H2020 5G-TRANSFORMER Project
Grant No. 761536

Communication, Dissemination, and Exploitation achievements of Y1 and plan for Y2

Abstract

This document presents an update for Y2 of the Communication, Dissemination, and Exploitation Plan (CoDEP) taking as reference the initial plan described in D6.1. Communication includes all the activities related with the promotion of the project, the interaction with other research projects (including coordination with other 5GPPP projects), as well as with the non-specialist, i.e., society at large. Dissemination includes activities related to raising awareness of the 5G-TRANSFORMER results in technical communities much closer to the project topics. This is done through peer-reviewed publications in academic conferences and journals, and it also includes participation and organization of technical events. Exploitation includes the activities aiming at using the results from the 5G-TRANSFORMER project in developing, creating and marketing products or processes, or provisioning a service. Project results will also be exploited through the standardization activities. In addition to updating and refining the CoDEP for Y2, this document also lists all the achievements and activities undertaken during the first year of the project. All the achievements are classified according to the CoDEP categorization. The activities carried out during the first year reflect the initial goal of raising awareness about the project, and so, the web site, social media posts, press releases, and presence at relevant events go in this direction. Additionally, publications, participation and organization of events, and contributions to standardization fora, among others, initiate the transition from the *raise awareness* phase of the project to the *presentation of results* phase, as defined in the plan.

Document properties

Document number	D6.2
Document title	Communication, Dissemination, and Exploitation achievements of Y1 and plan for Y2
Document responsible	Chia-Lin Lai (ITRI)
Document editor	Chia-Lin Lai (ITRI)
Editorial team	Josep Mangues-Bafalluy (CTTC), Giulio Bottari (TEI), Adlen Ksentini (EURECOM), Ulises Olvera-Hernandez (IDCC)
Target dissemination level	Public
Status of the document	Final
Version	1.0

Production properties

Reviewers	Josep Mangues-Bafalluy (CTTC), Thomas Deiß (NOK-N), Carlos J. Bernardos (UC3M)

Disclaimer

Table of Contents

List of Contributors

Partner Short Name	Contributor's name
UC3M	Carlos J. Bernardos, Antonio de la Oliva, Luca Cominardi, Carmen Guerrero
NEC	Andres Garcia-Saavedra, Xi Li
TEI	Giulio Bottari, Paola Iovanna
ATOS	Jose Enrique González
NOK-N	Thomas Deiß
IDCC	Alain Mourad, Ulises Olvera Hernandez
TID	Luis M. Contreras
ORANGE	Thouraya Toukabri
CRF	Giuliana Zennaro
SAMUR	Javier Quiroga
BCOM	Cao-Thanh Phan
NXW	Giada Landi
MIRANTIS	Dmitriy Andrushko
CTTC	Josep Mangues-Bafalluy, Iñaki Pascual, Ricardo Martínez
POLITO	Carla Chiasserini, Francesco Malandrino
EURECOM	Adlen Ksentini
SSSA	Luca Valcarenghi, Barbara Martini
ITRI	Chia-Lin Lai

List of Figures

List of Tables

List of Acronyms

Acronym	Description
3GPP	Third Generation Partnership Project
5G PPP	5G Public Private Partnership
API	Application Programming Interface
BTS	Base Transceiver Station
CDB	Common Dissemination Booster
CDN	Content Delivery Network
CPRI	Common Public Radio Interface
CSA	Coordination and Support Action
DWDM	Dense Wavelength Division Multiplexing
E2E	End-to-end
EPC	Evolved Packet Core
ETSI	European Telecommunications Standards Institute
ICT	Information and Communication Technology
IEEE	Institute of Electronics and Electrical Engineering
IETF	Internet Engineering Task Force
IMT	International Mobile Telecommunications
IoT	Internet of Things
IP	Internet Protocol
IPR	Intellectual Property Rights
IRTF	Internet Research Task Force
ITS	Intelligent Transport Systems
ITU-T	International Telecommunications Union – Telecommunications standardization sector
LTE / -A	Long Term Evolution / -Advanced (3GPP)
MEC	Multi-Access Edge Computing
MME	Mobility Management Entity
MTP	Mobile Transport and Computing Platform
MVNO	Mobile Virtual Network Operator
NFV	Network Functions Virtualization
NFVRG	NFV Research Group (IRTF)
NGMN	Next Generation Mobile Networks
OBSAI	Open Base Station Architecture Initiative
ONF	Open Networking Foundation
OPNFV	Open Platform for NFV
QoS	Quality of Service
SDN	Software Defined Networks
SDO	Standard Development Organization
SO	Service Orchestrator
S-/P-GW	Serving / Packet Data Network Gateway
V2X	Vehicle-to-everything
VNF	Virtual Network Function
VNFM	Virtual Network Function Manager
VS	Vertical Slicer
WG	Working Group

Executive Summary and Key Contributions

This document has two main objectives:

- Update/Refinement of the Communication, Dissemination, and the Exploitation Plan (CoDEP) of 5G-TRANSFORMER after the execution of the project for the first year.
- Report on all the achievements and activities undertaken during the execution of the project for the first year.

First, this document reviews the plan on Communication, Dissemination, and the Exploitation (CoDEP) presented in D6.1 [1] and updates/refines the plan according to the execution of the project for the first year. According to common practice ([4], [5]), *Communication* includes all the activities related with the actions targeting a wide audience, including the interaction with other EU and international projects and society at large. *Dissemination* focuses on the actions with a research audience working in the same technical field. *Exploitation* deals with the actions that extend the results of the project beyond the project duration aiming at having a long-lasting impact in the form of new products and services, standardization efforts, and their integration in future projects.

The following paragraphs introduce the most relevant aspects of the plan, including the differences with respect to what was presented in D6.1. In this sense, the Communication plan for Y2 follows the plan presented D6.1 [1]. The original plan covers actions targeting the widest possible audience, including coordination with other 5G-related projects (e.g., other 5GPPP projects). The *Communication plan* will continuously be monitoring to see if any adaptation is needed.

The *Dissemination plan* for Y2 also follows the plan in D6.1 [1], and given that the project is now entering the *presentation of results* phase, some metrics and the list of activities were reviewed to better adapt it to the tasks to carry out. In this sense, a new activity, named *participation to events* was added. Overall, dissemination now covers:

- Publication of research results.
- Academic activities.
- Technology demonstrations.
- Organization in events.
- Participation to events.

The plan also integrates the Common Dissemination Booster (CDB) [6] services, which the project uses jointly with 5G-Crosshaul and 5G-Coral as part of the CDB04/05-5G-TRANSFORMER group. It consists of 5 services ranging from portfolio identification to dissemination campaign management.

The *Exploitation plan* for Y2 extends the plan presented in D6.1 [1] and refines the potential impact on the products and services of the partners. Particularly relevant as far as exploitation is concerned is the *Standardization plan* for Y2, which further elaborates the Standardization Activity Roadmap (SAR), according to the guidelines set by the Standardization Advisory Committee (SAC) of the project. These actions set the basis for long-lasting impact of the project results.

Finally, this document reports all the activities and events undertaken during the first year of the project, which focused on raising awareness of the project, and so, the communication part had a starring role. These achievements are presented following the same order and classification of the CoDEP, which offers a systematic way of checking the results of its execution.

The project is now transitioning to the *presentation of results* phase, in which dissemination and, partially, exploitation will increase their relevance.

The key achievements of the execution of the CoDEP during the first year are:

- Communication:
    ◦ Generation of promotion material (incl. web, social media, press releases, leaflets, posters, video, communication articles and presentations) used on the web and in a number of events to raise awareness of the project.
    ◦ Steady increase of the web and social media impact, for instance, reaching 4000 visits on the web or 32000 Twitter impressions.
- Dissemination:
    ◦ Publication of a remarkable number of papers in peer-reviewed journals, conferences, and workshops (6 in Journals, 20 at conferences and 9 at workshops).
    ◦ Organization of four technical workshops or special sessions (and more under preparation) and participation to multiple events to present the scope and initial results of the project.
    ◦ Start of the common dissemination booster activities.
- Exploitation:
    ◦ Steady-state operation of the standardization advisory committee and continuous refinement and tracking of the standardization roadmap.
    ◦ As part of these roadmap, a number of contributions, mostly to ETSI MEC and IETF working groups (e.g., NFVRG, CCAMP) were submitted. 16 contributions to four different SDOs: 10 to IETF, 1 to 3GPP, 4 to ETSI MEC, and 1 to NGMN.
- Additionally, the Communication, Dissemination, and Exploitation plan has also been refined.

1 Introduction

As shown in Figure 1, the 5G-TRANSFORMER project is in *Milestone 2* (*MS 2*): *Updated CoDEP plan for Y2*. Therefore, this document reports on all activities undertaken corresponding to CoDEP in the execution phase of the 5G-TRANSFORMER project during the first year as well as its update for Y2. The project is now transitioning from the *raise awareness* phase to the *presentation of results* phase. As a consequence, dissemination and exploitation will start increasing their relevance. In any case, some results have already been obtained, as presented in the achievement sections of this document.

As presented in D6.1 [1], the CoDEP of 5G-TRANSFORMER includes the following groups of activities:

- **Communication:** It includes all the activities related with the promotion of the project and its results beyond the project's own community. This includes the interaction with other research projects (e.g., H2020 5G PPP) as well as communication of its research in a way that is understood by the non-specialist, e.g., the media and the public.

- **Dissemination:** It includes activities related with presenting its results in a technical community working on the same research field. In general, this will be done through peer-reviewed publications in academic conferences and journals, and participation and organization of technical events.

- **Exploitation:** In accordance with the European IPR Helpdesk [4], it covers activities aiming at using the results in further research activities other than those covered by the project, which mostly imply 1) developing, creating and marketing products or processes, 2) creating and providing a service, or 3) standardization activities.

In addition, the original CoDEP may need to be adapted during the project lifetime if new relevant opportunities appear. Therefore, the current CoDEP will be updated/refined based on those relevant events or activities.

The Communication plan for Y2 is basically the same as that in D6.1 [1]. The Dissemination plan for Y2 also follows that presented in D6.1 [1], but it introduces a new activity related with participation to events to better reflect all the types of activities carried out. It also introduces the Common Dissemination Booster (CDB) services, jointly developed with 5G-Coral and 5G-Crosshaul. The Exploitation plan for Y2, as far as products and services is concerned, is updated. Of high relevance is also the Standardization plan for Y2, which derives from the Standardization Activity Roadmap (SAR) defined by the Standardization Advisory Committee (SAC).

More specifically, the communication part has carried out a number of activities related to:

- Web portal and social media accounts.
- Project brochure.
- Project poster.
- High-level project presentation and participation at events to explain project scope.

- Videos.
- Participation in events for a general audience (e.g., open science week).
- Collaboration with other projects.
- University lectures.

The dissemination part has carried out a number of activities related to:

- Publication of research results in technical journals and conferences.
- Enrolment of PhD and Master Students on the topics dealt with in the 5G-TRANSFORMER project.
- Participation in technical events, public exhibitions and demonstrations.
- Organization of special events (e.g., technical workshops).

The exploitation part carried out a number of activities related to:

- Technology roadmap (including improvement to products and services).
- Contribution to standardization bodies.
- Patent and licensing.
- Contribution to relevant open source software projects.
- Use of Common Dissemination Booster (CDB) services jointly with 5G-Crosshaul and 5G-Coral.

The above activities will continuously be tracked throughout the project lifetime and, specifically for the exploitation part, are conceived to achieve an impact after the project ends.

In order to give a clear guide to this document, the following paragraphs present the structure of the document.

Section 2 focuses on the update/refinement of the 5G-TRANSFORMER CoDEP. Based on the planned roadmap presented in D6.1 [1], it adds events/activities during Y2 that are relevant for the project and are included in the CoDEP.

Section 3 specifically focuses on the achievements on Communication in Y1. It reports on the communication and public activities undertaken in Y1. These activities target society at large through various channels, including portal, social networks, videos, and press releases. It also reports on related collaboration activities undertaken with other 5G-PPP projects and working groups. These activities mainly focus on promotion of the 5G-TRANSFORMER project to 5G R&D stakeholders to create collaboration opportunities with other projects.

Section 4 reports on the dissemination activities including talks, workshops, and peer-reviewed journals and conference papers as well as participation in the CDB.

Section 5 reports on the exploitation activities, including the development of 5G-TRANSFORMER components with potential impact on product/service portfolios of partners. It also reposts on the activities related to relevant standard bodies, such as 3GPP, IETF, or ETSI.
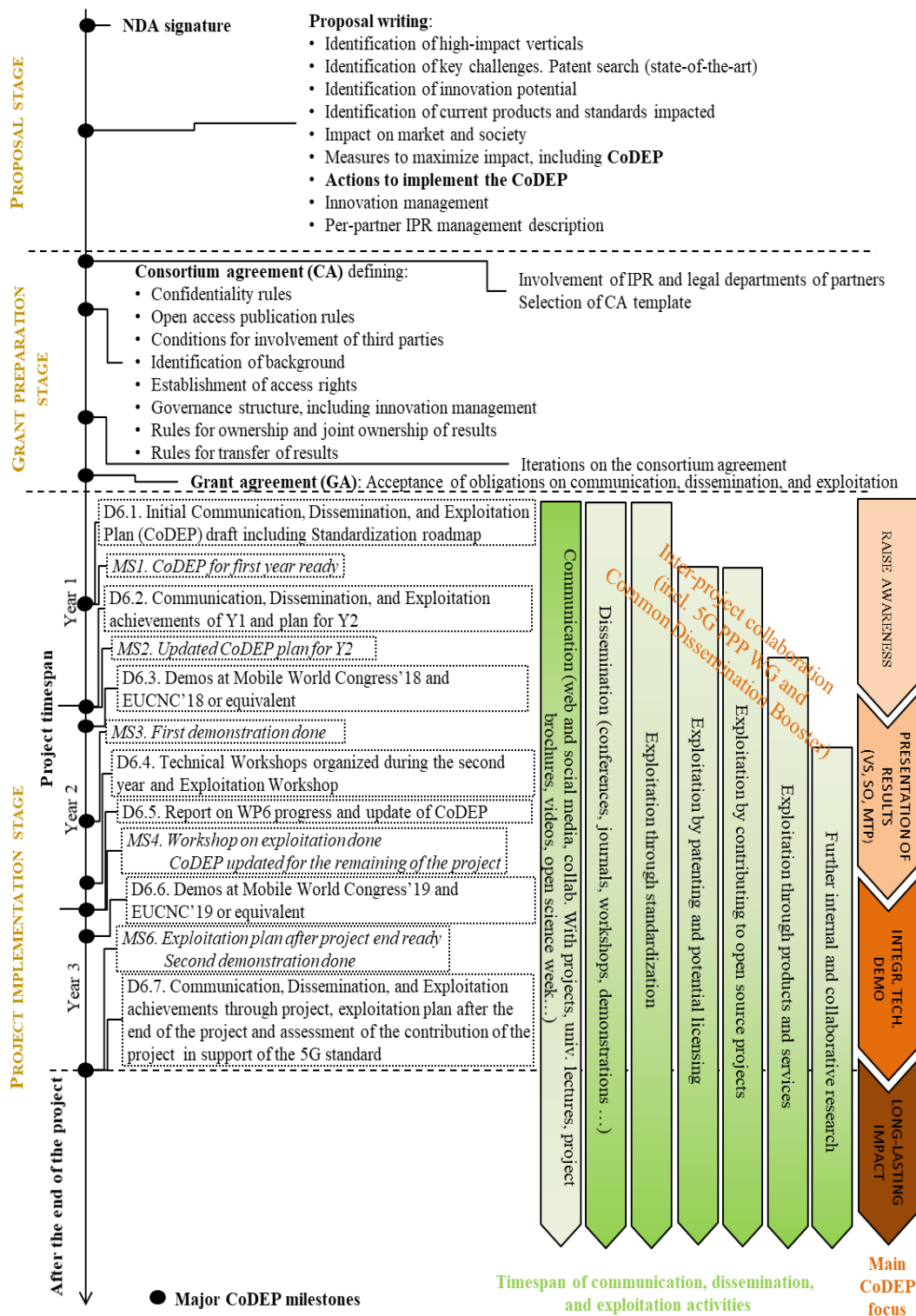
PROPOSAL STAGE

• NDA signature

Proposal writing:
• Identification of high-impact verticals
• Identification of key challenges. Patent search (state-of-the-art)
• Identification of innovation potential
• Identification of current products and standards impacted
• Impact on market and society
• Measures to maximize impact, including **CoDEP**
• **Actions to implement the CoDEP**
• Innovation management
• Per-partner IPR management description

GRANT PREPARATION STAGE

Consortium agreement (CA) defining:
• Confidentiality rules
• Open access publication rules
• Conditions for involvement of third parties
• Identification of background
• Establishment of access rights
• Governance structure, including innovation management
• Rules for ownership and joint ownership of results
• Rules for transfer of results

Involvement of IPR and legal departments of partners
Selection of CA template

Iterations on the consortium agreement

Grant agreement (GA): Acceptance of obligations on communication, dissemination, and exploitation

PROJECT IMPLEMENTATION STAGE

Project timespan

Year 1
D6.1. Initial Communication, Dissemination, and Exploitation Plan (CoDEP) draft including Standardization roadmap

MS1. CoDEP for first year ready

D6.2. Communication, Dissemination, and Exploitation achievements of Y1 and plan for Y2

MS2. Updated CoDEP plan for Y2

D6.3. Demos at Mobile World Congress'18 and EUCNC'18 or equivalent

MS3. First demonstration done

Year 2
D6.4. Technical Workshops organized during the second year and Exploitation Workshop

D6.5. Report on WP6 progress and update of CoDEP

*MS4. Workshop on exploitation done
CoDEP updated for the remaining of the project*

D6.6. Demos at Mobile World Congress'19 and EUCNC'19 or equivalent

Year 3
*MS6. Exploitation plan after project end ready
Second demonstration done*

D6.7. Communication, Dissemination, and Exploitation achievements through project, exploitation plan after the end of the project and assessment of the contribution of the project in support of the 5G standard

After the end of the project

● Major CoDEP milestones

Communication (web and social media, collab. With projects, univ. lectures, project brochures, videos, open science week…)

Dissemination (conferences, journals, workshops, demonstrations…)

Exploitation through standardization

Exploitation by patenting and potential licensing

Exploitation by contributing to open source projects

Exploitation through products and services

Further internal and collaborative research

Inter-project collaboration (incl. 5G PPP WG and Common Dissemination Booster)

RAISE AWARENESS

PRESENTATION OF RESULTS (VS, SO, MTP)

INTEGR. TECH. DEMO

LONG-LASTING IMPACT

Timespan of communication, dissemination, and exploitation activities

Main CoDEP focus

FIGURE 1: ILLUSTRATION OF THE COMMUNICATION, DISSEMINATION, AND EXPLOITATION (CODEP) PLAN OF 5G-TRANSFORMER

2 Communication, Dissemination, and Exploitation Plan (CoDEP) for Y2

This section outlines the CoDEP for Y2. Section 2.1 describes the communication plan for Y2, Section 2.2 describes the dissemination plan for Y2, and Section 2.3 describes the Y2 plan on Exploitation, including products and services, patent and licensing, and standardization. It is noted that the CoDEP follows what was initially presented in D6.1 [1] and it is adapted according to the project evolution (e.g., to reflect new activities).

2.1 Communication plan in Y2

2.1.1 Work plan

The main objective of the 5G-TRANSFORMER communication plan is to raise awareness of the 5G-TRANSFORMER project vision, concept, objectives, and results among the various stakeholders. Table 1 lists each target audience, the scope of activity, timing and the corresponding metrics to measure the progress and success. Therefore, in Y2, it follows what is defined in Table 1 to continue promoting the 5G-TRANSFORMER project.

TABLE 1: COMMUNICATION ACTIVITIES IN 5G-TRANSFORMER

Audience	Activity	Timing	Metric
General audience	A project **website** will be designed, implemented and maintained. **Social media** accounts will also be created. They will include information about concepts, vision, objectives and expected outcomes as well as public documents deriving from the project work, which will be regularly updated, offering links to other relevant sites and links to partner' websites.	Initial content, and after that, event driven	Number of unique visits, Pages most visited, Papers most download, LinkedIn and Twitter metric
General audience (mostly technical)	**Project brochures and videos** with information on the project scope and results, demonstrations carried out, and any relevant event related with the project activities.	Initial content, and event-driven	Number of downloads and number of times video played
Other research projects	**Collaboration with other EU and international research projects** (e.g., through 5G PPP working groups, or working groups of other platforms, such as networld2020, will also be key towards a coordinated action inside the 5G PPP and with other H2020 projects related with the vertical industry involved in the project. One of the expected results is the joint production of white papers.	5G PPP WGs and ad hoc bi-lateral collaboration	Number of meetings attended (target: at least two per year) Number of joint documents generated (target: at least two per year)

Grad and undergrad students	Introducing 5G-TRANSFORMER concepts and results to **lecture materials** prepared by academic partners for undergraduate and graduate students.	Potential input every semester	Number of courses related with project topics
Society at large	Press releases in newspapers and magazines. Generic **communication activities for society at large** will be undertaken by partners in various forms. For instance, open days taking place in the premises of the partners will serve to explain and demonstrate projects results and their implications to the general public. In a similar way, participation in the Science Week where lectures to approach technology to society will also be exploited in this direction. Appearance in general media will also be exploited as communication channel to a wider audience	Pre-scheduled yearly events plus ad hoc continuous actions	Published press releases (target: two global press releases, backed by all partners per year) Number of events organized/attended (target: at least one organized per year)

2.1.2 Synergies with other projects

Synergies with other (mostly) 5G PPP projects are considered in order to maximize the impact of 5G-TRANSFORMER. Though these activities are presented as a subsection of communication, these collaborations are transversal in the sense that they also include dissemination and exploitation, and so, they have an impact throughout the whole CoDEP. These activities will target the establishment of links with other relevant research actions, projects, and alliances, in particular within the framework of European H2020 Information and Communication Technology (ICT) research focused on next generation communication networks. The following paragraphs explain the actions carried out in this respect.

Within 5G PPP, the project participates in the cross-project work groups (WG) [2], where the work of multiple projects converges into identifying the shared issues and developing supported program-level position on technical and strategic items. 5G-TRANSFORMER actively participates in seven working groups. Table 2 only lists the main representatives of the project. Other partners participate as well. The following paragraphs describe the scope of each of the groups.

TABLE 2: 5G-TRANSFORMER REPRESENTATIVES INTO 5G PPP CSA WORKING GROUPS

5G PPP CSA working group	5G-TRANSFORMER representative
Pre-Standardization WG	IDCC
5G Architecture WG	NEC
Software Networks WG	NOK-N, UC3M
Vision and Societal Challenges WG	TEI
Trials WG	UC3M
Network Management & QoS WG	POLITO

Automotive WG	CRF

More specifically, the pre-standardization working group strives:

- To identify standardization and regulatory bodies to align with, e.g., ETSI, 3GPP, IEEE, and other relevant standards bodies, and ITU-R and the World Radiocommunication Conference (WRC) (including, e.g., Electronic Communications Committee Project Team 1, responsible for International Mobile Telecommunications, or IMT).
- To develop a roadmap of relevant standardization and regulatory topics for 5G by also evaluating existing roadmaps at international level, and to propose its own roadmap for 5G being aligned at international level.
- To influence pre-standardization on 5G and related R&D by potentially proposing where topics should be standardized.
- To influence timing on R&D work programs (e.g., European Commission Work Programmes).

The goal of the 5G Architecture WG is to serve as a common platform to facilitate the discussion between 5G PPP projects developing architectural concepts and components and to foster the discussions on the basis of the KPI's described in the 5G PPP contract. The group could also facilitate consensus building on the 5G architecture.

Another relevant working group is the Software Networks [2] one, in which 5G-TRANSFORMER partners actively participate and co-chaired the group until November 2017. The goal of this group is to analyze and address unification and applicability of key research topics related to Software Networking including software defined concepts, infrastructures, systems and components for Wire and Wireless Networks, including Networked Clouds, IoT and Services, i.e., Software Defined Networks (SDN) and Network Function Virtualization (NFV), as developed and promoted by the 5G PPP projects.

Additionally, the Vision and Societal Challenges WG works for:

- Developing a consensus in Europe on 5G systems / infrastructures / services.
- Identifying vertical application domains which would benefit from 5G (views of other sectors on 5G requirements) and associated challenges.
- Identifying the societal, economic, environmental, business and technological benefits obtainable from the realization of 5G main concepts.
- Collecting publicly available visions and major technical trends from industry, research community and available information from other regions.
- Identifying commonalities, bottlenecks and differences in visions and technical trends.
- Preparing input documents for Pre-Standardization and Spectrum Working Groups and International Cooperation Activity.
- Developing H2020 call proposals for 5G PPP in partnership with the EC.

Furthermore, the project also actively participates in the Trials WG [2] of the 5G Infrastructure Association, and whose objectives are:

- To develop the European Trial Roadmap based on the 5G Manifesto.
- To facilitate the involvement of verticals in the trials roadmap.

- To discuss and define business principles underpinning the economic viability of trials.
- To consider and coordinate the activity on trials with other relevant initiatives at international level (e.g., proposal from China Mobile).
- To investigate and propose how to link trials to Horizon 2020 5G PPP Phase 3 in order to get funding for parts of the overall trial roadmap.

Network Management, Quality of Service and Network Security are three themes closely correlated. This is the scope of the Network Management & QoS WG, by considering its impact to control and data planes.

Finally, the Automotive Working Group has the goal to serve as a common platform to facilitate the discussion between 5G PPP projects developing V2X and Vehicle-as-Infrastructure concepts and components. Indeed, there are several 5G PPP projects dealing with automotive: 5GCAR, NGPaaS, 5G-XCast and ONE5G. The main objectives are:

- To perform the business analysis.
- To collect and analyze information from relevant 5G PPP projects as well as other global projects and initiatives on V2X research solutions and results.
- To facilitate consensus building on the 5G automotive roadmap strategy. The 5G Automotive WG contributions and input towards standardization will only take place in collaboration with the pre-standards WG and Spectrum WG.
- To provide support to the projects and other WGs in V2X related aspects. Foster collaboration between projects on the aspect of overall 5G system - to 5G automotive system.

Additionally, the project is also represented in the technical board and steering board of 5G PPP projects.

As for collaboration with specific research projects, Table 3 lists the projects, provides a short description of their scope, and identifies the specific topics in which collaboration activities are expected. Tight links with these projects will be set by exploiting the common partners. In fact, these partners are in the best position to understand the work in both projects and to spot specific technical topics for collaboration as well as opportunities for joint communication, dissemination, and/or exploitation (e.g., joint workshops). Of course, this list does not preclude potential collaboration with other projects or on other topics with these same projects. This will be adapted during the project lifetime according to their evolution.

Additionally, 5G-TRANSFORMER will also exploit other groups organized by coordination and support actions, like To-Euro-5G [3], towards joint inter-project communication, for instance.

Table 3 lists potential collaboration with other 5G related projects. However, some of the projects listed in D6.1 [1] have completed. Thus, Table 3 is updated to list the on-going projects for the potential collaboration with 5G-TRANSFORMER.

TABLE 3: POTENTIAL COLLABORATION WITH OTHER PROJECTS

Project name	Short Description	Technical relationships
SLICENET (EU/H2020)	Slicenet will design and develop a management and control framework to build "slices" of network resources in support of 5G vertical services, exploiting advanced software networking and cognitive network management.	NFV/MEC
5G Coral (EU/TW H2020)	Leverages on the pervasiveness of edge and fog computing in the Radio Access Network (RAN) to create a unique opportunity for access convergence	Service Orchestration/Edge /Fog/MEC
5G!Pagoda (EU/JP H2020)	Using the available network infrastructure to improve scalability, programmability, agility, and customization of services maintaining a common orchestration framework.	Network Slicing, Service orchestration.
Supersede (EU/H2020)	Contextual data analysis, decision making support in software evolution and adaption applied to vCDNs.	Online modification of virtual function based on user context
NeMo	NeMo will act as catalyst across the entire energy management cycle of electro mobility, including battery and smart grid recharging management.	NeMo actors as vertical users of 5G-TRANSFORMER, requirements and use cases
ESSENCE (EU/H2020)	5G ESSENCE addresses the paradigms of Edge Cloud computing and Small Cell-as-a-Service (SCaaS) by fueling the drivers and removing the barriers in the Small Cell (SC) market, forecasted to grow at an impressive pace up to 2020 and beyond and to play a key role in the 5G ecosystem.	SDN, NFV, virtualization, MEC
5G Car (EU/H2020)	5G Car develops an overall 5G system architecture providing optimized end-to-end V2X network connectivity for high reliable and low-latency V2X services, which supports security and privacy, manages quality of service and provides traffic flow management in a multi-rat and multi-link V2X communication system	V2X communication, multi-RAT, multi-Link
5G MoNArch (EU/H2020)	It is assumed that 5G requires a flexible, adaptable, and programmable architecture. 5G Monarch strives to bring into practice and to provide experimental results on the extension of existing architectural design with key enabling innovations, such as inter-slice control and cross-domain management, experiment-driven modelling and optimization, native cloud-enabled protocol stack. Additionally, it will contribute to functional innovations on resilience and security, and resource elasticity. Finally, it will also experimentally deploy and validate the architecture in two use cases, namely sea port and touristic city.	Network Slicing, Service orchestration.
5G PICTURE (EU/H2020)	5G-PICTURE will design and develop an integrated, scalable and open 5G infrastructure with the aim to support operational and end-user services for both ICT and "vertical" industries.	A converged fronthaul and backhaul solution, integrating advanced wireless access and novel optical network domains.

5GTango (EU/H2020)	5GTANGO puts forth the flexible programmability of 5G networks. Reduce the time-to-market for networked services by shortening the service development cycle and by qualifying those network services to be adopted.	Network Slicing, Service orchestration.
5G MATILDA (EU/H2020)	MATILDA aims to devise and realize a radical shift in the development of software for 5G-ready applications, as well as virtual and physical network functions and network services, through the adoption of a unified programmability model, the definition of proper abstractions and the creation of an open development environment that may be used by application as well as network functions developers.	Network Slicing, Service orchestration.
5G NGPaaS (EU/H2020)	An ideal 5G Platform-As-A-Service (PaaS) should not only facilitate building, shipping and running classical virtual network applications (VNF) with "telco-grade" quality, it should also combine all sorts of third-party applications with those VNF for creating new more versatile and powerful cloud objects, breaking silos between connectivity and computing	SDN, NFV, virtualization,

2.2 Dissemination plan in Y2

This section follows the dissemination plan of 5G-TRANSFORMER as described in D6.1 [1] and introduces the Common Dissemination Booster (CDB) services in which the project participates jointly with 5G-Crosshaul and 5G-Coral. The plan has been slightly updated by adding a new dissemination item, which is participation to events. The other items were kept as defined in D6.1 [1].

2.2.1 Work plan

Y2 (*presentation of results* phase) corresponds to the first implementation of 5G-TRANSFORMER components, allowing to: (i) demonstrate more technological components; (ii) gather more performance results. Therefore, the dissemination plan will be executed along the following directions:

- Publication of research results: The academic and industrial partners will continue publishing the research outcome of the project in high-profile scientific conferences and journals. In addition to individual publications, more joint ones are also planned for selected high-visibility venues. Furthermore, particular efforts will be put on publishing the results in specialized workshops related with vertical industries and venues with increased visibility at the EU level, such as EuCNC, where already a common workshop with other EU projects has been accepted; "Multi-provider, multi-vendor, multi-player orchestration: from distributed cloud to edge and fog environments in 5G".

- Academic activities: 5G-TRANSFORMER aims to use the academic activities of the partners as a further vehicle for dissemination. Besides the already enrolled PhDs and master students, partners intend to continue working on several master theses on the topics studied by 5G-TRANSFORMER.

- Technology demonstration: The goal of the project is to demonstrate the feasibility and innovation potential by means of proof-of-concept realizations (note that two demonstration deliverables are planned). As a critical dissemination action, key components of 5G-TRANSFORMER will be demonstrated at conferences and technology fairs, with the goal of having

presence in at least two events per year. Knowing that the Y2 will correspond to first implementations of 5G-TRANSFORMER components, the consortium members are planning to continue having an exhibition at each year's EuCNC conference; three demonstrations are already envisioned in 2018. Furthermore, the partners will aim at presenting demonstrations at flagship conferences, such as ACM MobiCom, ACM MobiSys, IEEE INFOCOM, etc. Further targets include industrial events, such as the Mobile World Congress, where consortium members have regular presence. Given the topics addressed by the project, vertical oriented events will be targeted, such as the New European Media Summit and the ITS World Congress.

- Organization of events: In the continuation of the Y1 activities, the consortium members will organize at least one workshop co-located with a major event. At the same time, they will be actively participating in scientific conferences and industrial venues by organizing and chairing panels and special sessions dedicated to topics related with 5G-TRANSFORMER.

- Participation to events: The consortium members will participate to events to present technical presentations on 5G-TRANSFORMER topics. These presentations could be a presentation of a paper, a keynote, or a panel.

The following tables summarizes the different actions for Y2. For each action, the first column indicates the target audience, the second provides details on the activities involved, the third shows the timing of each activity, i.e., whether it takes place in a continuous, periodic, or event-driven manner, and the fourth presents the metrics that will be applied to measure the success of the action. This table is similar to the one introduced in D6.1 [1], with slight modifications:

- An action has been added regarding participation to events
- We updated some metrics, such as the average papers to publish. We expect that the second year should be richer in terms of dissemination. Therefore, we updated the value from 8 to 10.

TABLE 4: DISSEMINATION ACTIVITIES

Audience	Activity	Timing	Metric
Academic and industrial researchers	**Publications**: 5G-TRANSFORMER partners will publish their works at high-profile conferences, magazines and journals in the fields of communications/network softwarization, such as IEEE INFOCOM, ACM MOBICOM, IEEE ICC/Globecom, as well as journals like ACM/IEEE Transactions on Networking, IEEE Transactions on Network and Service Management, IEEE JSAC - Network Softwarization Series, IEEE Communications Magazine, and Elsevier Computer Networks. All the above are established, highly regarded venues for academic	Continuous	Average of 10 papers per year.

	and industry publishing; they have recently experienced an increase in the number of authors and attendees coming from the industry. Note that project partners have regular presence in the above conferences/journals and are active in their organization. Moreover, the partners will participate and disseminate the project results in very specific workshops, such as those dedicated to vertical industry.		
Academic	**Academic activities:** Academic partners envision the enrolment of several master-level theses focusing on the project topics. This will allow to raise awareness on the 5G-TRANSFORMER vision among the very same people that, upon joining the workforce in a few months, will be in charge of carrying it on.	Event-driven	At least two master theses will be carried out per academic partner over the course of the project.
Industry and Academic	**Technology demonstration:** During Y2 5G-TRANSFORMER partners aim to increase the participation in demonstrating the project components in exhibitions booths at flagship conferences (e.g., ACM MobiCom, ACM MobiSys, IEEE INFOCOM) and scientific/technological fairs. The consortium members are planning to continue having an exhibition at each year's EuCNC conference. Moreover, the partners will target venues such as the Mobile World Congress (MWC), as well as vertical oriented events, such as ITS World Congress and European Media Summit. Furthermore, partners will participate to industry-oriented gatherings on 5G and the related technologies, such as MEC Congress and 5G World events.	Event-driven, approximately once every six months	Technology demonstration in at least two events per year.

Industry and Academia	**Organization of events:** 5G-TRANSFORMER partners will continue organizing one workshop co-located with a major event, and subsets of the partners will participate in the organization of at least one other event per year. The 5G-TRANSFORMER workshop will be held in conjunction with one of the following events: EuCNC'19, IEEE WCNC'19, IEEE ICC'19, IEEE INFOCOM'19, IEEE Globecom'19.	Event driven (one workshop over the project's duration; participation in the organization of one event per year).	Organization of one 50-person workshop with a score of at least 70% in the attendee satisfaction poll, co-located with a major event. Organization of one 30-person exploitation workshop approximately at M20 with at least 70% satisfaction as measured in the attendee poll. Participation in the organization of one event per year.
Industry and Academia	**Participation to events:** 5G-TRANSFORMER partners will continue participating to events, by giving talks in form of technical presentation, keynote and panels in events such as EuCNC'19, IEEE WCNC'19, IEEE ICC'19, IEEE INFOCOM'19, IEEE Globecom'19.	Event driven	Average of 10 talks per year

2.2.2 Common Dissemination Booster

The Common Dissemination Booster (CDB) [6] is a service from the European Commission which encourages projects to come together to identify a common portfolio of results and shows them how best to disseminate to end-users, with an eye on exploitation opportunities. 5G-TRANSFORMER has formed a CDB group, named "CDB04-5G-Transformer", with 5G-Crosshaul and 5G-Coral: all projects deal with the orchestration and management of services, which may encompass different transport domains as well as services residing at the edge, the three projects also deal with federation of different administrative domains (or at least, combination of heterogeneous domains) and slicing with special focus on vertical applications. The application has been approved for all the five services available in the CDB portfolio. The timeline is reported in Figure 5 where the initial time "0" refers to the kick-off meeting held on May 14, 2018.
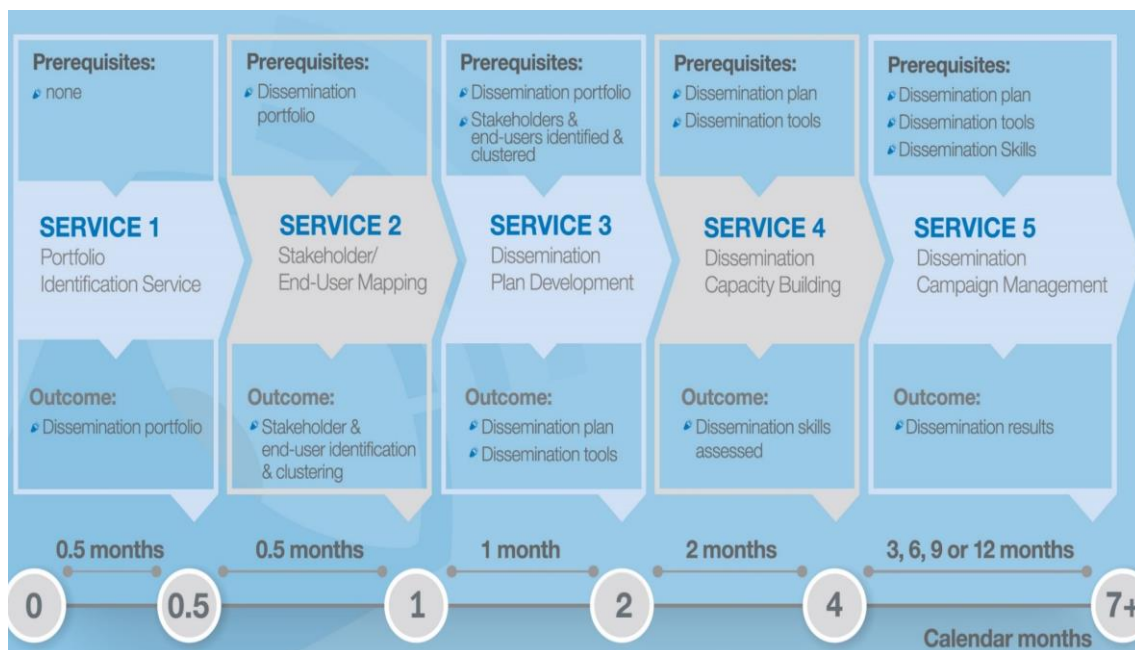
FIGURE 2: COMMON DISSEMINATION BOOSTER SERVICE RANGE AND TIMELINE

2.3 Exploitation plan in Y2

2.3.1 Products and services

As indicated in D6.1 [1], exploitation on products and services is categorized following the three building blocks in which the project is organized: respectively for the VS, SO, and MTP building blocks. The following paragraphs describe how each of the architectural discussions and developments of the project may have an impact in the various product and service lines of the partners. For those impacts spanning multiple layers of the architecture, they have been classified under that where more impact is expected, or if there are multiple expected impacts that have the same relevance, both are explained under the corresponding building block.

2.3.1.1 Vertical Slicer (VS)

2.3.1.1.1 ATOS

ATOS, the Worldwide Information Technology Partner for the Olympic & Paralympic Games, will mostly focus on the media distribution vertical industry

ATOS needs new transport technology able to cope, on one hand with the expected increase of bandwidth requirements coming from the advent of 4K/8K and High Dynamic Range (HDR) streams. On the other hand, ATOS has detected a need in the sport market to support massive content distribution within venues and stadiums, where in a relative small area there could be up to 50K viewers.

Outcomes of the project will be considered in ATOS SMART PLATFORM, Smart Stadium offering and Fan Engagement solution. In these scenarios, the media and entertainment content will be distributed through 5G-TRANSFORMER infrastructure instead of traditional CDNs. This will enhance the service offered providing a flexible on-

demand content distribution based on dynamic allocation of VNFs to support specific user needs. ATOS, which is also a Cloud Infrastructure Provider will exploit the technology developed in the project to integrate its Cloud Infrastructure with the transport networks of operators.

2.3.1.1.2 CRF (Centro Ricerche Fiat)

CRF is an independent legal entity even if integral part of Fiat Chrysler Automobiles (FCA) Research and Development. Therefore, the transfer of related project outcomes will be done with a direct link to support planning of novel vehicles and backend solutions. For what concerns 5G-TRANSFORMER, FCA is already analyzing 5G technologies and mobile operators leveraging the deployment of connected services to the worldwide markets. In fact, the availability of 5G technology is expected to create a drastic change in vehicle connectivity. 5G performances can be used in several application domains, from safety, to entertainment to data driven services. The availability of 5G can create a booming effect on all vehicle connected services and functions thanks to its intrinsic characteristics.

CRF plans to transfer the 5G-TRANSFORMER results to FCA by frequent internal dissemination events targeting new FCA models within 5 years (medium-term) of the end of the project. Managing connected devices across diverse industries and communication network requires a horizontal platform that acts as a fabric between data acquisition systems, data services, and applications.

The transfer of 5G-TRANSFORMER project outcomes will be done with a direct link to support planning of novel vehicles and backend solutions.

The availability of 5G technology is expected to create a drastic change in vehicle connectivity. 5G performances can be used in several application domains with each one with specific requirements. The availability of 5G can create a booming effect on all vehicle connected services and functions thanks to its intrinsic characteristics.

2.3.1.1.3 IDCC

For **IDCC**, the CHORDANT platform is particularly relevant for potential exploitation of the VS. The platform allows verticals to enable their own solutions by consolidating, exposing, and monetizing their data. It supports diverse types of devices, data and services, along with standards-based architecture and APIs that hide complexity from application developers, so they can focus on creating applications for cities, consumers and enterprises. 5G-TRANSFORMER Vertical Slicer hides the complexity of the transport network to the verticals, in a similar way the CHORDANT platform does it to the verticals.

The CHORDANT platform allows verticals to enable their own solutions by consolidating, exposing, and monetizing their data. The platform supports diverse types of devices, data and services, along with standards-based architecture and APIs that hide complexity from application developers, so they can focus on creating amazing applications for cities, consumers and enterprises.

5G-TRANSFORMER Vertical Slicer hides the complexity of the transport network to the Verticals, in a similar way the CHORDANT platform does it to the Verticals. The VS design is therefore relevant for potential impact on the CHORDANT platform.

2.3.1.1.4 BCOM

BCOM plans to exploit the results of the project to evolve its experimental Convergent Unifier Gateway (UGW), which integrates computing and networking capabilities in a single node. Possible impacts of project outcomes on the UGW: extending the UGW capabilities to radio backhaul; introducing network slicing management and configuration capabilities; experimenting micro services architecture and orchestration and going beyond MEC architecture using SDN and micro services. BCOM intends to demonstrate the Convergent GW to internal subscribers and experiment with different usages and traffic. BCOM will finally push the Convergent GW into a product state, transferring this technology to Partners of BCOM, i.e., large industrial companies and SMEs, or other companies in a period of 3 years.

2.3.1.1.5 NXW (Nextworks)

NXW aims at exploiting the project results to enhance its know-how in NFV, SDN and MEC areas and apply it to consultancy services as 3rd party developer for ICT solutions and training courses on NFV products, cloud and MEC services. Moreover, the knowledge acquired on vertical requirements in 5G will be transferred to the product division to drive company products for automation, A/V entertainment and building management towards IoT-based and virtualized services exploiting cloud and MEC technologies. Target products are Symphony and Sealux, smart-home platforms where the re-engineering of product components towards NFV-based deployments can provide more efficient, flexible, and customizable IoT-based solutions that exploit cloud technologies for the delocalization of storage, control and backend functions. NXW is a small company with a very agile development process, expecting that project-inspired evolution of products are in place by the last 10 months of the project.

In 5G-TRANSFORMER, NXW will be responsible for the implementation of the VS, a core component of the 5G-TRANSFORMER architecture that allows to bridge the gap between the vertical's perspective about service design and lifecycle management and the NFV modelling of the service combined with its infrastructure-dependent deployment and runtime management. The VS concepts and prototype will be an important asset for NXW since it will allow the company to evolve its NFV MANO solution (already including an NFV Orchestrator and an OpenStack-based VIM) in order to simplify the modelling, automated deployment and runtime operation of NXW smart-home products in virtual environments, exploiting also their MEC capabilities. Moreover, the development of the VS prototype will provide NXW personnel with hands-on experience in the area of network slicing management and vertical services definition. This expertise will allow the company to offer more effective consultancy services in the NFV area, specifically targeting customers like service providers or small operators who are interested in delivering custom virtual infrastructure solutions providing simplified tools and interfaces towards a wide range of vertical industries.

2.3.1.1.6 SAMUR

As mentioned in Section 2.3.1, SAMUR-Civil Protection has proposed a use case to be developed and tested during the project, which consists of a 5G connected T-Shirt with sensors to monitor the heart rate. The system will be able to automatically alert the emergency service by using the mobile phone as a bridge.

2.3.1.2 Service Orchestrator (SO)

The SO has the role of federating transport networking and computing resources from multiple domains and allocating them to slices.

2.3.1.2.1 NEC

NEC will use the SO platform developed in the project including the developed service orchestration algorithms to evolve the current fronthaul/backhaul product portfolio towards the fronthaul/backhaul integration paradigm, and to develop an E2E management and orchestration platform that brings the flexibility of SDN/NFV to NEC line of products, impacting the Mobile Radio Access Networks and Mobile Wireless Networking business units. NEC Backhaul Resource Manager (BRM) and 5G-Crosshaul Resource Manager (WizHaul) will be extended with MEC integration, NFV placement functionalities and end-to-end network slicing algorithms. In addition, NEC will use the project results to demonstrate the benefits of the proposed architecture both to its internal development groups and to potential customers, e.g., European network operators.

2.3.1.2.2 MIRANTIS

Mirantis Cloud Platform (MCP) is a comprehensive multi-cloud software stack built with an operations-centric approach. It continuously delivers automated infrastructure updates and intelligent application delivery through a CI/CD pipeline toolchain while also providing proactive monitoring and analytics to ensure maximum availability. MCP can include OpenStack and/or Kubernetes to offer bare metal, VMs and containers, along with Ceph, OpenContrail and Calico for software-defined storage and networking. Having cutting-edge field experience in the NFV-related development, deployment and integration projects, in scope of the 5G-TRANSFORMER, Mirantis will do exploitation and trailing in both SO and MTP.

For SO, considering Cloudify as foundation platform for the 5G-TRANSFORMER Service Orchestration layer, Mirantis will develop a set of plugins and extensions to enable Cloudify communication with the underlying infrastructure, like 5G-TRANSFORMER MTP component or Public cloud providers (i.e., AWS). Additionally, Mirantis will perform integration of the 5G-TRANSFORMER Monitoring platform with the Cloudify orchestration platform. As some project features like SO federation are not available at the open source world yet, Mirantis jointly with partners will develop appropriate functionality and integrate it into the 5G-TRANSFORMER platform. Considering numerous new add-ons and functionality to be introduced during development phase of the SO component, Mirantis will create build of the 5G-TRANSFORMER SO component and relevant Continuous Integration/Continuous Delivery (CI/CD) pipeline.

2.3.1.3 Mobile Transport and Computing Platform (MTP)

2.3.1.3.1 NOK-N (Nokia)

Nokia will consider the project results on MEC integration to increase flexibility of its 5G-BTSs (Base Transceiver Station) deployed as VNFs, allowing better resource utilization and supporting different slice and service types on the BTSs. From the project, NOK-N will gain a better understanding of deployment and integration scenarios of its products into operator and vertical environments. In addition, 5G-TRANSFORMER will impact the following NOK-N portfolio:

- Airframe. The cloud-based base station may be extended with the interfaces towards the MTP to improve its control by a Virtual Network Function Manager (VNFM) for deployments with multiple network slices, considering the non-virtualized part of the BTS as a physical network function shared among network slices.

- Airframe data center. The cloud platform may be extended with interfaces and functionality for the compute part of the MTP and be better used in regional data centers and for deployment of vertical services.

- NFV-based packet core. These VNFs may be extended with service-aware monitoring as defined in 5G-TRANSFORMER. With or without this extension, the VNFs may be deployed directly from templates of network services.

- MEC Platform. The MEC software platform may be extended with the interfaces and functionalities defined within 5G-TRANSFORMER to support network slicing. It would become more useful for vertical industries.

2.3.1.3.2 NEC

NEC will exploit the project results to improve its Control Platform: extensions on already commercialized OpenFlow solutions, Enterprise Radio Access Network (E-RAN), vEPC (Virtualized Evolved Packet Core: vMME and vS/P-GW) and vMVNO-GW. Management extensions to NEC iPASOLINK wireless transport equipment including mmWave and microwave.

In the NEC Controller Platform, it is expected the extensions on already commercialized OpenFlow solutions, Enterprise Radio Access Network (E-RAN), vEPC (Virtualized Evolved Packet Core: vMME and vS/P-GW) and vMVNO-GW.

In the NEC iPASOLINK, management extensions to NEC iPASOLINK wireless transport equipment including mmWave and microwave.

2.3.1.3.3 TEI (Ericsson)

Ericsson TEI will consider 5G-TRANSFORMER results as input for developing new transport solutions and to further preserve value of the existing ones. TEI also intends to better understand requirements from partner verticals to further increase capacity, coverage and flexibility of its radio access and transport platforms.

The impact of 5G-TRANSFORMER outcomes on Ericsson product portfolio will primary address the Ericsson Fronthaul 6020 and 6080 families, which provide a managed WDM networking solution for fronthaul transport of (e)CPRI, Open Base Station Architecture Initiative (OBSAI) and Ethernet from the radio Baseband Unit (BBU), such as the Ericsson RBS 6000, to Remote Radio Units (RRU), Ericsson Integrated Antenna & Radio Units (AIR) and the Ericsson Radio DOT System.

Ericsson Fronthaul 6020 is a low footprint and high density WDM networking solution for all CRAN topologies with speeds up to 25 Gbit/s and is equipped with enhanced monitoring and test capabilities.

Ericsson Fronthaul 6080 passive solution can offer the transport of up to 24 CPRI services over a single fiber. Ericsson Fronthaul 6080 active solution implements managed CPRI, OBSAI and Ethernet networking over WDM when passive solution is not enough and management, demarcation and high availability through ring protection are important requirements. The fronthaul 6080 active solution is built on the passive

solution's modules and offers an active optical fronthaul that can thereby cope with all different network application scenarios, serving up to 24 x CPRI services per configuration depending on the topology. The Fronthaul 6080 active solution provides high capacity and low latency to ensure that even the most stringent transport requirements of LTE, LTE-advanced and 5G are met.

The Ericsson Fronthaul 6020/6080 transport solutions, will be evolved to support the federation scenario that will be defined in 5G-TRANSFORMER.

In the project, Ericsson will primarily consider results relevant to optical transport/DWDM for radio access network. TEI will consider evolving its line of optical hybrid switches, designed in cooperation with 5G-Crosshaul, following the path of the MTP.

In Cloud and NFV infrastructure, Ericsson provides proven and standards-based solutions to telecom operators while ensuring the evolution towards 5G. The benefits include short time to market for new services and low TCO with a pre-integrated and system verified NFVi solution. With distributed cloud we expand the possibilities of edge computing, using technology to create a unified approach across centralized, distributed and edge resources. 5G-TRANSFORMER is expected to impact the Cloud and NFV solutions portfolio in terms of architecture and building blocks, to support vertical services.

2.3.1.3.4 IDCC

IDCC EdgeHaul is a mmWave fronthaul and backhaul transport solution featuring support for SDN-based control and management. The 5G-TRANSFORMER MTP goals, i.e., the integration of MEC with transport network resources and the support of various vertical traffic requirements, are clearly relevant to EdgeHaul and present several potential exploitation paths, including.

- The extension of EdgeHaul to support network slicing over the mmWave transport, e.g. utilizing the dynamic configuration of VLAN tags to isolate and prioritize traffic from different verticals.
- The integration of EdgeHaul and Edge Computing through a co-location of EdgeHaul nodes and MEC platform(s).
- The extension of EdgeHaul to support FOG RAN architectures and platforms that are inherently distributed in nature.

2.3.1.3.5 MIRANTIS

Mirantis will provide a platform for automatic 5G-TRANSFORMER MTP layer deployment using an OPNFV reference scenario, which integrates and automatically provisions OpenStack, SDN Controller (Opendaylight) and relevant software components. Further, this scenario might also be enhanced with the Kubernetes container management platform for lightweight MEC applications. This will enable automatic MTP and virtualization layer deployment across multiple locations. As a separate development activity, Mirantis will empower Virtlet (https://github.com/Mirantis/virtlet/blob/master/ACKNOWLEDGE.md) and CRI Proxy (https://github.com/Mirantis/criproxy/blob/master/ACKNOWLEDGE.md) upstream code development with 5G-TRANSFORMER specific focus and overall code stabilization. As a result, the Virtlet platform will be trialed for the 5G-TRANSFORMER MEC and NFV workloads and use cases, including instantiation and service function chaining.

2.3.2 Patents and licensing

The 5G-TRANSFORMER project addresses an area which provides significant opportunities for standard essential patents. All 5G-TRANSFORMER partners are committed to producing European IPR as important channel for exploiting project outcomes.

Partners have declared a strong background of over 40 patents related to 5G-TRANSFORMER area. At least 5 patents are expected to be filed in the project deployment, targeting VS, SO, and MTP. This may lead to subsequent licensing, depending on the interests of the partners. One patent, out of the 5 expected, has been registered by SSSA (see Section 2.3.2).

2.3.3 Open Source

Open source software is, in some cases, becoming the de facto standard for areas in which the traditional standardization process is not fast enough. Parts of all the software produced in the project will be published as open source, e.g., in the framework of ETSI OSM, led by one of the partners of the project.

Details on code publishing are regulated by the consortium agreement (CA). Based on current interest of the project and its partners, contributions will be mainly aligned with the following open source projects: OPNFV, Open Source MANO, ONAP, OpenStack, and Open Air Interface.

Considering recent industry shift to the containers and light-weight virtualization, the consortium will also follow the development of container-oriented platforms and solutions, particularly Kubernetes and Virtlet, which are suitable for MEC and Edge cloud cases.

Additionally, work on Cloudify is at its initial stages in the framework of the project and is expected to produce results during year 2, since it is one of the key software projects in use (and development) in 5G-TRANSFORMER.

2.3.4 Standardization

The Standard Advisory Committee (SAC) will continue executing in accordance to the Standardization Activity Roadmap (SAR) that has been produced. As described below in the standardization achievements section (Section 5.3), this roadmap was presented and agreed during the 5G TRANSFORMER plenary meeting held in Rennes, France from January 16th, 2018 to January 18th, 2018. See Section 5.4 for further information.

To guide standardization activities using the SAR, the SAC will continue executing the following activities:

- Updating this roadmap as the work in the project progresses in relation to the individual progress of the relevant SDOs.
- Coordinating the project and standardization groups through constant monitoring of activities and standardization discussion held through regular conference calls with standardization experts.
- Helping to identify opportunities to push technology contributions into ongoing specifications.
- Helping to improve and to socialize contributions ahead of standard meetings.

- Helping promote the project at standardization-related workshops, panels, and summits.

To this end, the following steps are planned:

1. Analyze SDO meeting cycle gaps to ensure effective SAC meetings
   a. SAC Meeting cycles timed with SDO cycles.
   b. Contribution planning should allow for sufficient time for partners to review the material.
   c. Meeting should be held so that agreements and recommendation can be used to improve contribution being fed in subsequent meetings.
   d. The SAC from the outset was meant to meet as needed, with little disruption to the rest of the project activities, however more than one meeting per moth might be required.
2. Analyze possibilities for contributions to other SDOs
   a. E.g., ITU-T.
3. Analyze possibilities to contribute to other forums such as NGMN
   a. What are the advantages and disadvantages?
   b. Do we get enough "bang for the buck"?
4. Follow up on initial thrust
   a. E. g., ETSI MEC, further contribute to new slicing WI.
   b. E. g., analyze the possibility to contribute to new work items in 3GPP, such as FS_eSBA (Feasibility Study on Enhancements to Service Based Architecture) and FS_eNS (Feasibility Study on Enhancements to Network Slicing).

A potential way forward could be, e.g., work on solutions to proposed key issue in any of the two FSs referenced above

3 Achievements on Communication in Y1

This section reports on the Communication activities undertaken related to the society at large and the events fostering interaction with other projects. Each subsection describes different activities and events for the promotion of the 5G-TRANSFORMER project. As target plan described in Table 1, Table 2 and Table 3, all 5G-TRANSFORMER partners promote the 5G-TRANSFORMER project to the general public at large, and many activities (e.g., social media and video post, press releases and news release, communication articles published, etc.) were carried out, as seen in the following subsections.

3.1 Web, social media, and project communication material

Following the project kick-off on June 1, 2017 in Stockholm, activities have been undertaken towards fulfilling the objectives set above. Additionally, the official project press release was released in Madrid, Spain in June 2017. Additionally, partners also released their own internal (company-wide) and external press releases as listed in Section 3.4. More details can also be found in the project website (http://5g-transformer.eu/). Also, the statistics of 5G-TRANSFORMER social media are presented in Annex II.

The social media accounts of 5G-TRANSFORMER were also set up, and are the following:

- Twitter: https://twitter.com/5g_transformer
- LinkedIn: http://linkedin.com/in/5g-transformer-eu-project-a05311144
- Instagram: https://www.instagram.com/5g_transformer/
- YouTube: https://www.youtube.com/channel/UClQXD0lCxTK9eh_mQzMweww

By looking at the metrics, one can conclude that there has been a steady increase of the impact of the website and of social media, which is a relevant outcome as part of the CoDEP execution during the *raise awareness* phase of the project.

3.2 Communication leaflets and poster

The following figures show the communication leaflets and posters used in various events and available on the web for the promotion of the 5G-TRANSFORMER project. A specific version was generated to be used in the 5G-Infrastructure Association booth and booths from partners during Mobile World Congress 2018.
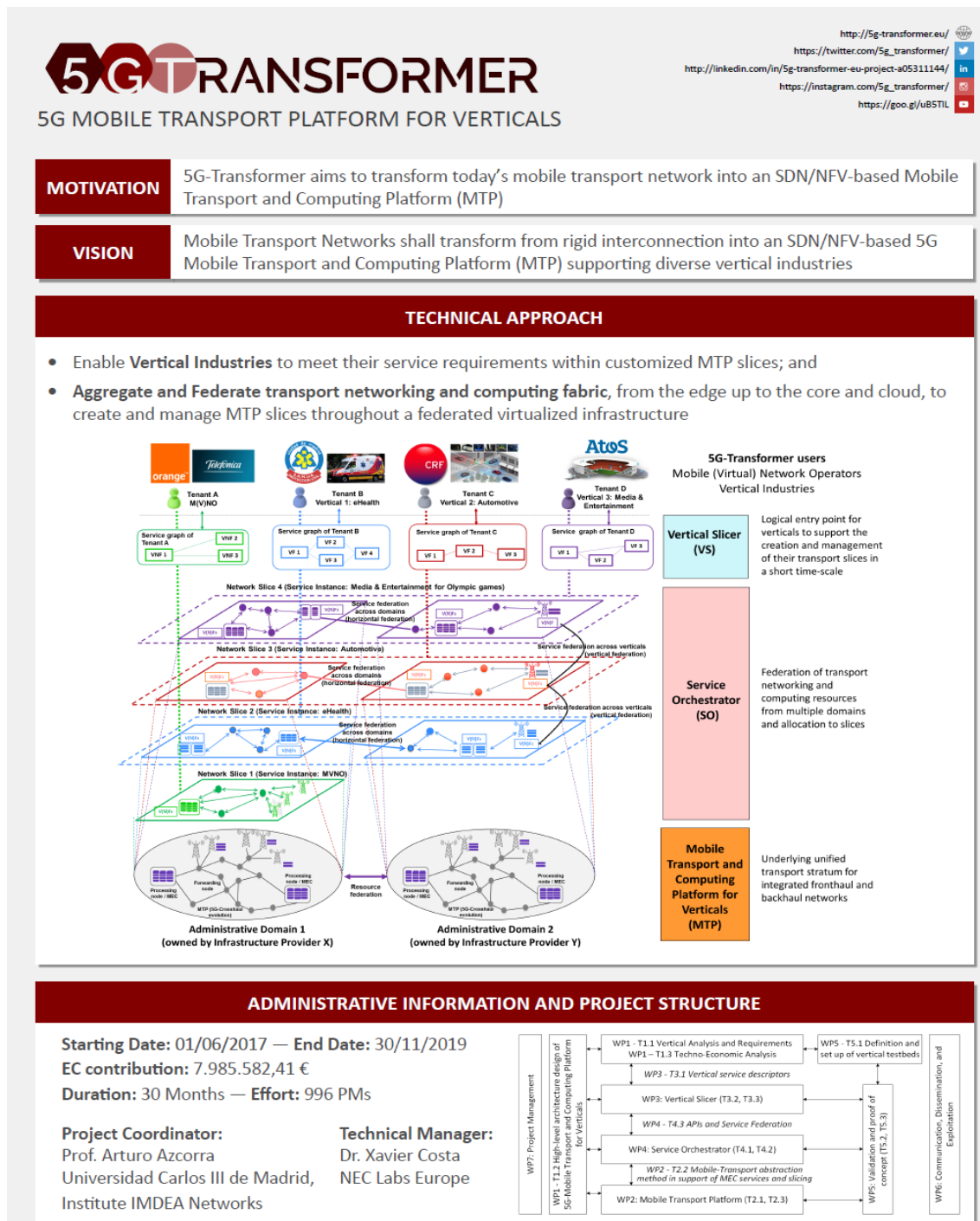
FIGURE 3: 5G-TRANSFORMER POSTER

5G TRANSFORMER
5G MOBILE TRANSPORT PLATFORM FOR VERTICALS

VISION

Mobile Transport Networks shall transform from rigid interconnection into an SDN/NFV-based 5G Mobile Transport and Computing Platform (MTP) supporting diverse vertical industries.

TECHNICAL APPROACH

Media

Automotive

Healthcare

M(V)NO

- Enable Vertical Industries to meet their service requirements within customized MTP slices; and
- Aggregate and federate transport networking and computing fabric, from the edge up to the core and cloud, to create and manage MTP slices throughout a federated virtualized infrastructure.

MAIN BUILDING BLOCKS

VS Vertical Slicer

Logical entry point for verticals to support the creation of their transport slices in a short time-scale.

SO Service Orchestrator

Federation of transport networking and computing resources from multiple domains and allocation to slices.

MTP Mobile Transport and Computing Platform

Underlying unified transport stratum for integrated fronthaul and backhaul networks.

Starting Date: 01/06/2017

End Date: 30/11/2019

Cost: 7.985.582,41 €

Project Coordinator:
Dr. Arturo Azcorra
Universidad Carlos III
de Madrid

Technical Manager:
Dr. Xavier Costa
NEC Labs Europe

More information at:
http://5g-transformer.eu/

https://twitter.com/5g_transformer/

https://goo.gl/uB5TlL

https://www.instagram.com/5g_transformer/

https://www.linkedin.com/in/5g-transformer-eu-project-a05311144/

FIGURE 4: 5G-TRANSFORMER LEAFLET

FIGURE 5: MOBILE WORLD CONGRESS 2018 5G-TRANSFORMER LEAFLET

3.3 Communication video

The 5G-TRANSFORMER general video was published on the 19 February, 2018. This video introduces the use cases considered in the 5G-TRANSFORMER project: eHealth, Automotive, M(V)NO, Media, Cloud robotics. It also explains how 5G-TRANSFORMER can enable vertical industries to meet their service requirements within customized MTP slices and how it can also enable the federation among transport networking and computing fabric from the edge up to core and cloud belonging to different domains. Also, this video was shown in Mobile World Congress in Barcelona, Spain, 2018 in the 5G-Infrastructure Association booth as well as in the booth of partners.

Additionally, this video was registered to participate in the "Showcase your project!" initiative (http://ec.europa.eu/research/investeuresearch/index.cfm), which builds a library of videos explaining how European research impacts the daily lives of citizen. It is available   at: https://www.youtube.com/playlist?list=PLvpwIjZTs-LjHDvRTqIyjfLeflXDak5er

3.4 Press releases and news

A list of the press releases on 5G-TRANSFORMER project that appear in 5G-TRANSFORMER website. Two official project-wide press releases were published, for the kick-off and for Mobile World Congress 2018:

- http://5g-transformer.eu/index.php/2017/06/20/5g-transformer-press-release/
- http://5g-transformer.eu/index.php/2018/02/23/the-5g-transformer-project-presents-the-future-5g-mobile-transport-platform-for-verticals-at-mwc18/

Additionally, several press releases were also issued by various partners at various stages of the project, which were promoted through their respective communication channels (including their website):

- https://www.mirantis.com/blog/network-slicing-and-5g-and-wireless-oh-my/
- http://www.cttc.cat/european-industrial-and-academic-partners-join-to-develop-a-5g-mobile-transport-platform-for-verticals/
- https://www.ericsson.com/research-blog/5g-transformer-eu-project-underway/
- https://www.networks.imdea.org/whats-new/news/2018/investigadores-uc3m-presentan-sus-novedades-sobre-5g-mobile-world-congress-2018
- http://www.cttc.cat/cttc-contributes-to-the-future-5g-mobile-transport-platform-for-verticals-at-mwc18/
- http://5g-xcast.eu/2018/04/26/prof-narcis-cardona-presentation-at-the-5g-forum-in-malaga/
- http://www.madrid.es/portales/munimadrid/es/Inicio/Emergencias-y-seguridad/SAMUR-Proteccion-Civil/?vgnextfmt=default&vgnextoid=c88fcdb1bfffa010VgnVCM100000d90ca8c0RCRD&vgnextchannel=f9cd31d3b28fe410VgnVCM1000000b205a0aRCRD&idCapitulo=6149819
- http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool?p_p_id=%20digitalinnovationhub_WAR_digitalinnovationhubportlet&p_p_lifecycle=0&p_%20p_state=normal&p_p_mode=view&p_p_col_id=column-%201&p_p_col_count=1&formDate=1524592222123&freeSearch=5tonic&evolStages=3

- http://5g-transformer.eu/index.php/2018/04/20/5g-transformer-in-collaboration-with-samur-proteccion-civil/

But most notably, the project also had some presence in relevant technical communication media, such as sdxcentral or globenewswire:

- http://www.globenewswire.com/news-release/2017/06/21/1027019/0/en/European-Industrial-and-Academic-Partners-Join-to-Develop-a-5G-Mobile-Transport-Platform-for-Verticals.html
- https://www.sdxcentral.com/articles/news/new-european-5g-group-will-focus-on-network-slicing-industry-verticals/2017/06/
- https://www-sdxcentral-com.cdn.ampproject.org/c/s/www.sdxcentral.com/%20articles/news/trials-use-cases-top-5g-developments-2017/2017/12/amp/%20Network%20Slicing%20Gets%20Traction

The channels available through the 5GPPP COMMS group, coordinated by the To-Euro-5G CSA were also exploited throughout the first year of the project. This is a group established at the 5GPPP projects level to raise awareness of the activities of these projects among them and also outside, through various media (e.g., newsflash, social media, periodic audioconferences). For instance:

- https://5g-ppp.eu/european-industrial-and-academic-partners-join-to-develop-a-5g-mobile-transport-platform-for-verticals/
- https://5g-ppp.eu/newsflash-october-2017/
- https://5g-ppp.eu/the-5g-transformer-project-presents-the-future-5g-mobile-transport-platform-for-verticals-mwc18/

3.5 Communication articles

In addition to publishing technical papers, the project also promotes the project scope and vision at a higher-level. Table 5 lists the communication articles published to introduce the 5G-TRANSFORMER project from the point of views of a mobile network operator and verticals.

TABLE 5: COMMUNICATION ARTICLES

	Title	Venue
1	A Network Service Provider Perspective on Network Slicing	IEEE Softwarization, January 2018
2	5G-TRANSFORMER (5G Mobile Transport Platform for Verticals) (sent)	5G Annual Journal Third Edition

3.6 Communication presentation/lectures

Table 6 lists the presentations and talks targeting a wide general audience. This includes high-school students or society at large. It also includes lectures given to undergraduate and graduate students, as part of this general, but a bit more technical audience. And finally, it also includes general talks given at more technical for a but not necessarily specifically working on the same topics as 5G-TRANSFORMER (e.g., 5G Summit) as part of the interaction with other projects. They all describe the project general ideas and scope without entering too much into technical details.

TABLE 6: COMMUNICATION PRESENTATION AND LECTURES

	Activity
1	Talk entitled "5G Networks to realize Network society" at the "5G technology for automotive domain" workshop, 2017, including the 5G-TRANSFORMER approach.
2	A talk on 5G in general, and more specifically, on 5G-TRANSFORMER was given to high-school students and general public in the context of 22nd Open Science Week (Setmana de le Ciència) in November 2017. It is organized by the Catalan Research and Innovation Foundation (FCRi). Information available at: http://www.cttc.cat/the-cttc-will-participate-in-the-22nd-edition-of-the-science-week-2017/
3	Organization of the Internet Festival (http://www.internetfestival.it/), the Robotics Festival 2017 (http://www.festivalinternazionaledellarobotica.it/en/)
4	Three-hour course taught at the National Chiao Tung University (NCTU) in Taiwan on topics related with 5G-TRANSFORMER
5	Master courses in UC3M on NFV and SDN for 5G networks
6	SSSA presents 5G-TRANSFORMER in 5G Summit in Trento
7	5G-TRANSFORMER presentation: 5G Mobile Transport Platform for Verticals in EuCNC workshop in 2017
8	POLITO presents 5G-TRANSFORMER in IEEE 5G Summit 2017 talk
9	SAMUR participation and presentation in 5G Forum in Malaga

3.7 Collaboration with other projects

A series of activities have been carried out together with 5GPPP projects in the framework of the various working groups (see section 2.1). Table 7 lists the main activities within the 5G PPP CSA Working Groups (WGs). A variety of other activities, like joint organization of events or special sessions, joint booth applications at events, or joint writing of papers were carried out. They will be explained in the corresponding sections below. This section focuses on the 5GPPP working group activities.

TABLE 7: ACTIVITY WITHIN 5G PPP CSA WGS

	Activity with 5G PPP WGs
1	Presentation to EC H2020 5G Infrastructure PPP Technical board on Performance KPIs and 5G-TRANSFORMER status in this respect. Active participation on this activity (periodic calls).
2	Inputs on 3GPP and 5G-TRANSFORMER to 5GPPP Pre-Standardization Working Group (WG). Various conference calls, including one with the WG Chair on including other non-3GPP activities.
3	Input on 5G-TRANSFORMER for preparation of a brochure for EUCNC. 5G PPP Network Management & QoS WG
4	Participation to 5G PPP Trials WG and the roadmap (5G Pan-European trials roadmap 3.0.) generated by the group (https://5g-ppp.eu/5g-trials-roadmap/).
5	Participation to 5G PPP Architecture WG. The group organized a session at EuCNC 2018.
6	Active participation to the 5G PPP Software Networks WG. The 5G-TRANSFORMER project was presented in September 2017. 5G-TRANSFORMER contributed actively to the white paper 'From Webscale to Telco, the Cloud Native Journey''. The white paper will be presented at a EUCNC 2018 workshop, to which 5G-TRANSFORMER participates as well.

4 Achievements on Dissemination in Y1

This section describes the dissemination activities of 5G-TRANSFORMER during the first year. The dissemination activities follow the plan described in D6.1 [1], that is, publication of research results (Table 8), Technology Demonstration (Table 9), Academic activities (Table 10) and Organization and Participation in events (Table 11). A modification to the initial plan has to be highlighted. It is related to the participation to events in order to give technical talks related on 5G-TRANSFORMER topics, such as keynote, panels and technical presentation. Table 12 summarizes this new activity.

The first year of the project was very rich in terms of dissemination activities. Notably, 35 scientific publications have been published in peer reviewed journals, conferences and workshops (Table 8); 6 in Journals, 20 at conferences and 9 at workshops. Some of these publications are joint publications with other projects. Further, 5G-TRANSFORMER partners have participated to the organization of very successful events and workshops (Table 10) co-located with prestigious conferences. For example, the positive feedbacks from COMPASS workshop attendees (see Annex I).

Regarding the academic activities, several students have been enrolled to work on 5G-TRANSFORMER topics; 5 PhD, 2 Masters, and 2 Bachelor students have been enrolled during the first year.

Although it is the first year of the project, partners have made strong efforts to start demonstrating the 5G-TRANSFORMER results. Besides an INFOCOM and Mobile World Congress demo, three demos are in preparation for EuCNC 2018 on different topics treated in 5G-TRANSFORMER.

TABLE 8: PUBLICATIONS (J: PEER-REVIEWED JOURNAL, C: PEER-REVIEWED CONFERENCE, W: PEER-REVIEWED WORKSHOP)

	Title	Venue
J	WizHaul: On the Centralization Degree of Cloud RAN Next Generation Fronthaul	IEEE Transactions on Mobile Computing (TMC), February 2018
J	Efficient Caching through Stateful SDN in Named Data Networking	Transactions on Emerging Telecommunications Technologies, Jan. 2018
J	Virtualization-based evaluation of backhaul performance in vehicular applications	Computer Networks, April 2018
J	5G-TRANSFORMER: Slicing and Orchestrating Transport Networks for Industry Verticals	IEEE Communications Magazine, accepted in 2018
J	On Enabling 5G Automotive Systems Using Follow Me Edge Cloud Concept	IEEE Transactions on Vehicular Technology (TVT), accepted 2018
J	Scheduling Advertisement Delivery in Vehicular Network	IEEE Transactions on Mobile Computing (TMC), accepted in 2018
C	Sharing of Crosshaul Networks via a Multi-Domain Exchange Environment for 5G Services	IEEE NetSoft 2017
C	A Simulation-based Testbed for Vehicular Collision Detection	IEEE VNC 2017

C	Software Defined 5G Converged Mobile Access Networks: Energy Efficiency Considerations	Asia Communications and Photonics Conference, 10 - 13 November 2017, The Garden Hotel, Guangzhou, Guangdong China
C	SDN-enabled Latency-Guaranteed Dual Connectivity in 5G RAN	Asia Communications and Photonics Conference, 10 - 13 November 2017, The Garden Hotel, Guangzhou, Guangdong China
C	Network Orchestration in Reliable 5G/NFV/SDN infrastructures	19th International Conference on Transparent Optical Networks (ICTON) 2017, Girona, Spain
C	Requirements for 5G fronthaul	19th International Conference on Transparent Optical Networks (ICTON) 2017, Girona, Spain
C	Network Orchestration in Reliable 5G/NFV/SDN infrastructures	19th International Conference on Transparent Optical Networks (ICTON) 2017, Girona, Spain
C	Virtualized eNB latency limits	19th International Conference on Transparent Optical Networks (ICTON) 2017, Girona, Spain
C	Joint VNF Placement and CPU Allocation in 5G	IEEE International Conference on Computer Communications (INFOCOM) 15-19, April 2018, Honolulu, USA
C	FluidRAN: Optimal vRAN/MEC Orchestration	IEEE International Conference on Computer Communications (INFOCOM) 15-19, April 2018, Honolulu, USA
C	Present-day verticals and where to find them: A data-driven study on the transition to 5G	IEEE WONS 2018
C	Service migration versus Service replication in Multi-access Edge Computing (MEC)	IEEE IWCMC 2018, June 24-29, Cyprus
C	Orchestrating Lightpath Adaptation and Flexible Functional Split to Recover Virtualized RAN Connectivity	OFC 2018, March 11-15, 2018, San Diego, CA, USA
C	Software Defined 5G Converged Access as a viable Techno-Economic Solution	OFC 2018, March 11-15, 2018, San Diego, CA, USA
C	Enabling Flexible Functional Split through software 5G converged access	IEEE ICC 2018, Kansas City, MO, USA
C	Performance analysis of C-V2I-based Automotive Collision Avoidance	IEEE WoWMOM 2018, Chania, Greece
C	Optimization-in-the-Loop for Energy-Efficient 5G	IEEE WoWMOM 2018, Chania, Greece
C	Experimental SDN Control Solutions for Automatic	IEEE ONDM 2018

	Operations and Management of 5G Services in a Fixed Mobile Converged Packet-Optical Network	
C	Enabling Vertical Industries Adoption of 5G Technologies: A Cartography of Evolving Solutions	Accepted in EuCNC 2018
C	The Vertical Slicer: Verticals' Entry Point to 5G Networks'	Accepted in EuCNC 2018
W	Orchestrating Lightpath Adaptation and Flexible Functional Split to Recover Virtualized RAN Connectivity (poster)	URLLC 2017
W	WizHaul: An Automated Solution for vRAN Deployments Optimization	WSA 2018 - ITG workshop on smart antennas, March 2018
W	Service Orchestration and Federation for Verticals	IEEE WCNC COMPASS workshop, April 2018, Barcelona, Spain
W	5G Mobile Transport and Computing Platform for Verticals	IEEE WCNC COMPASS workshop, April 2018, Barcelona, Spain
W	Network Slices For Vertical Industries	IEEE WCNC COMPASS workshop, April 2018, Barcelona, Spain
W	Impact of RAN Virtualization on Fronthaul Latency Budget: An Experimental Evaluation	International Workshop on 5G Test-Beds and Trials - Learnings from implementing 5G (5G--Testbed 2017) co-located with Globecom 2017, Singapore
W	Understanding QoS applicability in 5G transport networks	WS3: Second Edition of the Workshop on Control and Management of Vertical Slicing including the Edge and Fog Systems, IEEE International Symposium on Broadband Multimedia Systems and Broadcasting, Valencia, June 2018
W	Multi-domain VNF mapping algorithms	WS3: Second Edition of the Workshop on Control and Management of Vertical Slicing including the Edge and Fog Systems, IEEE International Symposium on Broadband Multimedia Systems and Broadcasting, Valencia, June 2018
W	Towards a resilient OpenFlow channel through MPTCP	WS3: Second Edition of the Workshop on Control and Management of Vertical Slicing including the Edge and Fog Systems, IEEE International Symposium on Broadband Multimedia Systems and Broadcasting, Valencia, June 2018

TABLE 9: TECHNOLOGY DEMONSTRATIONS

Title	Event
Demo of the initial heterogeneous network part of the MTP	Mobile World Congress'18

OVNES: Demonstrating 5G Network Slicing Overbooking on Real Deployments	IEEE INFOCOM 2018
Robotic Control Leveraging a Radio Network Iinformation Service (RNIS)	EuCNC 2018 (under preparation)
Orchestrating entertainment network service deployment in a hybrid cloud with Cloudify	EuCNC 2018 (under preparation)
Creating a media-oriented slice through the 5G-TRANSFORMER vertical slicer	EuCNC 2018 (under preparation)

TABLE 10: ACADEMIC ACTIVITIES

Title	Level	Status
eNB split functions (Distributed Unit --- DU --- and Central Unit --- CU) virtualization and its impact on fronthaul available latency budget.	PhD	Ongoing
Resource Orchestration in Virtualized Networks through SDN-enabled OpenStack	PhD	Ongoing
Software Defined Networking based mobility management in small cells	PhD	Ongoing
Mechanisms to integrate and enhance NFV and MEC	PhD	Ongoing
Design and optimization of solutions for discovery and federation for NFV in edge & fog scenarios	PhD	Ongoing
Multi-domain VNF mapping algorithms	Master	Defended
Development of a RNIS API based on Publish/subscribe using OAI	Master	Ongoing
Análisis de un orquestador NFV/SDN para redes de operador	Bachelor	Defended
Service Function Chaining en NFV: Evaluación práctica con OpenStack	Bachelor	Defended

TABLE 11: ORGANIZATION OF EVENTS

Title	Event
2nd Workshop on Control and Management of Vertical Slicing including the Edge and Fog Systems (COMPASS) (under preparation)	Co-located with IEEE International Symposium on Broadband Multimedia Systems and Broadcasting, June 6th - 8th, 2018, Valencia, Spain. Jointly organized with 5G-CORAL and 5GEx projects.
2nd Multi-provider, multi-vendor, multi-player orchestration: from distributed cloud to edge and fog environments in 5G (under preparation)	Co-located with EUCNC 2018, workshop takes place on 18 June 2018, 09:00-18:00
1st Workshop on Control and Management of Vertical Slicing including the Edge and Fog Systems (COMPASS).	Co-located with IEEE Wireless Communications and Networking Conference (WCNC) 2018, April, Barcelona. Jointly organized with 5G-CORAL project.
Organization of the "5G technology for automotive domain" workshop in Turin including industrial and academic presentations.	Industry-academia workshop organized in FCA, July 2017

Co-organization of a special session on 5G Mobile Transport Networks jointly with the 5G-Crosshaul project	Organized at Wireless World Research Forum (WWRF) 39 meeting in Barcelona, October 2017. More information available at: http://wwrf39.ch/WWRF.html
Organization of IEEE VNC 2017	2017 IEEE Vehicular Networking Conference (VNC), Nov. 2017, Torino

TABLE 12: PARTICIPATION TO EVENTS

Title	Type	Event
Connected Car and Digital Transformation	Keynote	IEEE Vehicular Networking Conference (VNC), Nov. 2017, Torino, Italy
5G and Verticals: The Connected and Automated Driving (CAD) Case	Panel	IEEE Wireless Communications and Networking Conference (WCNC), April 2018, Barcelona, Spain
MVNO congress	Talk	MVNOs World Congress, April 2018
RS-FCN: Resource Slicing for Future Clouds and Networks	Talk	IEEE International Conference on Computer Communications (INFOCOM), April 2018, Honolulu, USA
All conference and workshop publications have been presented in their corresponding venue	Talk	Several international conferences and workshops (see publications table)

5 Achievements on Exploitation in Y1

This section reports the Exploitation activities related to Products, Services, Patents and licensing, and participation to Open Source projects. Additionally, this section reports on the Standardization activities undertaken under the auspices of various Standard Development Organizations and forums.

5.1 Products and Services

A first step in the exploitation strategy has been to identify the pre-commercial proof-of concepts, commercial products, product families, solutions, and services, from the partners, for which outcomes of the project can have an impact and that can have the potential to evolve and support new 5G-TRANSFORMER features.

This preliminary identification activity has been reported in the Initial CoDEP D6.1 [1] where said products and services have been grouped following the three main architectural building blocks envisioned by the project: Vertical Slicer, Service Orchestrator, and Mobile Transport and Computing Platform. Such categorization will facilitate conceptually reporting how results and outcomes achieved in the three building blocks, and in the relevant WPs, will be exploited during the project. In this direction, there is a continuous monitoring task to identify the key technology innovations and to evaluate how they may impact the products and services developed by the partners.

In view of the high importance given by the project to the exploitation activities, the project has appointed an Innovation Manager (Dr. Giulio Bottari from Ericsson) to lead the work and ensure successful exploitation of the innovations from the project.

Even if Y1 has been largely dedicated to defining the architecture of the solution and the relevant building blocks, early achievements are reported in the following while exploitation opportunities planned for Y2 and beyond are detailed in Section 2.3.1.

SAMUR-Civil Protection, in close collaboration with the Subdirección General de Informática y Nuevas Tecnologías de la Dirección General de Emergencias y Protección Civil, in Spain, has defined and proposed a concrete use case to be developed and tested during the project, which consists of a "Smart T-Shirt", designed to save lives in cases of a medical emergency thanks to 5G technology. The "Smart T-Shirt" would measure the heart rate by means of sensors that, in case of potentially lethal arrhythmia, would generate an automatic alert to a nearby ambulance, through the mobile phone via Bluetooth. In turn, the mobile phone, would send this alert to the nearest useful hospital for the patient, without having to go through a communications center, significantly reducing the response time to a life-threatening emergency situation. The system also would locate, through an App, a volunteer near the incident to perform cardiopulmonary resuscitation (CPR) on the patient while waiting for the ambulance.

5.2 Patent and licensing

5G-TRANSFORMER partners have clear plans to patent novel systems and/or methods related to the innovation outcomes of the project, also building on an already strong background with over 40 patents related to 5G-TRANSFORMER topics. All the companies in the project are committed to continuously monitoring the patenting potential of the technological advances, with respect to existing art, achieved in the context of the activities carried on inside the project.

SSSA has submitted a patent to the Italian Patent Office which title is "Metodo per il ripristino della connessione di una rete di telecomunicazioni" ("Method for restoring the connection of a telecommunications network") which address the topic of the recovery of a lost connection in a 5G network. Submitting date 14/03/18. Submission Number: 102018000003571. Authors of the patent are Luca Valcarenghi, Nicola Sambo, Koteswararo Kondepu, Francesco Giannone, and Piero Castoldi.

5.3 Open Source projects

Even if the project did not still reach the *presentation of results* phase of the CoDEP, some initial development work was already carried out. This generated some contribution to relevant open source projects, which contribution has an acknowledgement to the 5G-TRANSFORMER (see the URLs provided below).

More specifically, as part of its platform, the project will develop Virtlet (https://github.com/Mirantis/virtlet/blob/master/ACKNOWLEDGE.md) and CRI Proxy (https://github.com/Mirantis/criproxy/blob/master/ACKNOWLEDGE.md) upstream code development with 5G-TRANSFORMER specific focus and overall code stabilization. As a result, the Virtlet platform will be trialed for the 5G-TRANSFORMER MEC and NFV workloads and use cases, including instantiation and service function chaining.

5.4 Standardization activities

The standardization framework we have adopted in 5G-TRANSFORMER is wide thanks to its mixture of enabling technologies used within 5G-TRANSFORMER, such as NFV, SDN, and MEC. These technologies are the subject of active areas of both standardization and open source developments in various Standard Development Organizations (SDOs) and forums. This is clearly advantageous, as 5G-TRANSFORMER does not necessarily depend on just one SDO to achieve its targeted impact on standards, as outlined above: Thus, we have taken a proactive approach towards contributing to key 5G related standardization SDOs, including 3GPP, ETSI MEC and IETF as well as other standardization forums, e.g., ONF, ETSI-NFV, IEEE (all strands).

To this end, we have achieved the following targets:

- A project standardization activity roadmap (SAR) has been designed and agreed. The SAR captures the standardization activities that may influence or get influenced by the project technological innovations and it focuses primarily on IETF, ETSI MEC and 3GPP, although other important SDOs and forums (e.g., ITU-T and NGMN) are also considered. 5G-TRANSFORMER has adopted this plan and it has started to execute on it with the aim of:
  1. Keeping track of existing or upcoming industry specifications or recommendations that might affect the project technological choices
  2. Identify opportunities for the project to contribute its proposed solutions to present and future standardization groups
  3. Disseminate project outputs into key standardization forums to raise awareness and help create an opportunity for standardization exploitation
  4. Contribute through the partners (individually or jointly) with project-related technology proposals into the relevant standardization forums. At least 10 contributions are targeted in the various SDOs.

The SAR focuses on 4 main areas:

- Technology Scope (e.g., Network Slicing and Virtualization).
- Targeted group within the SDO (e.g., SA WG2 in 3GPP).
- Objective or Technology Target within 5G-TRANSFORMER (e.g., Orchestration of network resources).
- Specific impact in 5G-TRANSFORMER Architecture (e.g., Vertical Slicer).

As a means to execute the Standardization plans described in the SAR, 5G-TRANSFORMER has formed a standardization advisory committee (SAC) composed of standardization experts supporting 5G-TRANSFORMER in all the key relevant SDOs. These include 3GPP, IETF, ETSI MEC, and IEEE, in particular. Members and moderator of the SAC have been appointed from expert researchers from partners of 5G TRANSFORMER with relevant and operational involvement in each of the key SDOs, which have been identified as essential within the project. This list of experts is outlined in Table 13 below:

TABLE 13: SAC MEMBERSHIP

Key SDOs	Member Partner	Company
IETF	Carlos Bernardos	UC3M
	Luis Miguel Contreras	Telefonica
IEEE	Antonio de la Oliva	UC3M
ETSI MEC	Fabio Giust	NEC
	Thomas Deiß	NOKIA
	Luis Miguel Contreras	Telefonica
ETSI NFV	Giulio Bottari	ERICSSON
	Luis Miguel Contreras	Telefonica
3GPP	Thouraya Toukabri	Orange
	Ulises Olvera Hernandez	IDCC
	Chia-Lin Lai	ITRI

The SAC is now in operation and it meets regularly and on-demand as needed. The SAC is responsible for:

- Setting up the standardization activity roadmap, and continuing updating this roadmap as the work in the project progresses in relation to the individual progress of the relevant SDOs.
- Coordinating the project and standardization groups through constant monitoring of activities and standardization discussion held through regular conference calls with standardization experts.
- Helping to identify opportunities to push technology contributions into ongoing specifications.
- Helping to improve and to socialize contributions ahead of standard meetings.
- Helping to promote the project at standardization-related workshops, panels, and summits.

To monitor and record the progress of 5G TRANSFORMER project activities as outlined in the SAR, the SAC has produced a progress tracking spreadsheet, used for both planning and progress tracking.

The tool has the following advantages:

1. Monitoring and Planning

      a. Allows for focused planning
      b. Tracks progress and accountability
         i. Per SDO (one per sheet)
2. Enhancing contribution process:
      a. Support of socialization of contributions
      b. Possibility to request expert reviews
      c. Support contribution on the floor

An example of how this progress tracking tool is used to executed on the SAR plan is shown below in Figure 6:

FIGURE 6: SAC PROGRESS TRACKING AND REPORTING

As outlined above, a contribution topic/subject is first identified and discussed with the relevant team and SAC expert, based on the current technology development within 5G-TRANSFORMER and the development of a particular topic in a SDO, matching this area of technology. The specific working group, contribution scope and meeting slot are identified and agreed. An SDO lead within the SAC is tasked with ensuring that an agreed standards contribution is brought to the relevant forum and progress is monitored on every SAC meeting. Meetings are usually timed with Standards meeting cycles. In that meeting, 6 contributions were brought to 4 different IETF groups, and 2 of them were adopted and one more is reported to be in the process of being adopted.

This method proves useful to ensure that 5G-TRANSFORMER goals in terms of standards insertion be met. The current status is reported next.

So far, we have submitted 16 contributions to four different SDOs: 10 to IETF, 1 to 3GPP, 4 to ETSI MEC, and 1 to NGMN. Out of these 16, three of them have been adopted.

During the first year of 5G-TRANSFORMER we can already obtained important results in the standardization arena. Partners have contributed significantly to both key standardization activities within 5G-TRANSFORMER itself and standardization forums. Table 14 shows the complete list of achievements during this period (not only including contributions):

TABLE 14: STANDARDIZATION ACTIVITIES

Target SDOs	Activity	Status	Date
ETSI MEC	Creation of WI ETSI MEC by 5G-TRANSFORMER	Agreed	21/11/2017

NGMN	NGMN abstraction based on 5G-TRANSFORMER E2E Architecture diagram		25/07/2017
SAC	Creation of Standardization Activities Roadmap (SAR) within the 5G-TRANSFORMER project	Done	09/04/2018
ETSI MEC(24)	1. Instantiating a Network Slice integrating MEC applications, using 3GPP elements. 2. Use case on creation and termination of a slice 3. MEC reference architecture in a NFV environment 4. Managing Traffic Redirection from the Mobile Edge Platform: Approaches to Address Issue#9 of ETSI MEC017	Accepted	07/05/2018
MEC	MEC meeting presentation by IDCC, requirements for MEC Systems with 3rd Parties		10/05/2018
IETF (DMM WG)	Proxy Mobile IPv6 extensions for Distributed Mobility Management (https://tools.ietf.org/html/draft-bernardos-dmm-pmipv6-dlif-01)	Adopted	02/03/2018
IRTF (NFVRG)	Network Virtualization Research Challenges (https://datatracker.ietf.org/doc/draft-irtf-nfvrg-gaps-network-virtualization/) draft-irtf-nfvrg-gaps-network-virtualization	Adopted	03/07/2017 (+ updates)
IETF (NFVRG)	Multi-domain Network Virtualization (https://datatracker.ietf.org/doc/draft-bernardos-nfvrg-multidomain/) draft-bernardos-nfvrg-multidomain		05/03/2018 (+ updates)
IETF (SFC WG)	Service Function discovery in fog environment (https://datatracker.ietf.org/doc/draft-bernardos-sfc-discovery/) draft-bernardos-sfc-discovery		05/03/2018
IRTF (NFVRG)	IPv6-based discovery and association of Virtualization Infrastructure Manager (VIM) and Network Function Virtualization Orchestrator (NFVO) (https://datatracker.ietf.org/doc/draft-bernardos-nfvrg-vim-discovery/) draft-bernardos-nfvrg-vim-discovery		05/03/2018
IETF (COMS BoF)	COMS Architecture (https://datatracker.ietf.org/doc/draft-geng-coms-architecture/) draft-geng-coms-architecture		05/03/2018
IETF (COMS BoF)	Problem Statement of Common Operation and Management of Network Slicing (https://datatracker.ietf.org/doc/draft-geng-coms-problem-statement/) draft-geng-coms-problem-statement		05/03/2018
IETF (CCAMP WG)	A YANG Data Model for Microwave Topology (https://datatracker.ietf.org/doc/draft-ye-ccamp-mw-topo-yang/) draft-ye-ccamp-mw-topo-yang		05/03/2018

IETF (CCAMP WG)	A framework for management and control of microwave and millimeter wave interface parameters (https://datatracker.ietf.org/doc/draft-ietf-ccamp-microwave-framework/) draft-ietf-ccamp-microwave-framework	Adopted	05/01/2018
IETF (CCAMP WG)	A YANG Data Model for Microwave Radio Link (https://datatracker.ietf.org/doc/draft-ietf-ccamp-mw-yang/) draft-ietf-ccamp-mw-yang		03/03/2018
3GPP SA2	(S2-183925-S2-183923) New Key Issue: Identify scenarios when Network Slices cannot coexist within a single PLMN	Agreed	16/04/2018

6 References

[1]. 5G-TRANSFORMER. "Initial Communication, Dissemination, and Exploitation Plan (CoDEP) draft including Standardization roadmap." Deliverable D6.1, November 2017.

[2].   5G PPP. "5G PPP Work Groups." Available at: https://5g-ppp.eu/5g-ppp-work-groups/

[3]. To-Euro-5G project. Project website. Available at: https://5g-ppp.eu/to-euro-5g/

[4]. IPR Helpdesk. "IPR glossary". Available at: https://www.iprhelpdesk.eu/glossary

[5]. A. Ruete. "Communicating Horizon 2020 projects." Available at: https://ec.europa.eu/easme/sites/easme-site/files/documents/6.Communication-AlexandraRuete.pdf

[6]. European Commission. Common Dissemination Booster (CDB). Information available at: http://ec.europa.eu/research/participants/data/ref/h2020/other/comm/170927_cdb_en.pdf

7 Annex I. Survey of Overall Satisfaction of attendees to the 1st COMPASS Workshop

Despite the fact that the metric of the CoDEP related with event organization was related with the degree of satisfaction for one main event, the project plans to measure the satisfaction of attendees in all events organized. This is the result of the poll for the first COMPASS workshop, held in April 2018, co-located with IEEE WCNC. We observe that a huge percentage of the attendees was satisfied with the technical content and organization of the event.
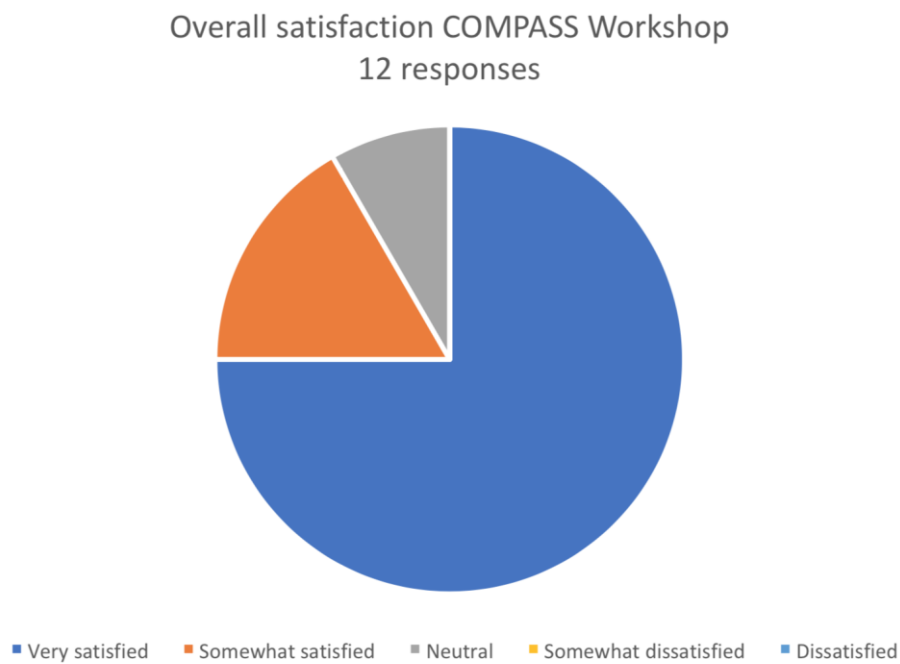
FIGURE 7: SURVEY ON OVERALL SATISFACTORY OF COMPASS WORKSHOP. 12 PERSONS HAVE ANSWERED TO THE SURVEY
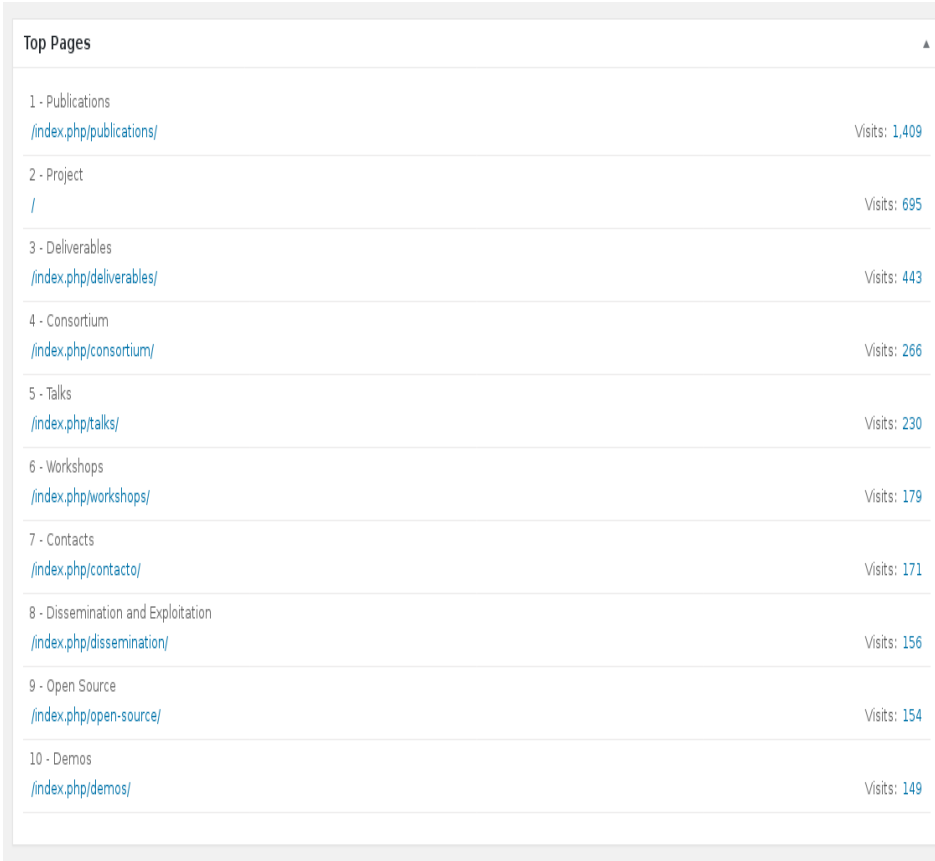
8 Annex II. Statistics of Web and Social Media

This annex presents a sample of the metrics obtained for the website and the social media of the project. Overall, one can observe a steady increase of the visits/hits and, in general, of the interaction with the 5G-TRANSFORMER content in the various channels used. This was the main goal of the *raise awareness* phase of the CoDEP.

8.1 Statistics of the 5G-TRANSFORMER website

Figure 8 shows the Top 10 most visited pages of the 5G-TRANSFORMER website. One can observe that the technical content is the one attracting more attention, though the rest of the content (including generic information, such as the consortium and general information about the project) is also often visited.

In summary, we have observed around 4000 visits and 1800 visitors in the last quarters with the most visited page reaching more than 1000 visits (/publications).

Top Pages	▲
1 - Publications /index.php/publications/	Visits: 1,409
2 - Project /	Visits: 695
3 - Deliverables /index.php/deliverables/	Visits: 443
4 - Consortium /index.php/consortium/	Visits: 266
5 - Talks /index.php/talks/	Visits: 230
6 - Workshops /index.php/workshops/	Visits: 179
7 - Contacts /index.php/contacto/	Visits: 171
8 - Dissemination and Exploitation /index.php/dissemination/	Visits: 156
9 - Open Source /index.php/open-source/	Visits: 154
10 - Demos /index.php/demos/	Visits: 149

FIGURE 8: TOP VISITED PAGES OF THE 5G-TRANSFORMER WEBSITE

Additionally, Figure 9 shows the trends of visits (versus time) the top 5 most visited pages activity since January 2018.
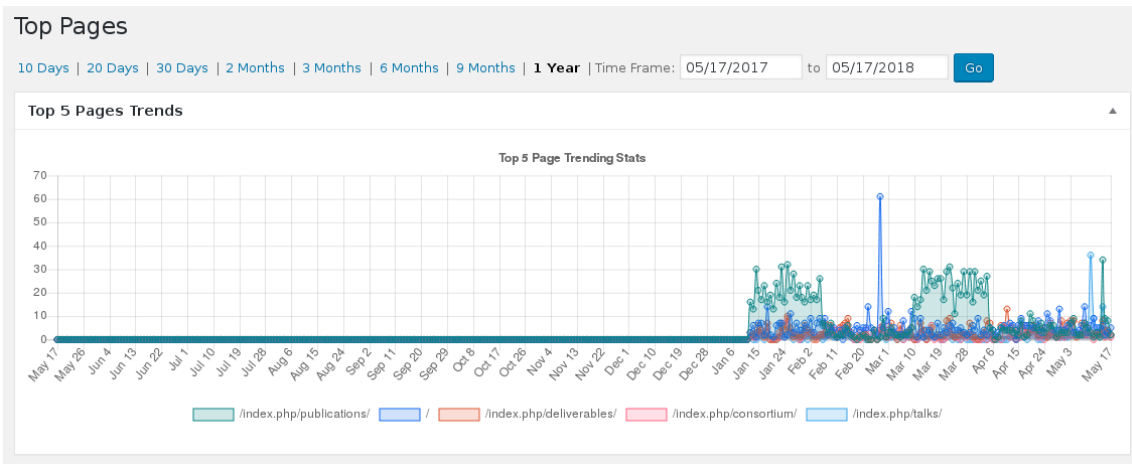
FIGURE 9: TOP 5 PAGE TRENDING STATES

8.2 The statistics of 5G-TRANSFORMER Twitter

This section provides some samples of the kind of information that is monitored to track the impact that the content published through Twitter has.

Furthermore, through the statistics data shown in the figures below (from Figure 10 to Figure 11 (a) to (d)), one can see that the awareness of the 5G-TRANSFORMER project is increasing, since the number of followers and the interactions with the tweets steadily increase. In particular, the number of followers reached 220. The number of impressions (i.e., times a user is served a Tweet in timeline or search results) moved from thousands during the initial months of the project to 10s of thousands in recent quarters (up to a max. of almost 33000).
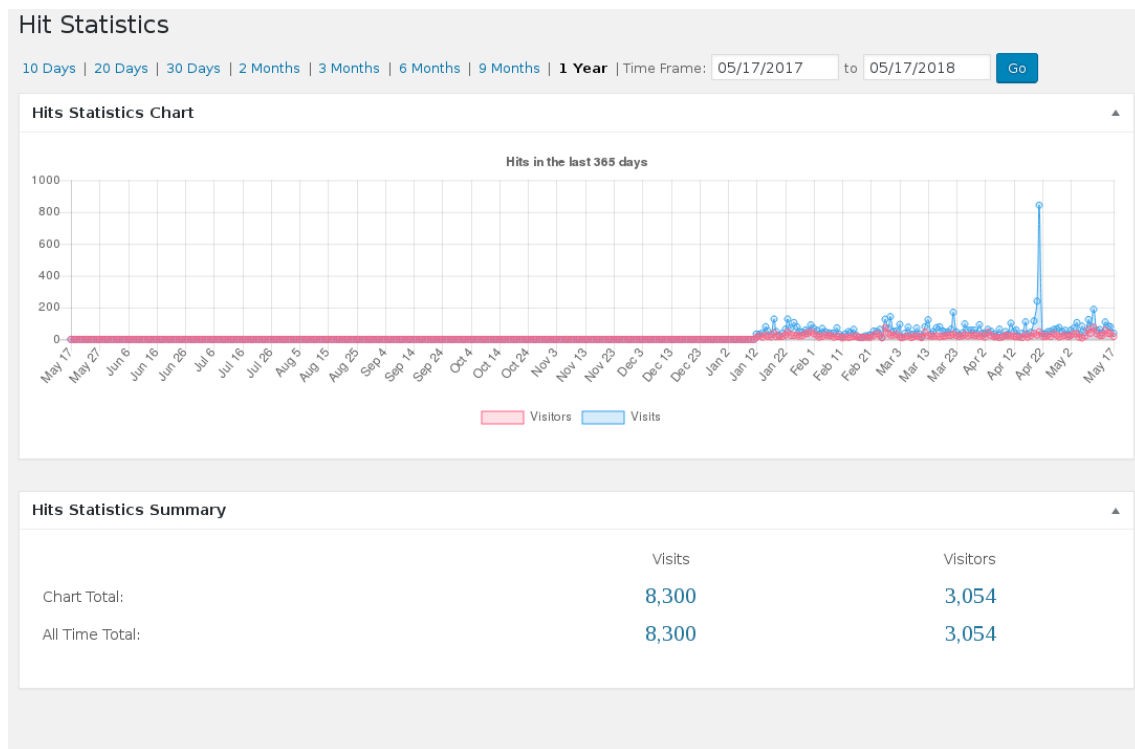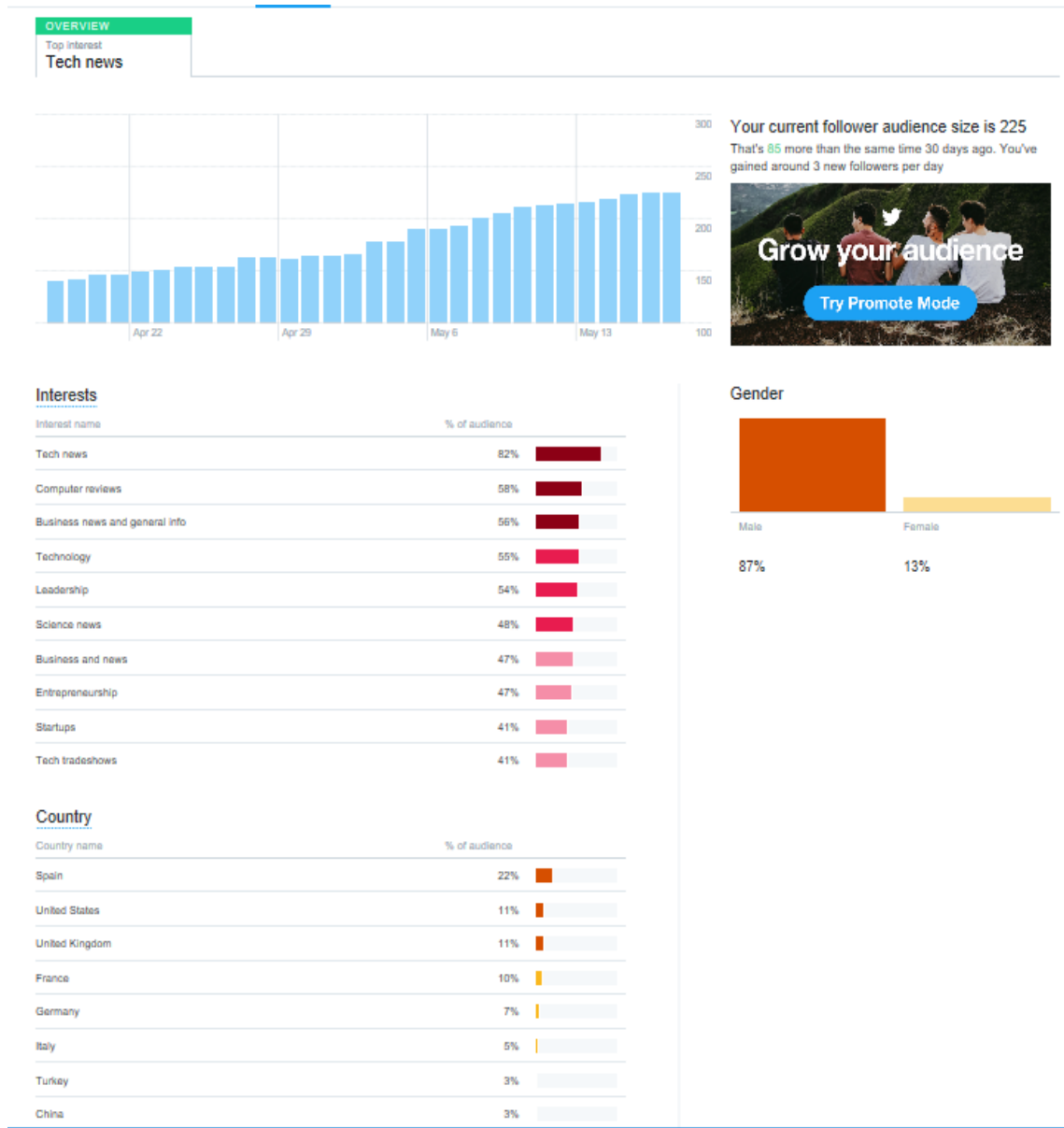

FIGURE 10: Hit statistics during first year: statistics of the 5G-TRANSFORMER Twitter account
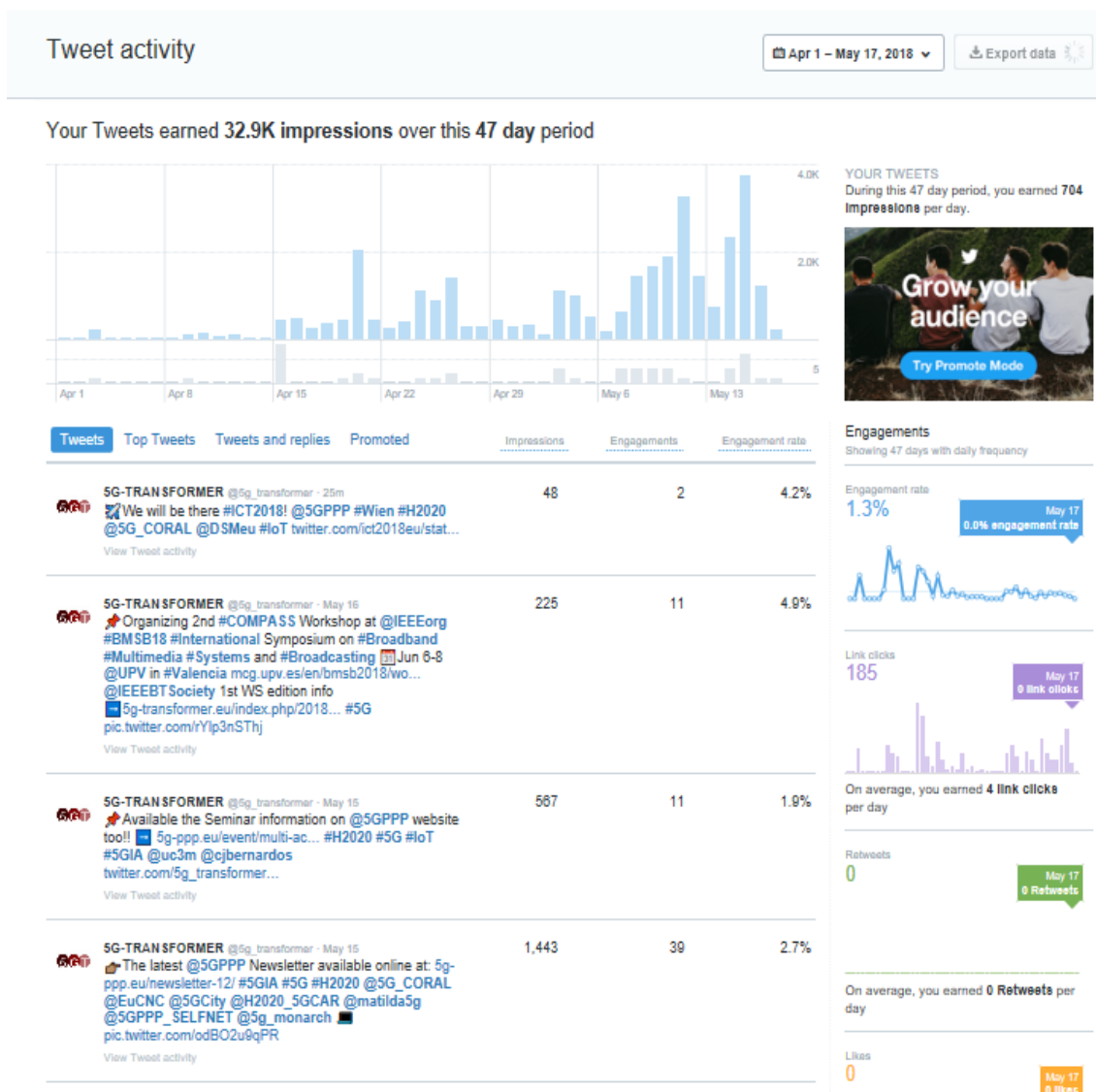
(a) Sample Twitter account activity: April 2018
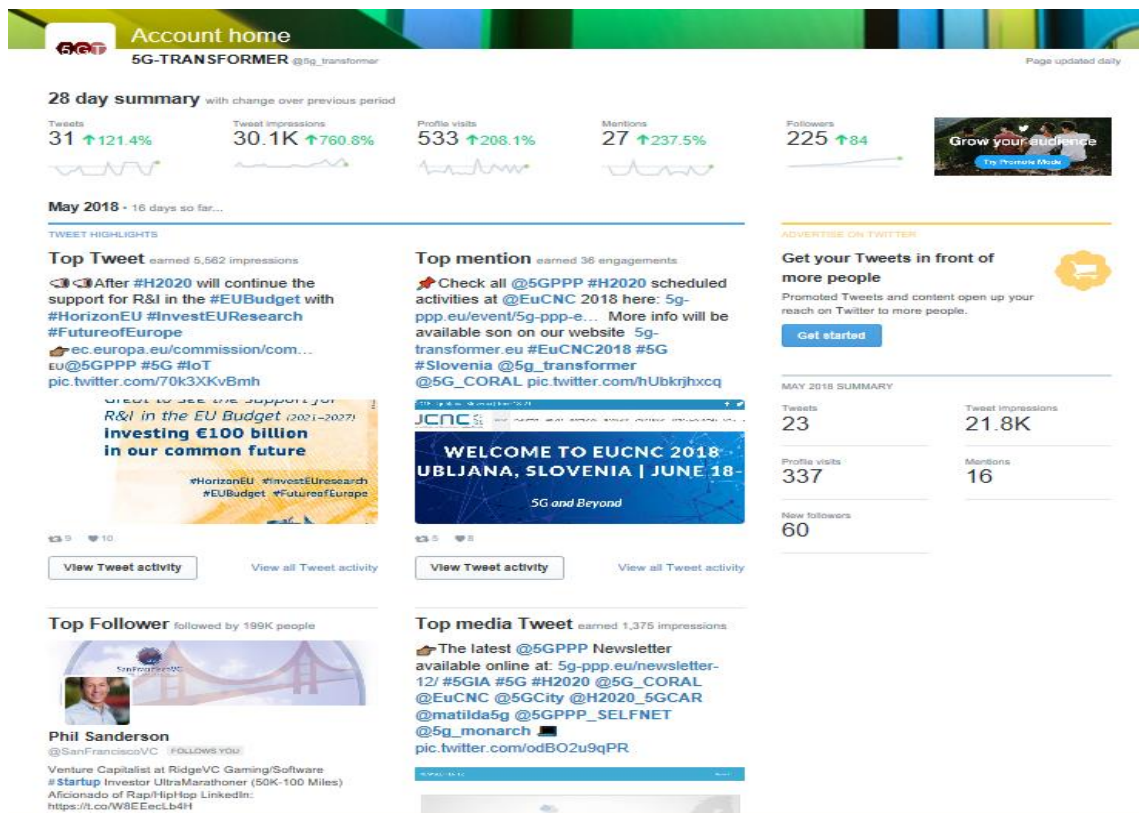
(b) Overall view of Twitter until May 2018

(c) Sample Twitter information: Top interests

(d) Sample Twitter activity statistics during April and May 2018

FIGURE 11: SAMPLE TWITTER STATISTICS SINCE JANUARY 2018

8.3 Instagram, Youtube, LinkedIn

Through the main focus in terms of communications channels was put on the web and Twitter, the project also has some presence in other social media. The same trend as in Twitter is observed in the rest of social media (Instagram, LinkedIn and YouTube), though with a lower intensity. For instance, in Instagram, as of April 2018, the project has 19 followers and 172 LinkedIn followers. Furthermore, the 5G-TRANSFORMER high-level video had more than 500 visualizations since February 2018 (in addition to those during the events in which it was played, such a Mobile World Congress). More technical videos will be recorded and published on the YouTube channel for some of the demonstrations of the project (e.g., EUCNC).