PROJECT "LOCUS": LOCalization and analytics on-demand embedded in the 5G ecosystem, for Ubiquitous vertical applicationS

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DELIVERABLE D7.3

Report on Communication, Dissemination Actions, Standardization and Open Source Contributions, v2

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Short Abstract:	Report on communication and dissemination actions, on the progress against initial plans, as well as on awareness

	and advice inferred from these activities. Report on Standardization and open-source contributions until the release date, the impact that these have been perceived to have, and the plans for further standardization and open-source contributions.
Keyword List:	Communication, Dissemination, Standardization, Open-Source Contributions

Executive Summary

This deliverable has the objective to report LOCUS activities and plan the ones for the upcoming year in three main areas: (1) Communication and dissemination; (2) Data management; (3) Standardization.

VERSION CONTROL TABLE			
VERSION N.	**PURPOSE/CHANGES**	**AUTHOR (S)**	**DATE**
1.0	First draft with ToC	CNIT, Stefania Bartoletti, Natascia De Fenzo	30 September 2021
1.1	Inclusion of the Standardization Plan	SAMS, Mythri Hunukumbure;	8 October 2021
1.2	Final Draft	CNIT, Stefania Bartoletti, Natascia De Fenzo	13 October 2021
2.0	Final Review from the Project Coordinator	Nicola Blefari Melazzi	15 October 2021

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1. Introduction

This report deals with the communication, dissemination, and standardization of LOCUS project, which are part of WP7 activities. More specifically, WP7 is structured in three main tasks related to (i) communication and dissemination, (ii) standardization and open-source contributions, and (iii) innovation and commercial exploitation.

In this deliverable, we focus on how LOCUS research outcomes, after a proper IPR analysis described in D7.3, are disseminated and communicated to the external world, and how the data is managed within the project, as shown in Figure 1.

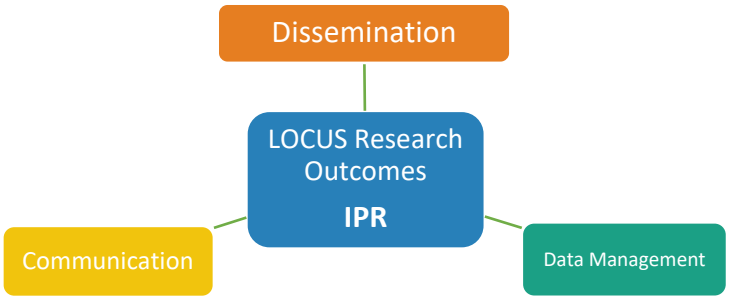

Figure 1: Dissemination, Communication and Data Management

Figure 2 presents the roadmap for the monitoring and reporting of WP7 activities, including the Four-monthly reports and the future versions of D7.x.

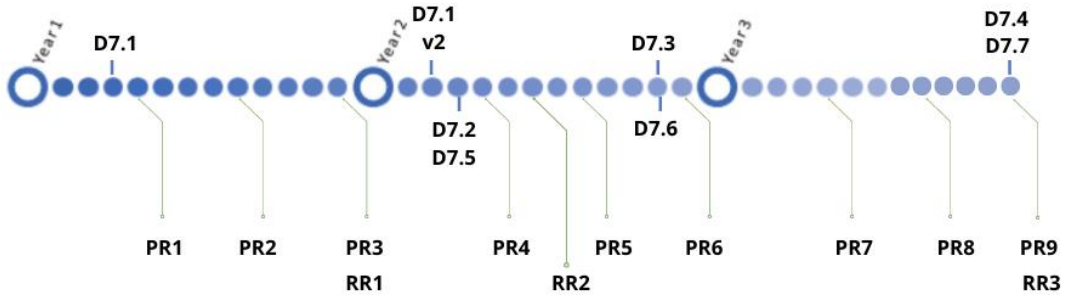

Figure 2: Roadmap of Communication and Dissemination Monitoring

In D7.2 we detailed the plan for the second year of the project by leveraging the individual plans from each partner, the planned joint activities, and the experience gained during the first year of the project. We also reported the main activities, the management and implementation of the plan that has been carried out within the first year of the project.

Furthermore, we gave a description of the main standardization activities in progress and the main activities planned for the upcoming year of the project, focusing on the main standardization bodies where LOCUS partners are active: ETSI and 3GPP.

Finally, we provided an integration of D7.5 by updating the exploitation plan for the partner Orange. Here, following the same approach, we will report the activities of the second year, with specific attention to the main outcomes of the communication and dissemination strategy as well as the standardization activities, both individually and jointly.

List of Abbreviations

ABBREVIATION	FULL NAME
5G-PPP	5G Infrastructure Public Private Partnership
API	Application Programming Interfaces
AGV	Automated Guided Vehicles
CAM	Connected and Automated Mobility
ICT	Information and Communication Technologies
ITS	Intelligent Transport System
IoT	Internet of Things
KPI	Key Performance Indicators
NFV	Network Functions Virtualization
OAI	Open Air Interface
O-RAN	Open Radio Access Network
RAN	Radio Access Network
RSS	Received Signal Strength
RB	Review Board
SI	Study Item
SRS	Sounding Reference Signals
SB	Scientific Board
GitLab	Subversion
VRU	Vulnerable Road User
UE	User Equipment
V2X	Vehicle-To-Everything
WI	Work Item

Table 1: Abbreviation List

1.1 Table Index

2. Report on Second Year's Activities

In this Section, we report the communication and dissemination activities carried out during the second year of the project. Specifically, we first comment on the effects of the Covid-19 outbreak on LOCUS communication and dissemination, and then report the activities that have been successfully completed.

2.1 The Covid-19 Outbreak: Updates

As already reported in D7.2, the Covid-19 outbreak called for a periodical revision of the communication and dissemination plan and most of all for an increase of effort for the management of such activities. For example, one of the LOCUS' strengths is a large and diverse consortium with a big potential of reaching a diverse set of audiences. However, their integration and the reciprocal transfer of knowledge, especially in a pandemic context, required specific measures and the direct involvement of partners in task forces targeting different audiences. The efforts are reflected also in the plan for the third year in Sec. 3 and concern the following:

- An increased effort towards the communication through the social media and the official website to reach general public, public administration, and industry.
- Tracing activity to analyse the audience of the social media channels and the website and to decide how to increase the number of people for the aforementioned audiences.
- An increased effort towards dissemination through joint papers within the consortium and with other projects.

In addition, as the target events (e.g., EUCNC) have been adapted to the current virtual participation and included virtual workshops; LOCUS successfully organized a virtual workshop together with other 5G-PPP projects (see the Second Year Report) at the EUCNC 2021. Also, it is currently organizing a hybrid (on-site and on-line) workshop at Globecom 2021, as well as a new virtual workshop at ICC 2022 with other 5G-PPP projects. Nevertheless, thanks to the recent reduction of restrictions in many countries, LOCUS partners already started to participate to some on-site events, mainly on a national basis, such as the Italian Telecommunications Group Meeting (GTTI) in Italy, while on-site international events are planned, such as the Mobile World Congress 2022.

2.2 Report on Second Year's Communication and Dissemination Activities

2.2.1 Communication Activities

All the communication activities have, as main focus, the promotion of the LOCUS project by sharing its objectives, achievements and publications with the public. In D7.2 we have presented the management, strategy, and tools of LOCUS communication and dissemination activities, together with the first results of LOCUS communication strategy. We recall that the main tools, which are mostly managed by the LOCUS communication team, are:

- Social media: Twitter and LinkedIn account
- Website
- Zenodo

In some cases, they are used directly by the individual partners for the internal and external communication of their activities, events, and/or research products.

2.2.1.1 LOCUS Website

The main Key Performance Indicators (KPIs) monitored for measuring the success of the websites are the number of visits and unique visitors per day and the top 10 pages visited. To this date, the average number of visits during the last month, is above 100 per day, whereas the number of visitors is above 30 per day. The most visited page is the homepage. As an example figure of merit, we show the hit statistics for the month of September 2021 in Figure 3 and Figure 4.

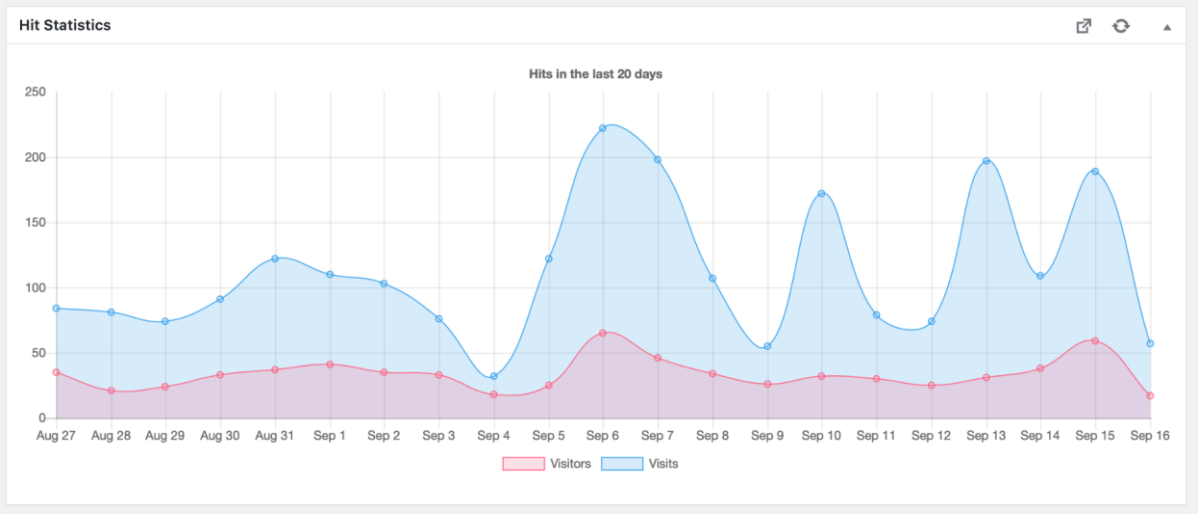

Figure 3: Hit statistics of the website.

Top 10 Pages

ID	Title	Link	Visits
1	Home Page	/	11,983
2	White paper on "Empowering Vertical Industries through 5G Networks – Current Status and Future Trends"	/white-paper-on-empowering-vertical-industries-through-5g-networks-current-status-and-future-trends/	690
3	Contacts	/contacts/	636
4	Specific Objectives	/about/specific-objectives/	563
5	About	/about/	521
6	Communication	/results/communication/	512
7	WPs Description	/about/wps-description/	510
8	Deliverables	/results/deliverables/	506
9	Step by Step	/about/step-by-step/	504
10	Benefits and Impacts	/about/benefits-and-impacts/	484

Figure 4: Top 10 pages visited.

2.2.1.2 LOCUS Social Media

LinkedIn

A LOCUS LinkedIn account has been created at the beginning of the project and is available at: https://www.linkedin.com/in/locus-project-h2020/. Here, many updates about deliverables, use cases, participations to international events and publications are being posted. The LinkedIn account currently accounts for 346 contacts and 350 followers (319 more than the beginning of September 2020) with an average of one post per week. From a deeper analysis in terms of target audience, days, and views, it emerges that, in general, the most active contacts of LOCUS are **engineers, software developers from industry and academics (i.e., researchers and professors)**. It also emerges that the most suitable days to be active on social network are Monday and Friday, considering the number of interactions and the number of views. The aim is to increase the number of contacts at least to 500 by the end of the third year.

For each post, LinkedIn analyses the target of the interactions (see Figure 5).

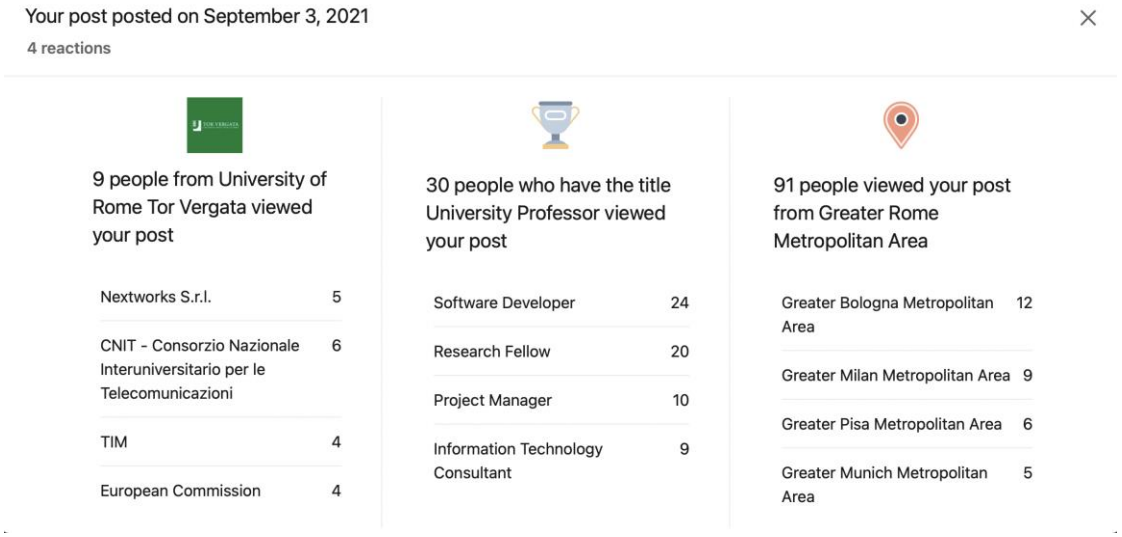

Figure 5: Single post target analysis

Twitter

The Twitter account is available at: https://twitter.com/H2020Locus. It currently has 366 followers (increased by 347 from the beginning of September 2020) with an average of one post per week. Twitter provides a tool called Analytics, which is used by the Communication Team to keep track of all the activity done so far, including the interactions and profile visits. Figure 6 shows an example of twitter analytics summary for the 28-day period between August and September 2021. Figure 6 shows that during the period considered, LOCUS Tweets earned 1,500 impressions (impressions help measure the number of people who have seen a post, even if they didn't click, comment, or otherwise engage with that post).

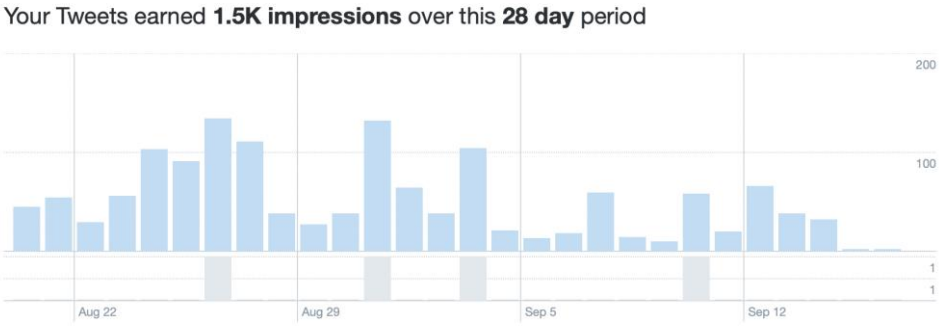

Figure 6: Twitter analytics

In addition, an analysis is performed on the social media channels to daily monitor the number of visits and unique users. An example result is shown in Figure 7, i.e., an example of *tracing of the social media interactions* for each post, including the weekdays of publications and the type of reactions, number of shares, and post views. This tracing is particularly important for analysing the audience and plan the future posts accordingly. Figure 7 shows the table

registering the posts shared on Twitter in September. Comparing the number of engagements, likes, shares and impressions, it can be seen that, LOCUS' followers are more active on Fridays.

Month	Date	Engagements	Likes	Shares	Impressions	Views	Followers	Week day
Sep-21	9/3/2021	6	2	0	99			Friday
	9/10/2021	7	1	0	84			Friday
	9/21/2021	0	0	0	48			Tuesday
	9/24/2021	13	2	2	163			Friday

Figure 7: Tracing of the interactions on Social Media

2.2.2 Internal Communication

Internal communication is being done mainly online, on the GoToMeeting app, due to the COVID-19 outbreak. This involves biweekly general calls where all partners participate, plenary meetings at regular intervals and WP and/or FG-specific calls.

Each Partner's PR communicates to WP7 leader all the communication activities related to LOCUS project and other relevant results related to it, which they want to share to strategically to collaborate together and promote their achievements.

A periodic e-mail is sent to each PR to give continuity to the communication activity through LOCUS social networks. Another periodic e-mail is sent to all LOCUS partners, asking for a continuous update on the dissemination activities reported on the Excel file and any available pre-print to be published on Zenodo: https://zenodo.org/communities/locus-project/?page=1&size=20.

2.2.3 Dissemination Activities

2.2.3.1 Scientific Publications

A total number of 23 scientific publications in peer-reviewed conferences or journals has been reported by the partners during the second year of the project, with journal publications on IEEE journals. Other papers have been submitted and are currently under review. The organization of a **Feature Topic entitled "Location Awareness for 5G and Beyond" for IEEE Communication Magazine** was particularly relevant for the dissemination activity. The feature topic focused on localization and analytics aspects in 5G and beyond. It was led by CNIT and included the Orange partner in the editorial board. The feature topic has received around 15 submissions not only from the LOCUS consortium but from many experts within the area of wireless localization.

In addition, **two joint magazine papers have been published from the collaboration between at least two partners in the consortium,** while an additional one is currently under

publication. The main scientific publications (i.e., already appeared) from the LOCUS consortium are reported in the following table:

Title	Authors	Target venue
High-Speed Millimeter-Wave Mobile Experimentation on Software-Defined Radios	Jesus O. Lacruz, Dolores Garcia, Pablo Jimenez, Joan Palacios and Joerg Widmer	ACM GetMobile magazine
Radio Positioning with EM Processing of the Spherical Wavefront	Francesco Guidi, Davide Dardari	IEEE Transactions on Wireless Communications
Mass tracking in cellular networks for the Covid-19 pandemic monitoring	Emil J. Khatib, María Jesús Perles Roselló, Jesús Miranda-Páez, Victoriano Giralt, Raquel Barco	Sensors
Pencil Beamforming Increases Human Exposure to ElectroMagnetic Fields'': True or False?	Luca Chiaraviglio, Simone Rossetti, Sara Saida, Stefania Bartoletti, Nicola Blefari-Melazzi	IEEE Access
Location-Awareness for Failure Management in Cellular Networks: An Integrated Approach	S. Fortes, C. Baena, J. Villegas, E. Baena, M. Asghar, R. Barco	SENSORS
Cellular KPI Estimation with Social Information	Javier Villegas, Sergio Fortes, Eduardo Baena, Raquel Barco	2nd Post-IRACON Meeting
Opportunistic fusion of ranges from different sources for indoor positioning	Carlos Álvarez Merino, Hao Qiang Luo Chen, Emil J. Khatib, Raquel Barco	IEEE Communications Letters
Accurate Ubiquitous Localization with Off-the-Shelf IEEE	Alejandro Blanco, Joan Palacios, Marco Cominelli, Francesco Gringoli, Joerg Widmer	ACM MobiSys 2021
A Real-Time Experimentation Platform for sub-6 GHz and Millimeter-Wave MIMO Systems	Jesus O. Lacruz, Rafael Ruiz, Joerg Widmer	ACM MobiSys 2021
Beam Searching for mmWave Networks with sub-6 GHz WiFi and Inertial	Maurizio Rea, Domenico Giustiniano, Pablo Jiménez Mateo, Yago Lizarribar, Joerg Widmer	Elsevier Computer Networks

Sensors Inputs: an experimental study		
D2D-based QoS prediction analysis in beyond 5G V2X	Tomasz Mach, Galini Tsoukaneri, Daniel Warren	IEEE ICC 2021
Indoor 3D localization in emergency scenarios through drone based rapid 5G deployment	Mythri Hunukumbure, Oluwatayo Kolawole, Shangbin Wu, Yinan Qi	IEEE Globecom 2020 workshops, Taiwan, 7-11 Dec. 2020
Social-Aware Forecasting for Cellular Networks Metrics	J. Villegas, E. Baena, S. Fortes, R. Barco	IEEE Communication Letters
Location-aware Wireless Resource Allocation in Industrial-like Environment	Maurizio Rea, Domenico Giustiniano	IEEE Transaction on Mobile Computing
Location Security under Reference Signals' Spoofing Attacks: Threat Model and Bounds	Stefania Bartoletti, Giuseppe Bianchi, Danilo Orlando, Ivan Palamà and Nicola Blefari-Melazzi	ARES 2021 - ACM Conference
Location-based Analytics in 5G and Beyond	Stefania Bartoletti, Luca Chiaraviglio, Sergio Fortes, Takai Eddine Kennouche, Gurkan Solmaz, Giacomo Bernini, Domenico Giustiniano, Joerg Widmer, Raquel Barco, Giuseppe Siracusano, Andrea Conti, and Nicola Blefari Melazzi	IEEE Communications Magazine
5G and beyond for contact tracing	Domenico Giustiniano, Giuseppe Bianchi, Andrea Conti, Stefania Bartoletti, and Nicola Blefari Melazzi	IEEE Communication Magazine - Special issue on Networking Technologies to Combat the COVID-19 Pandemic
Cellular Network Radio Monitoring and Management through Virtual UE Probes: A Study Case Based on Crowded Events	Eduardo Baena, Sergio Fortes, Özgü Alay, Min Xie, Håkon Lønsethagen, Raquel Barco	SENSORS

Social-Aware Load balancing System for Crowds in Cellular Networks	Renato Torres, Sergio Fortes, Eduardo Baena, Raquel Barco	IEEE Access
Virtual Inertial Sensors with Fine Time Measurements	Maurizio Rea, Domenico Giustiniano, Joerg Widmer	IEEE MASS 2020
LSTM-based GNSS Spoofing Detection Using Low-cost Spectrum Sensors	Roberto Calvo-Palomino, Arani Bhattacharya, Gerome Bovet, Domenico Giustiniano	IEEE WOWMOM 2020
Uncertainty in Position Estimation Using Machine Learning	Yuxin Zhao, Deep Shrestha	IPIN 2021
5G Deployment Strategies for High Positioning Accuracy in Indoor Environments	Maria Posluk, Jesper Ahlander, Deep Shrestha, Sara Modarres Razavi, Gustav Lindmark, Fredrik Gunnarsson	IPIN 2021

Table 2: Scientific publications

2.2.3.2 Exhibitions, workshops, congresses

Table 3 reports the main exhibitions, congresses and workshops attended by LOCUS participants and where the LOCUS research outcomes have been presented in terms of tutorial, invited talk, or other types of dissemination activities.

Exhibition, Congress, Workshop	Partner Involved/Proposer	Name of the activity	Type of activity	Location	Date
Ericsson Research Open House Day	EAB	Deployment considerations for 5G positioning	Demo	Virtual	23-25 November 2020
5G International PhD School	IMDEA	Millimeter-Wave Localization and Location-Based Network Management	Keynote speech	Virtual	1 December 2020
5GPPP Technical Board Workshop	NXW	Localization analytics as a service platform for Smart 5G Network Management	Presentation	Virtual	9 December 2020
IEEE MASS	IMDEA	Virtual Inertial Sensors with Fine Time Measurements	Presentation	Virtual	11 December 2020
IEEE Radio Communications Committee	CNIT	Localization-of-Things in 5G Ecosystem	Invited Talk	Virtual	8 January 2021
WiLab - Huawei JIC Workshop on "Intelligent IoT for 6G"	CNIT	“Security and Privacy in 5G and Beyond: False Myths and Emerging Challenges" - Giuseppe Bianchi,	Presentation	Virtual	11 January 2021

		CNIT/University Rome Tor Vergata, IT			
IBM Telco Conference	IBM	Technical session	Presentation	Virtual	25 January 2021
POST-IRACON COST	CNIT	Localization-of-Things in the 5G Ecosystem	Keynote speech	Virtual	8 February 2021
2nd Post-IRACON Meeting	UMA	Cellular KPI Estimation with Social Information	Dissemination	Virtual	8-9 February 2021
IEEE WCNC 2021	CNIT	Integration of Radar Sensing and Communications	Panel	Virtual	30 March 2021
Workshop on Synchronization and Timing Systems 2021	CNIT, TEI	Synchronization and Positioning: Key Functions in 5G	Presentation	Virtual	31 March 2021
EUCNC 2021	CNIT, NXW	Autonomous Network Management towards 6G	Workshop	Virtual	11 June 2021
Spectrum Sensing and IoT workshop - Armasuisse	IMDEA	5G localization - Challenges and Opportunities	Invited Talk	Virtual	29 June 2021
IEEE MobiSys	IMDEA	Accurate ubiquitous localization with off-the-shelf IEEE 802.11ac devices	Presentation	Virtual	June 24 – July 1, 2021
IEEE MobiSys	IMDEA	A real-time experimentation platform for sub-6 GHz and	Presentation	Virtual	June 24 – July 1, 2021

		millimeter-wave MIMO systems			
IEEE SECON 2021	EAB	5G positioning for applications – opportunities and challenges	Keynote speech	Virtual	7 July 2021
IEEE SECON 2021	CNIT	5G positioning for applications - opportunities and challenges	Organization and Keynote Speech	Virtual	8 July 2021
IEEE WF-IoT 2021	NEC	Topical track on computing	Topical track	Hybrid (New Orleans)	12 July 2021
ACM ARES 2021	CNIT	Location Security under Reference Signals' Spoofing Attacks: Threat Model and Bounds	Presentation	Virtual	17-20 August 2021
GTTI 2021	CNIT	Location Security	Keynote Speech	In person	3 September 2021
URSI 2021	UMA	Análisis de Interferencia Cross-Link sobre un escenario 5G mmWave	Participation to a national conference	Virtual	20-24 September 2021
URSI 2021	UMA	Modelos de movilidad para simulación de multitudes sociales en entornos celulares	Participation to a national conference	Virtual	20-24 September 2021
URSI 2021	UMA	Aplicación móvil para localización de interior	Participation to a national conference	Virtual	20-24 September 2021

		mediante fusión de tecnologías			
URSI 2021	UMA	Sistema de detección cercana para misiones SAR basado en BLE y sistemas robóticos	Participation to a national conference	Virtual	20-24 September 2021

Table 3: Exhibitions, workshops, congresses

2.2.3.3 Related Projects

The collaboration between LOCUS and other research projects is classified in two main categories: (a) individual collaboration from partners with specific projects in research and common development topics, or (b) the collaboration of LOCUS as a whole in the area of 5G-PPP. The second type of activity is coordinated by CNIT and involves also other partners from the consortium.

2.2.3.3.1 Collaborations for research and development activities

LOCUS is collaborating with other EU projects in the framework of the 5G-PPP program and with projects of the ICT calls, as shown in Table 4:

Joint Collaboration with LOCUS	Partner Involved/Proposer	Type of activity	Key Points	Target (e.g., R&D collaboration)	Location	Date
CEF ODALA	NEC	EU project	Deployment in multiple smart cities in EU	R&D collaboration with cities	Europe	2021-2022
5G-POS	CNIT, IMDEA, SAMS, EAB	Joint project collaboration	Joint magazine on positioning and sensing for the V2X safety scenario	Research Activity	Europe	2021

HumAid	NEC Laboratories Europe, NEC Japan, ICRC	Joint project collaboration	Development of Humanitarian AI and IoT platform	R & D collaboration for humanitarian applications and mine action	Japan & EU	2020-2022
5G Solutions	IBM	Joint project collaboration	Deployment of localization service on 5G solutions test bed	R&D collaboration	Ireland	On-going activity from Jan 2021
PinPoint5G+	IMDEA	Research project	Positioning and network management	R&D collaboration	Spain	January 2019-December 2021

Table 4: Collaborations for research and development activities

2.2.3.3.2 Collaboration with 5G-PPP

The 5G Infrastructure Public Private Partnership (5G-PPP) is a joint initiative between the European Commission and European ICT industry (ICT manufacturers, telecommunications operators, service providers, SMEs and researcher Institutions). The coordinator of the LOCUS project is part of the steering board committee of 5G-PPP, attending periodical meetings with the coordinators of other ICT projects.

The scientific supervisor of the project, coordinating the scientific team, is also part of the technical board committee of 5G-PPP, attending periodical meetings and phone calls to organize dissemination events together with other ICT projects and present LOCUS results.

Within the 5G-PPP, LOCUS is part of the Automotive and Architecture working group. In terms of communication, the main activities carried out within 5G-PPP are:

1. Participation to the Annual Journal in 2020
2. Coordination of a joint workshop at EUCNC 2021 with other ICT-20 projects of 5G-PPP
3. White paper on “Empowering Vertical Industries through 5G Networks – Current Status and Future Trends”, presented on 9th September at a webinar co-organized by 5GPPP and 5G IA.

4. Presentation of the LOCUS work in the “White Paper V4.0: A European View on 5G Architecture and Beyond”
5. Organization of a Session dedicated to Localization within the workshop of the 5G-PPP technical board.
6. Organization of a joint workshop at ICC 2022 with other projects of 5G-PPP.

3. Plan for the Communication and Dissemination Activities in the Third Year (Oct 2021 - Oct 2022)

In D7.1v2, we have defined the main KPIs to measure LOCUS' success in conveying research outcomes. For each KPI, we have also presented target values for the second and third year of the project. In this Section, we detail the plan for the third year, by presenting the main joint communication and dissemination activities that the consortium intends to carry out, and the individual dissemination and communication plan for each partner, i.e., the activities that are planned individually, in addition to the joint ones.

3.1 Joint Communication and Dissemination Plan

Several activities have been planned for the next reporting period as joint activities among multiple partners. The main joint activities follow:

- The organization of the accepted workshop at the IEEE Globecom 2021 conference. The workshop is led by CNIT and VIAVI. Other partners will participate as keynote speakers or through the presentation of a conference paper.
- The organization of the accepted workshop at the IEEE ICC 2022 conference. The workshop is led by CNIT and IMDEA and in collaboration with other 5G-PPP projects. Other partners will participate as keynote speakers or through the presentation of a conference paper.
- Proposal of participation at the Mobile World Congress 2022.
- The participation to the 5G-PPP Annual Journal.
- The submission of joint technical papers will be incentivized during general and internal calls.

3.2 Individual Dissemination and Communication Plan

In addition to the joint activities involving multiple partners, each partner provided a dissemination plan, considering the main activities and proposing an expected number of activities for each category related to the second year, as detailed in the following table:

Activity	CNIT	ERI	IBM	IMDEA	INCE	NEC	NXW	ORA	OTE	SAMS	VIA	UMA
Journal papers on international peer-reviewed journals	5 (IEEE VTC 2021, IEEE Transactions on Information		1	2	1	1 (IEEE ComMag)		3 planned journal papers				5 (IEEE journals or similar, SENSORS)

	Forensics & Security, IEEE Transactions on Wireless Communications, KICS Winter 2021, IEEE Access)											
Participation to international conferences	5 (e.g., EUCNC, Globecom, ICC, IRACON, WCNC)	1	2	3	2	6	2	1	2	3 (in main IEEE conf)	2	1 (EUCNC, GLOBECOM, VTC or similar, IRACON)
Number of events targeting the general public.	5G Italy								1 (Infocom World)			3
Press articles	1	2		1								1
Number of policy-makers, societal, and environmental stakeholders and institutions reached	3 (Italian Government, Regional Government)					3 (Stakeholders in City of Heidelberg, ICRC)	1 (wholesale infrastructure operator)			2 (Developing UK ESN stakeholders, European EENA)		
Number of participations to industry events.	MWC 22				1	3 (IOWN, GICHD workshop)				2		
Number of demonstrations through PoCs tested in relevant environments (TRL 5).	1					1	1	1 Demo in Orange Research Exhibition		1		

Number of people involved from general public	>100	>100				>100	>100	>100		>100		>100

Table 5: Individual Dissemination and Communication Plan

Several partners are planning to collaborate with peer projects also during the second year, i.e.:

- CNIT is leading the LOCUS activities within 5G-PPP, within the technical and steering board, as well as the Automotive Working Group.
- INCE is representing LOCUS within the 5G-PPP Architecture Working Group.
- SAMS is leading a measurement campaign within T3.3 with facilities provided by 5G-VINNI.
- IMDEA is collaborating with the projects 5GPos and 5GSmart.

In addition, several partners are participating to working groups within standardization bodies and will propose specific contributions based on LOCUS research outcomes. A detailed standardization plan is presented in Section 4.

4. Standardization Activities

There are several important standardisation activities happening around localization and the LOCUS project has managed to contribute to many of them. These activities range from the planned activities in 3GPP which aim to enhance localization accuracy for enabling 5G vertical applications to the new efforts in ETSI related to track and trace applications as a response to the COVID-19 pandemic. The open standards, particularly O-RAN and OAI, are looking at supporting localization applications in a more virtualized and open manner. The project is closely following these developments and will contribute to these where possible.

Details of the first-year activities in these fronts are provided in the sections below.

4.1 3GPP

4.1.1 Monitoring and Contribution

With localization related topics in 3GPP 5G-NR standardisation, there is a clear emphasis to improve the localisation accuracies and other KPIs from the levels required for traditional outdoor and indoor emergency use cases to more commercial applications in 5G verticals. In this regard, there is a number of related activities in the RAN and SA working groups.

In RAN (mainly in RAN1), the NR-positioning study and work items in release 16 defined the simulation parameters and the basic positioning signals of PRS (positioning reference signal for downlink) and SRS (sounding reference signal for uplink) respectively. In the subsequent NR-positioning enhancements study item in release 17 (https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_86/Docs/RP-193237.zip), the high precision localization for Industry IoT applications is studied. In RAN2 of NR Rel.17 work, it is the first time that the topic of positioning integrity is being discussed and studied. While until now 3GPP has been mainly focusing on positioning accuracy, currently in Rel.17 both latency and integrity are being also studied, together with other KPIs. Ericsson on behalf of LOCUS has been contributing to the integrity topic in RAN2 and the following contributions are with respect to the work carried in LOCUS:

- R2-2006954, **"POSITIONING INTEGRITY KPIS", RAN2 CONTRIBUTION, ERICSSON.**
- R2-2006955, **"FACTORS IMPACTING RAT DEPENDENT POSITIONING INTEGRITY", RAN2 CONTRIBUTION, ERICSSON.**
- R2-2006957, **"LPP SIGNALING FOR INTEGRITY SUPPORT", RAN2 CONTRIBUTION, ERICSSON.**

Figure 8 shows the 3GPP positioning anatomy history for RAN1 and RAN2 positioning study items and work items throughout different releases.

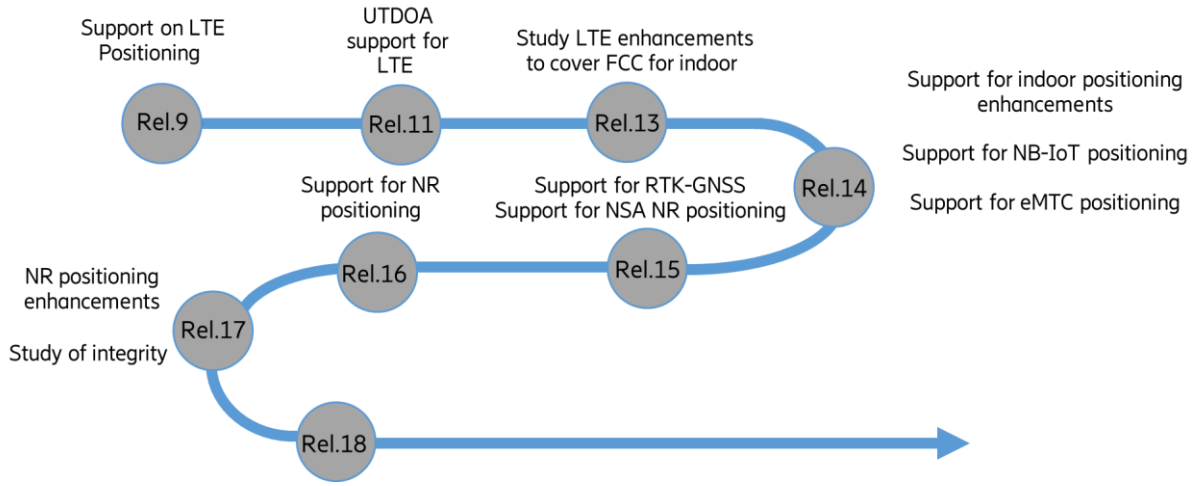

Figure 8: 3GPP positioning anatomy.

The Rel.17 SI for RAN1 has been finalized in 2020, and the Rel-17 WI was approved in the 3GPP RAN plenary in March 2021. The work in RAN1 is intended to be finalized by the end of the year, while RAN2 and RAN3 work are expected to last until March 2022. There has been a large Rel-18 scoping workshop and process happening in 3GPP RAN, and currently after the September plenary there is a quite a stable list of items for Rel-18 standardization ready to be approved in the December RAN plenary.

Expanded and improved positioning is one of the RAN1-led items within Rel-18. There is an expected study item with 9 months duration for sidelink positioning and ranging which will include study solutions including reference signals, measurements, procedures and also to include ranging (i.e. relative positioning) and absolute positioning. Coverage scenarios will focus on out-of-coverage (with the understanding that in-coverage and partial-coverage are supported if out-of-coverage is supported). Moreover, the improved accuracy, integrity (RAT-dependent positioning techniques), and power efficiency are considered by specifying higher layer solutions for Integrity for RAT dependent positioning techniques and for accuracy improvement based on PRS/SRS bandwidth aggregation and NR carrier phase measurements.

Reduced Capability (RedCap devices) positioning is also considered by evaluating performance of existing Rel-17 positioning procedures and measurements with RedCap UEs.

Also there is an AI/ML in PHY layer study item for the first time in Rel-18 and positioning has become one of the three focus areas to be studied. Therefore, 3GPP RAN Rel-18 will cover several positioning items and therefore we believe there will be a lot of potential for LOCUS project to contribute and monitor.

In SA2, there are concurrent work items as enhanced Localisation Services (eLCS) and eLCS phase 2 for Rel. 16 and 17 respectively. These work items define the architectural framework for 5G-NR localisation services and for high precision Industry IoT applications, respectively. Samsung is actively participating in this SA2 eLCS phase 2 topic and has provided a number of

contributions in 2021. Samsung proposed the new Multiple QoS class in Release 17 eLCS, also referring to some of the work done in the LOCUS project, particularly in simulations to show the benefits in reducing latencies with this new QoS class. These latency reductions are reported in LOCUS deliverable D3.4. Samsung and Ericsson discussed this new proposal in the 3GPP focus group meetings organised by the LOCUS standardisation task working group and Ericsson agreed to co-sign these related SA2 Tdocs from Samsung. This new concept was approved in SA2, in May 2021. All these Tdocs (listed below) refer to the LOCUS project, as the project where part of the related work was conducted:

- S2-2100393, S2-2100394, S2-21002525, "**Support for Multiple QoS Class in deferred location requests**"
- S2-2102524, **"Discussion of Multiple QoS Class for efficient, flexible location estimation"**
- S2-2103836, "**Support for Multiple QoS Class in deferred location requests**" – *addresses editor notes*
- S2-2105125, **"Support for Multiple QoS Class in deferred location requests" –** *approved CR*

Looking ahead at 3GPP plans for Release 18, currently there are discussions and workshops to agree on the respective study and work items for RAN and SA. It is very likely that localization related topics will become part of release 18 development, as many companies showed interest in such topics in the initial discussions, in both RAN and SA. The LOCUS project 3GPP focus group will continue to follow these discussions and will support a common approach w.r.t. localization within the focus group members, as detailed in section 4.1.2 below.

4.1.2 Work progress in LOCUS w.r.t. 3GPP

At the beginning of the LOCUS project, it was identified that WP3 work is well aligned with the NR-positioning enhancements study item in 3GPP RAN working groups and several steps have been taken even from the early preparation of the 3GPP enabler technology task (T3.1) to be compatible with this. The NR-positioning work in Rel.16 was introduced to the partners and they were encouraged to follow the simulation specifications of TR 38.855. A 3GPP focus group was created with the joint leadership of Samsung and Ericsson, the two industry partners active in the 3GPP NR-positioning enhancements study and in LOCUS T3.1. There have been many discussions in the focus group targeting to identify and agree on potential areas that technical contributions to 3GPP RAN can be made. The positioning integrity topic in RAN2 and the use of multiple reference signals (to broaden the scope than the PRS and SRS reference signals defined as per 3GPP release 16 specs) are two of the areas that have emerged. So far Ericsson has made 3 technical contributions to the 3GPP RAN2 working group on the topic of positioning integrity.

With 3GPP Release 17 work, it was identified that some of the areas discussed in the eLCS phase 2 topic can be quite relevant to the 'Integration with non-3GPP technologies' theme of LOCUS T3.2. Samsung undertook a new work area in this Task on 'Integration of 5G and UWB localization in crowded environments. The new QoS class Samsung proposed in the eLCS phase 2 was used in the research study developed in this work area, as discussed above. This study is continuing and will show the final results in D3.4. This research activity is also focusing on the use of user clustering and the NR-sidelink for positioning amongst the cluster members to reduce the overheads. The NR-sidelink usage is likely to be a main topic in 3GPP Release 18 NR-positioning work thread.

Moreover, LOCUS is involved in 3GPP RAN3 activities related to Self-Organized Networks (SON) and Minimization of Drive Tests (MDT), topics that involve the exploitation of geolocation information for RAN management and optimization. In particular, Orange is supporting an ongoing work item on enhancement of data collection for SON/MDT in NR which can be fed with LOCUS WP4 activity.

The 3GPP focus group meetings within LOCUS are held once every 4 months. All partners are invited, and the meetings are chaired by Samsung as the Standardisation task leader. These meetings are used to update the LOCUS partners on the latest developments in the Localization related topics in RAN 1, 2 and SA2 by relevant Standards delegates from Ericsson and Samsung. Also, opportunities to collaborate and push ideas relevant to the LOCUS project are also discussed, as illustrated by the case of the Multiple QoS class detailed in Section 4.1.1. Future meetings will cover the localization topics that are likely to emerge in Release 18 and also on possibilities for the 3GPP partners (Samsung, Ericsson, Orange and NEC) to collaborate.

4.2 ETSI

During the first two years, the LOCUS project actively contributed to various standardization activities in ETSI. The partner Samsung was the one leading this activity, and this encompassed the following groups:

a) **ETSI Intelligent Transport Systems (ITS) Technical Committee**: From the beginning of the project both in WP4 and WP5, LOCUS championed topics related on how improved 5G localization and analytics mechanisms developed by LOCUS could contribute to novel 5G verticals applications such as Connected and Automated Mobility (CAM), including Vehicle-To-Everything (V2X) communications, considering their specific characteristics such as importance of road users, safety aspects etc. In WP5 this work, in collaboration with other partners resulted in developing Vulnerable Road User (VRU) use case (NSE-UC3) and other technical contributions on corresponding new functionalities and their data models such as 'Vulnerable Road Users clustering', which aim to improve V2X communication system

performance by leveraging improved 5G location accuracy. In addition, the 'Time-To-Collision as a service in V2X' functionality (described in D5.1) is also applicable to Logistics in a seaport terminal using AGVs use case (NSE-UC4). These solutions may be the future enabler for new applications in CAM leveraging 5G analytics. It is worth highlighting that the proposed mechanisms were developed based on the current progress of V2X technology standardization in Europe, in ETSI ITS. This includes ongoing VRU standard development for ITS standard [1] and for V2X globally (5G Automotive Association), where Samsung is actively involved, seeking potential relevance and contribution opportunities for LOCUS research and technology. So far, this activity ensured technical insights and direct relevance of LOCUS work into recent developments in the automotive vertical ecosystem.

b) **ETSI Europe For Privacy-Preserving Pandemic Protection (E4P) Industry Specification Group**: This new group, formally created in May 2020, has been developing COVID-19 proximity tracing systems as an interoperability framework for contact tracing applications. The current standardization work is focused on smartphone-based proximity systems using Bluetooth technology for proximity detection, however later, the group will explore other systems including cellular based solutions. Samsung as rapporteur of one of the core technical specifications [2] provided periodic E4P progress and roadmap updates to LOCUS partners facilitating potential contribution of developed solutions addressing COVID-19 to E4P in Q2 2021. In addition, Samsung indicated challenges and technical areas not fully addressed by currently deployed Bluetooth based solutions, enabling better Health Authority insight into pandemic development. This could be addressed further by LOCUS research activities and platform development, leveraging improved 5G location accuracy and analytics. This activity supports corresponding COVID-19 focused research in WP5, demonstrates consortium flexibility and proactive approach as far as timely addressing of global challenges posed by the coronavirus. It should be mentioned that this action is beyond the initial scope of the project.

4.3 FiRa consortium

Recently, Ultra-Wideband (UWB) based positioning has gained much attention due to the very high accuracy levels it can provide (up to 10 cm accuracy). The FiRa (or Fine Ranging) consortium [5] promotes the use of UWB for several localization applications and has seen a rapid growth of its membership over the past year. It develops specifications for the higher management and application layers but uses the specs of IEEE 802.15.4z for the PHY and MAC layers of the UWB based localization solutions. Samsung is a member of the FiRa consortium and will closely follow its developments. If there is an opportunity, Samsung will contribute, citing the LOCUS project, from the T3.2 UWB based study.

4.4 Open-Source Contributions

This section presents a brief introduction of some existing open standards emphasizing on their compatibility to the LOCUS project. It also shows how the work carried out within the LOCUS project can contribute to these standards.

4.4.1 Open Air Interface (OAI)

OAI [3] is a flexible software platform providing 3GPP compliant reference implementations of key elements of 4G and 5G Radio Access Network (RAN). The current focus of OAI is in the development of a 5G NSA solution using the EN-DC architecture where the eNB handles all the control-plane traffic and the gNB only needs to handle the user-plane traffic.

The physical layer already implements 4G features according to 3GPP 36.211, 36.212, 36.213 specification and 5G features according to 3GPP 38.211, 38.212, 38.213 specification under development. These features support all downlink and uplink channels including sounding reference signals (SRS) which can be used to retrieve location information.

Within the LOCUS project, IMDEA Networks is deploying a testbed in the 5TONIC lab to use OAI and implement a 5G link between the UE and BS in the context of WP3 for fast and low-overhead localization for URLLC service and had conducted the first experiments which are reported in D3.2. The testbed has been upgraded using the latest USRP N310 as BS and a powerful server with 16 cores for data processing. This link will allow the testing of the proposed fast localization strategies.

4.4.2 Open-Source MANO (OSM)

OSM [4] is an operator-led ETSI community with the objective to deliver production-quality open-source solutions for Network Functions Virtualization (NFV) Management and Orchestration (MANO). The solutions are closely aligned with ETSI NFV Information Models and are versatile, easily applied in both laboratory and field (real-world) trials.

As regards LOCUS, the ETSI MANO architecture is very relevant as it offers application programme interfaces (APIs), data models and workflow logic for building complex services.

The LOCUS platform can be implemented and deployed as a specific case of NFV. The LOCUS platform can be implemented and deployed as a specific case of NFV. In particular, Nextworks is using the ETSI OSM for the management and orchestration functionalities of the virtualization platform used in WP4 and WP5, as well as for LOCUS PoCs in WP6. The PoC #1 demo Nextworks prepared for the project review meeting in July 2021, for example, contained these ETSI OSM functionalities.

4.4.3 O-RAN Alliance

The Open-Radio Access Network (O-RAN) alliance is a community of network operators, vendors, and research institutions working on the RAN industry [6]. The main focus of the O-RAN alliance is to build the virtualized RAN on open hardware and cloud, with embedded AI-powered radio control. To this aim, an O-RAN architecture is conceived, based on standards defined by the alliance itself, which are aligned and complimentary to standards promoted by 3GPP and other industry standards organizations.

Orange is a founding member of O-RAN and is actively involved in the definition and standardization of several use cases. In this context, the Orange division involved in LOCUS is focusing on data enrichment for use cases involving geolocation data. These can include geolocation, user context information for mobility management, application layer data etc. The work performed in WP4, i.e., the use of geolocation for smart network management, will be exploited for contributing to location-based use cases in O-RAN standardization. The selection of LOCUS outcomes to be proposed in O-RAN is under discussion within WP4 and led by Orange and VIAVI. Based on such discussion, specific contributions will be agreed with the consortium at the beginning of the second year of the project.

References

1. ETSI TR 103 300-1 ‘Intelligent Transport Systems (ITS); Vulnerable Road Users (VRU) awareness; Part 1: Use Cases definition; Release 2’ V2.1.1 (2019-09)
2. ETSI GS E4P-006 ‘Device-based mechanisms for pandemic contact tracing systems’
3. Kaltenberger F, Silva AP, Gosain A, Wang L, Nguyen TT. OpenAirInterface: Democratizing innovation in the 5G Era. Computer Networks. 2020 May 1:107284.
4. ETSI Open-Source MANO, https://osm.etsi.org/
5. Fira consortium, https://www.firaconsortium.org/
6. O-RAN Alliance https://www.o-ran.org/about