IA verticals engagement task force	The 5G-PPP white paper "Empowering Vertical Industries through 5G Networks - Current Status and Future Trends" prepared by 21 5G-PPP Phase II and Phase III R&I projects and the 5G-IA verticals engagement task force is now available in the 5G-PPP official website. You may download it here: https://5g-ppp.eu/wp-content/uploads/2020/09/5GPPP-VerticalsWhitePaper-2020-Final.pdf
20	Aalto University	IEEE Transactions on Wireless Communications	Journal paper: H. Hellaoui, M. Bagaa, A. Chelli, and T. Taleb, "Joint Sub-carrier and Power Allocation for Efficient Communication of Cellular UAVs", in IEEE Transactions on Wireless Communications	
21	Aalto University, Eurocom	IEEE Network Magazine	Journal paper: T. Taleb, A. Ksentini, H. Hellaoui, and O. Bekkouche, "On Supporting UAV based Services in 5G and Beyond Mobile Systems", in IEEE Network Magazine	
22	Aalto University	IEEE Globecom'20, Taipei, Taiwan, Dec. 2020	Conference paper: Y. Dang, C. Benzaid, Y. Shen, and T. Taleb, "GPS Spoofing Detector with Adaptive	

			Trustable Residence Area for Cellular based-UAVs", in IEEE Globecom'20, Taipei, Taiwan, Dec. 2020	
23	Robots Expert, Gokul Krishna Srinivasan	5G Momentum webinar organized by Liikenne-ja viestintävirasto Traficom, 3 Sept 2020	Presentation-Webinar: Our team member Gokul Krishna Srinivasan talked about the challenges and benefits of 5G technology in the context of Urban Air Mobility. He also had the opportunity to briefly talk about the recent feasibility tests conducted by 5GDrones project.	#LearnAbout5GDrones: 5G!Drones partner robots.expert, participated in the #5G #Momentum #webinar organized by Liikenne- ja viestintävirasto Traficom / Transport- och kommunikationsverket Traficom on Thursday 3 Sept 2020. Our team member Gokul Krishna Srinivasan talked about the challenges and benefits of 5G technology in the context of #Urban #Air #Mobility. He also had the opportunity to briefly talk about the recent #feasibility #tests conducted by #5GDrones project.
24	Robots Expert, Gokul Krishna Srinivasan	"5G technology and drones" presentation at Low Latency Conference 6 Oct 2020	Online Conference: This presentation will explore the various application of 5G technology in the UAV industry in the Low Latency conference on 6th of October. The conference will take place during the Photonics Applications Week. Also, this presentation will cover the work done by the 5G!Drones Project, an EU H2020 project exploring various use cases with 5G technology and drones.	#LearnAbout5GDrones: Gokul Srinivasan from robots.expert a 5G!Drones partner will participate in the online Low Latency Conference on 6th of October 2020, where he will talk about 5G technology and drones. The conference will take place during the Photonics Applications Week. Register Online at: https://lowlatency.photonicsapplicationsw eek.com/speaker/gokul-srinivasan-5g-technology-drones/. Video presentation: https://www.youtube.com/watch?v=VVO W_vckdnM&app=desktop

| 25 | Robots Expert, Gokul Krishna Srinivasan | International Conference on Smart Cities, Smart Infrastructures and Smart Buildings 23-24 Sept 2020 (European Digital Week) | Robots.expert, 5G!Drones partner, participates in the International Conference on Smart Cities, Smart Infrastructures and Smart Buildings, European Digital Week 23-24 Sept 2020, and presents how 5G technology can leverage smart cities applications, including Urban Air Mobility, V2X and other relevant use cases and also share important insights from 5G!Drones project. | #LearnAbout5GDrones: Robots.expert, 5G!Drones partner, participated in the International Conference on Smart Cities, Smart Infrastructures and Smart Buildings, European Digital Week 23-24 Sept 2020, and presented how 5G technology can leverage smart cities applications, including Urban Air Mobility, V2X and other relevant use cases and also share important insights from 5G!Drones project. Read all the information about the event at: https://ditech.media/eudw/icscib/gokul-srinivasan/ VIDEO: https://www.youtube.com/watch?v=toRMVOjt6Io |
| 26 | NCSR "Demokritos" and Dr. Harilaos Koumaras, 5GENESIS project coordinator | Online workshop entitled "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" on 14 Oct 2020, 09:00-15:00) | The Institute of Informatics & Telecommunications of NCSR "Demokritos" invites you to participate at the online workshop entitled "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" on 14 Oct 2020, 09:00-15:00. This online workshop is organized by the Institute of Informatics & Telecommunications of NCSR Demokritos (Athens, Greece), 5GENESIS coordinator, in the frame of EU projects 5GENESIS and 5GDrones with the support of the 5G-PPP partnership | #LearnAbout 5GDrones The Institute of Informatics & Telecommunications of NCSR "Demokritos" invites you to participate at the online workshop entitled "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" on 14 Oct 2020, 09:00-15:00. This online workshop is organized by the Institute of Informatics & Telecommunications of NCSR Demokritos (Athens, Greece), 5GENESIS coordinator, in the frame of EU projects 5GENESIS and 5GDrones with the support of the 5G-PPP partnership. The workshop will focus on 5G Experimentation Facilities and Vertical Trials, their status, and future perspectives. More information on the workshop, agenda and registration process, available at: https://5g-ppp.eu/event/5g-experimentation-facilities-and-vertical-trials/ |

27	Robots Expert	U-Space ConOps webinar hosted by EUROCONTOL 2 Oct.	5G!Drones partner, participated in the U-Space ConOps webinar hosted by EUROCONTROL, and presented by Andrew Hately.U-Space concept s, described the airspace structure, the different services and how they are used together to allow different levels of traffic to safely operate above different densities of ground population	#LearnAbout5GDrones: Robots.expert, 5G!Drones partner, participated in the U-Space ConOps webinar hosted by EUROCONTROL, and presented by Andrew Hately. The presentation lead to interesting explorations and discussions about how U-Space architecture can be used in the 5GDRONES Project. Apart from that, U-Space concept s, described the airspace structure, the different services and how they are used together to allow different levels of traffic to safely operate above different densities of ground population. More information on the following link: https://www.unmannedairspace.info/emerging-regulations/delegates-to-discuss-u-space-conops-at-eurocontrol-webinar-registration-now-open/
28	Prashant Shah (UO)	THESIS: Enabling seamless application migration over multi-core network environments	Master Thesis publication at the University of Oulu, University of Oulu, Faculty of Information Technology and Electrical Engineering, Communications Engineering, June 26th, 2020.	Persistent ID: http://urn.fi/URN:NBN:fi:oulu-202006212616
29	Jussi Haapola (UO)	Online workshop entitled "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" on 14 Oct 2020, 09:00-15:00)	Jussi Haapola from UniOulu and 5G!Drones Project Coordinator participated and presented at the online workshop "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" organized by NCSR "Demokritos" and supported by EU projects 5genesis and 5GDrones. The discussion was about 5G Vertical Experimentation of 5G!Drones.	Presentation title: Towards UAV trials - architectural advancements and takeaways from feasibility tests. Watch the video of presentation: https://www.youtube.com/watch?v=yCpf8GH7KxI&feature=youtu.be. Only 5G!Drones presentation: https://www.youtube.com/watch?v=ya7P6uZ5DSk

30	5G!Drones	5G!Drones feasibility Tests in 5GENESIS Platform in Athens (Municipal stadium of Egaleo) 19-20 Oct. 2020	5G!Drones partners conducted feasibility tests in 5GENESIS Athens platform in municipal stadium of Egaleo. The trials coducted in the frame of Use Case 4 "Connectivity during crowded events"	#LearnAbout5GDrones Feasibility tests and trials executed at 5GENESIS Athens 5G platform (Municipal stadium of Egaleo) as per 5G!Drones use case #4 scenario.
31	Jussi Haap ola (UO)	6G Waves Magazine by 6G Flagship	Article: Feasibility tests for future air mobility.	#LearnAbout5GDrones: 5G!Drones project was hosted on the 2nd version of 6G waves magazine by 6G Flagship. Dr Jussi Haapola from UniOulu shared some insights about the features and the distinctiveness of the project. In addition, he gives information about the long-term evaluation of drones. For more information about the 5G!Drones project and the latest news about the evolution of 6G click the following link: http://jultika.oulu.fi/files/isbn97895262276 41.pdf
32	5G!Drones	5G!Drones feasibility Tests in 5GENESIS Platform in Athens Cosmote Platform (Cosmote Academy) 21 Oct. 2020	5G!Drones partners conducted feasibility tests in 5GENESIS Athens platform in Cosmote premises (Cosmote Academy). The trials coducted in the frame of Use Case 4 "Connectivity during crowded events"	#LearnAbout5GDrones Feasibility tests and trials accomplished yesterday at the Athens 5GENESIS platform at Cosmote premises (Cosmote Academy). The trials executed using the Cosmote Edge server in the context of Use Case #4 (connectivity during crowded events). The main goal was to offer a better level of network services with drones under 5G and avoid dropped calls and degraded Internet connectivity during mass events.
33	5G!Drones	Website Article: aigaleo.gr (In Greek)	Feasibility tests and trials in 5GENESIS Athens Platform at Municipal stadium of Egaleo on 19th of October	#LearnAbout5GDrones: An article (in Greek) was published from the official website of Municipal of Egaleo exploring the nature of feasibility tests executed at 5GENESIS Athens 5G platform (Municipal stadium of Egaleo). The trials conducted in the context of Use Case 4 (connectivity during crowded events). To access the article, click on the following link: https://www.aigaleo.gr/2020/10/22/techni kes-dokimes-5g-me-drones-sto-dimotiko-gipedo-aigaleo/

34	5GPPP	5GPPP Annual Progress Monitoring Report	This document reports the progress achieved by the 5G Public-Private Partnership (5G PPP) during 2019.	#LearnAbout5GDrones The 5G PPP Annual Progress Monitoring Report has been published. The report is giving insights and information about progress and development of ict projects under the supervision of 5GPPP. It also provides information about the format of the consortiums within these projects. Link: https://5g-ppp.eu/annual-progress-monitoring-reports/
35	Samir Si-Mohammed , Adlen Ksentini , Maha Bouaziz, Yacine Challal, and Amar Balla	Conference Paper in IEEE Globecom 2020	Conference Paper in IEEE Globecom 2020 "UAV mission optimization in 5G: On reducing MEC service relocation"	A 5G!Drones conference paper entitled "UAV mission optimization in 5G: On reducing MEC service relocation" and has been accepted in the context of IEEE Globecom 2020 and is affiliated with 5G!Drones project. You can read the whole paper at: https://5gdrones.eu/wp-content/uploads/2020/10/UAV-mission-optimization-in-5G-On-reducing-MEC-service-relocation.pdf
36	5G!Drones	Website Article: stadiumbusiness.com	Feasibility tests and trials in 5GENESIS Athens Platform at Municipal stadium of Egaleo on 19 - 20 of October	#LearnAbout5GDrones: An article was published from thestadiumbusiness website giving information about the feasibility tests that executed at 5GENESIS Athens 5G platform (Municipal stadium of Egaleo). The trials conducted in the context of Use Case 4 (connectivity during crowded events). To access the article, click on the following link: https://www.thestadiumbusiness.com/2020/10/27/5gdrones-project-carries-out-network-tests-at-greek-stadium/
37	5G!Drones	Website Article: commercial droneprofessional.com	Feasibility tests and trials in 5GENESIS Athens Platform at Municipal stadium of Egaleo on 19 - 20 of October	An article was published from commercialdroneprofessional website giving information about the feasibility tests that executed at 5GENESIS Athens 5G platform (Municipal stadium of Egaleo). The trials conducted in the context of Use Case 4 (connectivity during crowded events). To access the article, click on the following link: https://www.commercialdroneprofessional.com/drones-to-boost-mobile-and-internet-connection-in-crowded-events/

38	Unmanned Life, CAFA Tech, COSMOTE, Robots.Expert, NOKIA, INVOLI Frequentis.	Website Article: commercialuavnews.com	5G!Drones Is Putting the Pieces of the Drone Ecosystem Together to Make Sure They Fit and Can Deliver Value to Stakeholders by Danielle Cagne	A new 5G!Drones article just released! The website article of commercialuavnews by Danielle Cagne entitled "5G!Drones Is Putting the Pieces of the Drone Ecosystem Together to Make Sure They Fit and Can Deliver Value to Stakeholders " explores the nature, the dimensions and the extensions of 5G!Drones project with a view on the creation and validation of safe and reliable drones ecosystem in the next few years. For more information about this article you can click on the fallowing link: **https://www.commercialuavnews.com/europe/5g-drones-is-putting-the-pieces-of-the-drone-ecosystem-together-to-make-sure-they-fit-and-can-deliver-value-to-stakeholders?fbclid=IwAR1_FZiG1PnCesS0ZmA5Clmei_KclFftPxOPeHY3tRbEW-obqketTKY15OE**
39	NOKIA	Pre - trial measurements 27 - 28 August 2020	Pre - trial measurements in the context of Use Case 3 in Nokia premises in Oulu, Finland	5G!Drones partner Nokia conducted pre - trial measurements on the 27th and 28th of August in Nokia premises in Oulu, Finland. The trials conducted in the context of Use Case 3 Scenario 3: "Location of UE in non - GPS environments".
40	EURECOM, Aalto University, Orange Polska, Frequentis, Robots Expert, CAFA Tech, Involi, Oulu University	Journal Paper	IEEE Vehicular Technology Magazine "Supporting UAV Services in 5G Networks: New High-Level Architecture integrating 5G with U-Space"	A 5G!Drones journal paper entitled "Supporting UAV Services in 5G Networks: New High-Level Architecture integrating 5G with U-Space" has been accepted and is under publication in IEEE Vehicular Technology Magazine. You can read the whole paper at 5G!Drones website: **https://5gdrones.eu/wp-content/uploads/2020/11/Supporting-UAV-Services-in-5G-Networks.pdf**
41	5G!Drones	Website Article: urbanairmobilitynews.com	Feasibility tests and trials in 5GENESIS Athens Platform at Municipal stadium of Egaleo on 19 - 20 of October	An article was published on urbanairmobilitynews.com website giving information about the feasibility tests that were executed at 5GENESIS Athens 5G platform (Municipal stadium of Egaleo). The trials conducted in the context of Use Case 4 (connectivity during crowded events). Website: **https://www.urbanairmobilitynews.com/uncategorized/drones-alongside-**

				5g-to-solve-poor-network-connection-during-crowded-events/
42	NCSRD	Online Article	Article Feasibility tests and trials in 5GENESIS Athens Platform on 19 - 21 of October	A website article and a video presentation were published online by NCSR Demoktitos (News section) about the 5G!Drones feasibility trials in 5GENESIS Athens platform. Dr. Harilaos Koumaras along with repsentatives from 5G!Drones partners collected inputs and verified the interaction between 5G and drones. You can access the article and watch the video presentation at Demokritos website: **https://www.iit.demokritos.gr/newsevents/5gdrones-feasibility-tests-athens/**
43	NCSRD	Online Article	Article for the Online workshop entitled "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" on 14 Oct 2020, 09:00-15:00)	The Institute of Informatics & Telecommunications (IIT), NCSRD, dedicates in its newsletter the month of October to 5G Networks. The workshop "5G Trials in Europe: 5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" was successfully organised by the Media Networks Laboratory (MNL) on Wednesday 14 October, between 9:00-15:00 CEST, in the frame of H2020 projects 5GENESIS and 5G!Drones with the support of the 5G-PPP partnership. It was attended online by almost 100 participants. More information available at: **https://www.iit.demokritos.gr/newsevents/iit-dedicates-october-5g-networks/**
44	Jonas Stjernberg (robots.expert)	Webinar	FinDrones2020 conference - 12th of November	Jonas Stjernberg (robots.expert) presented at the FinDrones2020 online conference. The FinDrones2020 conference was held on 12 November 2020 (virtually). The presentation focused on "Scaling up advanced drone operations" and presented 5G!Drones project as well! The link to the conference for more details is **https://events.tuni.fi/findrones2020-en/programme/**

| 45 | 5G!Drones/ HEP | Online Article for trials and HEP | www.innoenergy.com | "Hepta Drones and 5G will solve poor network connection during crowded events", online article by www.innoenergy.com at **https://www.innoenergy.com/news-events/hepta-drones-and-5g-will-solve-poor-network-connection-during-crowded-events/** |
| 46 | Jyrkkä Johannes, University of Oulu, Faculty of Technology, Mechanical Engineering | Master Thesis/ University of Oulu | Master Thesis "Drone heading calculation indoors" | A Master Thesis by Jyrkkä Johannes entitled "Drone heading calculation indoors" was published by University of Oulu, Faculty of Technology, Mechanical Engineering on 15 of October 2020. This thesis is in the context of 5G!Drones. **http://jultika.oulu.fi/Record/nbnfioulu-202010153028** |

8.6. WP6 Project Management

8.6.1. Progress towards objectives and details for each Task

WP Objectives

This work package is responsible for coordinating the overall project aiming towards achieving effective operation of the project as well as timely delivery of quality results. The management structure and tools described within will be instrumental to the achievement of the following objectives:

- Implement management procedures, produce reports, carry out project meetings, conflict resolution mechanisms, knowledge management, and others.
- To steer the project to ensure the success of the UAV use case trials within the ICT-17 and other facilities.
- To liaise with the EC and share with the EU the status of project progress.
- To establish appropriate quality management procedures within the project.
- Planning, monitoring, and controlling project progress and outputs as well as anticipating and taking corrective actions.
- Administer the project funds in the interest of the success of the project, in accordance with the consortium, and according to individual partner performance.
- Management of the relationship with the ICT-17 5G facilities.
- Management of the relationship at 5G-PPP Programme level.

WP Tasks and interrelations:

- T6.1: Administrative, financial and contractual management (M1-M42)
- T6.2: Risk and quality management (M1-M42)
- T6.3: Technical coordination and innovation management (M1-M42)
- T6.4: 5G facility relationship management (M1-M42)

Main Progress in the period:

The first year EC review was successfully organised and held on July 9th, 2020. The project Amendment 2 was initiated in June then prepared, submitted, and accepted extending the project duration from 36 to 42 months. The details of the Amendment 2 are reported in Section 0. The Covid-19 pandemic related long-term impact planning was initiated and it is ongoing work. There has also been an iteration round of Covid-19 related risks assessment for the project implementation. The first External Advisory board meeting was scheduled and held in September. By the end of M18, all WPs have submitted at least one essential deliverable. The project had one virtual face-to-face meeting at the end of October, where matters of the General Assembly were also addressed. Work has been done addressing 1st year review comments, making improvements in identified activities and mapping the recommendations that are actionable and non-actionable. Finally, the WP has submitted two deliverables during the period: D6.3 and D6.7. The former, termed Mid-term review report is this one and it describes the state of the project and its achievements between M13 and M18 (June – November, 2020). The latter is information on cumulative expenditure of the Beneficiaries between M1 – M18 of the project.

8.6.2. Task 6.1 Administrative, financial and contractual management (M1-M36) [UO]

Task Objectives:

This Task is related with the overall project management from an organisational, administrative, and financial point of view. This Task is in the hands of the Project Coordinator. It covers the following activities:

- Ensuring knowledge sharing and communication within the consortium: the project management must receive from each consortium member periodic reports to present accurately and briefly the work performed during the period, problems encountered, expected impact, and resources consumed.
- Administration and contract management: the UO will ensure this activity. It will deal with the proper management of the Contract, the proper management of the decision process within the Consortium, and the liaison with the EC Office.
- Financial management: It will monitor that the project budget and resources are distributed in a timely manner, including the preparation of cost statements and of the supporting justification by the project partners and ensure that these are produced at dates according to the contract, and context meeting the EU financial procedures and guidelines.

Task Activities during the period:
Only the Coordinator – UO is partaking this Task.

1-UO Contribution and results: During the period UO led the preparations for the first-year review, which was successfully held on July 9th, 2020. The discussions related to Covid-19 impacts on the project implementation became concrete and UO collected, compiled, and generated Amendment 2 extending the project duration by 6 months, shifting Deliverables and Milestones, shifting resources, and added a new linked third-party for FRQ. UO submitted the Amendment and it was accepted. Actions to address the first-year review comments were initiated. UO has coordinated the effort on Deliverables D6.3 and D6.7. It has also facilitated the first External Advisory Board meeting and is orchestrating follow-up actions. UO has made agendas and hosted the project's virtual face-to-face meeting and project management team meetings. It has also acted as the liaison between the consortium and the project office on matters concerning 5G!Drones implementation requiring actions.

8.6.3.   Task 6.2 Risk and quality management (M1-M42) [UO]

Task Objectives:

This Task focuses on establishing risk and quality management procedures, monitoring and identification potential problems, and developing plans to mitigate the impact of such events, should one arise. Managing technical risks or quality deviations handled closely with the technical coordinator THA. The Task covers the following activities:

- Quality management: It will define quality assessment guidelines and monitor their implementation in the project on the different deliverables (e.g. reports, code, etc.).
- Risk management: It will define risk assessment guidelines, identify potential risks, and minimize their impact on the project implementation.

Task Activities during the period:

Only the Coordinator – UO is partaking this Task. The quality and risk management are, on the other hand, closely tied with project technical management. As a consequence, there is significant collaboration with the Technical Manager – THA on the topic.

1-UO Contribution and results: Risk management coordination by UO led to WPs adjusting their timelines and deliverables due to Covid-19 delays and impacts. The immediate risk management actions are reflected in Amendment 2 of the project. Long-term impact mitigation work has been started. Project quality management has been found satisfactory as all the submitted deliverables have been accepted. UO has taken note of the improvement recommendations for quality and risk management from the first-year review report. UO has coordinated the project effort on responding to 1st year review comments concerning Covid-19 and other risks identified affecting the project implementation. It has requested partners to fill in the project's risk management table and reviewed the risks periodically. UO has been monitoring the progress of WP deliverables and provided comments and recommendations, when necessary to boost activities.

Deviation and corrective action:

UO has internally experienced an unexpected materialised risk due to key personnel leaving from UO, which it has reported in the project risk management table and formulated mitigative actions. UO is reporting the risk mitigation actions' effects. By the end of the Reporting Period, UO has practically recovered from the realised risk.

The feasibility tests have been delayed beyond original expectations at the 5G-EVE Sophia-Antipolis facility due to the access limitations imposed by Covid-19 restrictions. EUR and the Beneficiaries involved in 5G-EVE feasibility tests are making preparations to timely engage in the tests once enough restrictions are lifted. They are also taking streamlining actions to minimise the amount of physically present personnel required to conduct the test. EUR has also investigated on using its own drones for the feasibility tests.

8.6.4.   Task 6.3 Technical coordination and innovation management (M1-M42) [THA]

Task Objectives:

This Task will be led by THA as Technical Manager of 5G!Drones in coordination with the Project Coordinator. This Task will ensure that all technical outcomes comply with the project work plan, and results fulfil the technical requirements set by the consortium for effective progresses toward the achievement of the project goals. It covers the following activities:

- Project planning and control: assessment of project progress and subsequent recommendations for work packages implementation.
- prepare proposals for the Project Management Team (PMT) on technical concepts, principles and architectural view.

- control the accomplishment of technical objectives and implementation of decisions and monitor WPs and overall project progress.
- approve deliverables for submission to the PMT and to ensure technical consistency within the project,
- verify milestones.
- manage communication with external liaison and External Advisory Board,
- control exploitation activities,
- identify potential major technical problems and propose solutions and actions to the PMT,
- coordinate the final report and technical audit, and
- contribute to the 5G-PPP program activities like the Technology Board and coordination with other 5G-PPP projects. Also organize and monitor project's representation at 5G PPP or IA WG of interest.

Task Activities during the period:
Only the Technical Manager – THA is partaking this Task.

2-THA continuously monitored & assessed the progress at both Project level (in terms of MSs, deliverables, individual and collective progress, etc.) but also at Programme level (i.e. monitored activities performed by each of the 5G!Drones appointed representatives to WG of interest; joined 5G TB and worked on action items). THA prepared and chaired TM slot at PMT meetings. THA interacted with PMT members, providing necessary guidance and support in view of progress towards objectives. THA carefully reviewed technical risks at these meetings but also supported IMT team for it to focus on topics of concerns for PMT but also review progress of it at regular meetings organised. THA prepared for and participated to 1st EC Review held on July 9th chairing TM slot on major achievements while in support of others. THA also orchestrated the 1st EAB meeting on September 22nd with UO. THA made an analysis of 1st EC Review report in order to take into account feedback received and trigger some of the actions in response.

17-CAF does not partake in this Task. Nevertheless, it has taken a coordination role in the project IMT where it participated in IMT telco meetings and provided contributions to IMT work regarding Regulation and UAV business use-cases.

8.6.5. Task 6.4 5G facility relationship management (M1-M36) [NCSRD]

Task Objectives:
This Task is dedicated for coordination of 5G facilities of the project. The Task contains frequent and timely communications between the facility owners, planning for common component adoption, such as UTM deployment, managing agreements, and managing permissions for the execution of trials. The Task covers the activities:

- Management of the communication between facility owners
- Manage agreements between facility owners
- Manage permissions for the execution of trials

Task Activities during the period:
The breakdown of the contribution, results, deviation and proposed corrective action of each partner in this Task are as follows. Only facilities and the TM are partaking this Task.

1-UO has attended the webinars of ICT-17 facilities and it is exploring the adoption possibilities of ICT-17 open source components to its 5G test network. UO is following ICT-17 facilities activities for catering ICT-19 projects. UO has been an observer of ICT-17 facilities portal and validation framework presentations. Within the project coordination has taken place in the technical WPs. UO has monitored 5GENESIS and 5G-EVE public activities and disseminated the information to the Consortium.

2-THA has done selective participation to ICT-17 facilities events organized. It continued monitoring of progress achieved as well as update of individual vs collective workplans. THA did further investigation of major components or features of concern for 5G!Drones as well as their delivery mode and attached APIs when it applies.

6-NCSRD has presented to the consortium the Open5GENESIS suite, which include various tools and software components that could be further exploited for the needs of the 5GDrones project. It made clarification of the complimentary architecture between ICT-17 and ICT-19 experimentation facilities, deducing to two different portals, one specialised to the needs of the UAV industry and the second one to be maintained the one provided by the ICT-17 facility. NCSRD has applied extension of the 5GENESIS project by Six months in order to appropriately support the ICT-19 project activities, due to Covid-19 crisis. NCSRD organised the "5G-trials in Europe" workshop, inviting ICT-17 platforms and ICT-19 projects in order to share experiences and lessons learnt between the different ICT-17 platforms and ICT-19 experimenters. NCSRD contributed in WP2 telcos the lessons learnt from the 5GENESIS experimentation methodologies towards defining the test cases and the KPIs before the execution of an experiment. NCSRD has contributed together with EUR on the definition of an appropriate and compatible abstraction layer, capable of interfacing 5GENESIS and 5G-EVE platforms. It presented in 5G-PPP SB the current extension of 5GENESIS project by six months in order to better support the ICT-19 experiments. 5G-EVE presented its commitment to further support the ICT-19 experiments after the project end.

14-EUR participated to meetings of the 5G-EVE French cluster.

19-MOE had no planned activity on this Task during the Reporting Period.

9. 5G-PPP CROSS-PROJECT CO-OPERATION

During the Reported Period (M13 – M18), 5G!Drones has been also deeply involved at 5G-PPP Programme level. First through representation of Project Manager and Technical Manager at respectively 5G-PPP Steering Board and Technology Board and second, through participation to 5G-PPP & IA WGs of interest for the project. 5G!Drones representation at 5G-PPP Programme level, which is shown in Table 7 depicts the level of involvement together with names of appointed representatives.

Table 7: 5G!Drones project 5G PPP & IA representatives

5G-PPP SB	5G-PPP	Jussi Haapola	**jussi.haapola@oulu.fi**
5G-PPP TB	5G-PPP	Pascal Bisson	**pascal.bisson@thalesgroup.com**
SME WG		Vaios KOUMARAS	**vkoumaras@infolysis.gr**
SEC WG	5G-IA	Tanel Järvet	**tanel.jarvet@cafatech.com**
ARCH WG	*5G-PPP*	Pascal Bisson Farid Benbadis	**pascal.bisson@thalesgroup.com** **farid.benbadis@thalesgroup.com**
PRE-STAND WG	5G-IA	Serge Delmas	**serge.delmas@airbus.com**
SOFT NET	5G-PPP	Wolfgang Kampichler Ludwig Kastner	**Wolfgang.KAMPICHLER@frequentis.com** **Ludwig.KASTNER@frequentis.com**
NET WMG & QOS			*WG stopped*
Spectrum	5G-IA		NA
Vision & societal Challenges	5G-IA	Pascal Bisson	**pascal.bisson@thalesgroup.com**
Trials WG	5G-IA	Gokul Srinivasan	**gokul.srinivasan@robots.expert**
5G Automotive	5G-PPP	Tanel Järvet	**tanel.jarvet@cafatech.com**
IMT 2020 Evaluation Group		Fotis Lazarakis	**flaz@iit.demokritos.gr**
Test, measurement & KPIs validation	5G-PPP	Ilkka Känsälä Gokul Srinivasan	**Ilkka.kansala@nokia.com** *KPI Champion:* **gokul.srinivasan@robots.expert**

During the Reporting Period a 5G workshop was co-organized by NCSR Demokritos partner, 5GENESIS project, 5G!Drones project and 5G-PPP. More information on the "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" workshop are available at our website (https://5gdrones.eu/workshop/online-workshop-by-ncsrd-5genesis-and-5gdrones/) and at https://5g-ppp.eu/event/5g-experimentation-facilities-and-vertical-trials/
Workshop organised by NCSRD on 14 Oct 2020 in the framework of 5GENESIS and 5GDrones, having the support of 5GPPP.
https://5g-ppp.eu/event/5g-experimentation-facilities-and-vertical-trials/

5G!Drones representatives participated in following Task forces:
- Set up of B5G-6G Research and Standardization Roadmap questionnaire (this questionnaire aims at collecting feedback on a per company-basis on the expected timeline, phases, and key areas of work for B5G and 6G research and that has potential to impact standardization towards 2030).
- 5G!Drones contribution to 5G-PPP projects SDO impact technical report (that has been approved by 5G IA Board end of October).

- In addition, 5G!Drones has provided inputs for Phase 3 5G-PPP Projects Brochures that will be released early next year.

In what follows we detail the activities which have been performed.

9.1. 5G-PPP Steering Board

Activityname	5G-PPP SB
Main interface	Jussi Haapola (UO)
Activities	The overall management of the 5G-PPP and cross-project co-operation
5G!Drones contributions	- Pascal Bisson (THA) as TM joined 5G-SB on July 21st on behalf of Jussi Haapola (PC). Contributed to the discussions and work on topics of concern and contributed to the topics working on action items of concern. - Active participation in the regular 5G-PPP SB meetings and conference calls. - Participation in 5G-PPP virtual events - 5G-SB virtual meeting on October 13th. - Dissemination of SB mailing list events to the Consortium - Coordination of the input of 5G!Drones for 5G PPP projects brochure and reviewing it.

9.2. 5G-PPP Technology Board

Activity name	5G-PPP TB
Main interface	Pascal Bisson (THA)
Activities	Overlooking the aspects related to the technology work of the projects and respective implementation of the initiative.
5G!Drones contributions	- Active participation in the regular 5G-PPP TB meetings organised during the reported period; - Work performed on all action items of concerns for 5G!Drones project (e.g. achievements 3.0, reference figure, top-20 documents, …) while informing and engaging on the matter with the project team at especially PMT. - 5GDrones contributions to TB Whitepaper on Edge computing as well as engagement with the 5GDrones team on new AI & ML for 5G networks Whitepaper.

9.3. 5G-PPP cooperation on 5G security

Activity name	5G-PPP SEC
Main interface	Tanel Järvet (CAF)
Activities	Join 5G IA SEC WG activities and contribute input on behalf of the 5G!Drones project. This according to SEC WG ToR and Work plan for Y2020 also in view of action items set for ALL.
5G!Drones contributions	- Foster contributions from 5G!Drones to Whitepaper (TB or SEC-WG) with also objective to propose a short whitepaper based on results achieved. - Tanel has participated in the work of 5G-PPP Security WG in the period M13-M18. Security WG has been primarily involved in compiling the Edge Computing Security chapter of the 5G-PPP Whitepaper "Edge Computing

	for 5G Networks". Results of work performed by 5G!Drones Security Task Force under consideration to now get valued in the context of short whitepapers Security WG was targeting.

9.4. SME WG

Activityname	SME WG
Main interface	Vaios Koumaras (INF)
Activities	The SME Working Group represents the NetWorld2020 SME community, and provides the networking place for the NetWorld2020 SME community related to EC and 5G-PPP research projects and activities.
5G!Drones contributions	5G!Drones project is represented at 5G PPP/Networld2020 SME WG by INF. During the period June 2020 - November 2020 the SME WG has organised 1 general telco and 3 dedicated telcos (discussing the role of SMEs at SNS association for Horizon Europe program). Below is a list of activities that were performed by SME WG in which INF, on behalf of 5G!Drones, has participated in and contributed to: - Contributing to the update of the latest SME brochure (**https://www.networld2020.eu/wp-content/uploads/2020/07/2020-sme-brochure-final_2020-07-03.pdf**). - Contributing to the update of the SMEs webpage - Find your SME at Networld2020 website (**https://www.networld2020.eu/find-the-sme-you-need-new-page/**). - Discussing and setting requirements for the characteristics of the new SNS association for Horizon Europe program and SMEs role and participation. - Editing and contributing the 5G!Drones brochure (as per 5G-PPP template) for a future 5G-PPP publication on Phase 3 projects.

9.5. 5G Architecture WG

Activityname	5G-PPP Architecture WG
Main interface	WG monitored by THA – acting TM (**pascal.bisson@thalesgroup.com**) and TM Deputy
Activities	Follow up evolement of overall 5G architecture and contribute
5G!Drones contributions	- 5GDrones was awaiting for Architecture WG to be revived. This WG being now revived since October 16th, 5GDrones represented by TM & TM Deputy has started to get organised to join and contribute. In the meantime a call for additional representative was launch to which Gokul Srivinisan volunteered and was added to the list. On December 11th 5G!Drones has already planned a presentation of its work to Arch WG members.

9.6. PRE-STAND WG

Activityname	Pre-stand. WG
Main interface	Serge Delmas (AIR)
Activities	Identify standardization and regulatory bodies to align with e.g. ETSI, 3GPP, IEEE and other relevant standards bodies, & ITU-R (incl. WPs) and WRC (including e.g. ECC PT1). Develop a roadmap of relevant standardization and regulatory topics for 5G: Evaluate existing roadmaps at international level; Propose own roadmap for

	5G being aligned at international level. Influencing pre-standardization on 5G and related R&D: Potentially propose where topics should be standardized; Influence timing on R&D work programs (e.g. EC WPs)
5G!Drones contributions	- Set up of B5G-6G Research and Standardization Roadmap questionnaire (this questionnaire aims at collecting feedback on a per company-basis on the expected timeline, phases, and key areas of work for B5G and 6G research and that has potential to impact standardization towards 2030). - 5G!Drones contribution to 5G PPP projects SDO impact technical report (that has been approved by 5G IA Board end of October).

9.7. SOFT-NET WG

Activity name	Soft Net WG
Main interface	Wolfgang Kampichler (FRQ) and now Ludwig Kastner (FRQ)
Activities	Define what is cloud native in the telco world and where real-time and the high availability aspects are critical. Consider different design rules and requirements for the system to be qualified as cloud native.
5G!Drones contributions	- Active participation in regular WG calls - Project specific KPIs and document review

9.8. 5G Automotive WG

Activity name	5G-PPP Automotive
Main interface	Tanel Järvet (CAF)
Activities	Join 5G Automotive activities and participation in all telcos.
5GDrones contributions	CAFA Tech has participated in the work of 5G-PPP Automotive WG in the period M13-M18. The Automotive WG hosts bi-weekly meetings and works closely with different verticals. In September 2020 Automotive WG prepared a new version of the terms of reference (ToR) and accomodated objectives relevant for 5G!Drones. One important and critical topic for 5G!Drones project is how to organise Drone-to-Drone communication via 5G to avoid and prevent collisions and coordinate routes. In the 5G-PPP ecosystem the Automotive WG is the most relevant for that (V2X researches). In the new ToR 2020 of Automotive WG the WG deals with all automated transportation (incl. Cars, trucks, UAVs, buses etc.). Even if not obvious at project start it appears that this WG managed to evolve and become of interest for 5G!Drones. On 27.07.2020, a representative of CAF gave a presentation at the Automotive WG teleconference, where he introduced the activities of the 5G!Drones project.

9.9. IMT 2020 Evaluation WG

Activity name	IMT 2020 Evaluation WG
Main interface	Fotis Lazarakis (NCSRD)
Activities	IMT-2020 5G IA Evaluation Group is an independent Evaluation Group that officially initiated their work in January 2018. The scope of the Group is the evaluation of

	candidate Radio Interface Technologies (RITs) submitted by standardization organizations.
5G!Drones contributions	During this period, NCSRD contributed to the evaluation of Control Plane and Use Plane Latency of the 3GPP submission NR (New Radio) and LTE Rel.15. After the submission of the Final Report, the Group interacted with ITU-R for various clarifications and provision of additional information during the W5D meeting in June 2020.

9.10. Test, measurement & KPIs validation

Activity name	Test, measurement & KPIs validation
Main interface	Ilkka Känsälä (NOK)
Activities	The Test, Measurement, and KPIs Validation (TMV) Working Group was founded as part of the 5G PPP effort to promote commonalities across projects that have strong interest in the T&M methodologies needed to provide support to the vertical use cases in the 5G Trial Networks
5G!Drones contributions	NOK participates to WGs meetings as an observer due to project stage well before Trials.