

## Deliverable D7.5

### 1<sup>st</sup> Report on Dissemination, Standardization and Exploitation Plans

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<b>Deliverable</b>	D7.5 – 1 <sup>st</sup> Report on Dissemination, Standardization and Exploitation Plans		
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## Executive Summary

This document is a publicly available deliverable of the MonB5G project that provides a comprehensive report of the activities of the H2020 ICT RIA project in the below areas, between months 1-15 of project execution:

- Dissemination – Sharing of research results with peers in scientific community & industry
- Communication – Informing the media and general public about the project and its results
- Standardization – Participation to the activities of standards developing organizations (SDOs)
- Exploitation – Plans & activities towards the use of project results for commercial purposes

On the dissemination and communication front, covered in *Sections 2 and 3* of this document, the project is able to demonstrate the significant results below:

- 2x press releases published
- 2x newsletters published
- 6x public workshop/seminar/invited talks
- 24x publications to journals and conferences (15 published, 9 accepted)
- contributions to 2x 5G PPP white papers

MonBG makes effective use of all the established communication channels (website, factsheet, social media) to keep the media and general public continuously informed about and engaged with the ongoing activities.

On the standardization front, covered in *Section 4* of this document: The project has mapped its use cases to corresponding 5G use cases specified by NGMN, ITU-R, 3GPP and 5G PPP. The project then extensively analysed and aligned to the extent possible the MonB5G concept, architecture and interfaces with the standards defined by NGMN, 3GPP, IETF (TEAS WG, Security) and ETSI (ISG NFV, ISG ZSM, ISG ENI, ISG AFI, ISG MEC), also adopting the security guidelines of ENISA and NIST. Last but not least, the project has identified specific opportunities for contributions to standardization activities, initially targeting ITU-T and IETF/IRTF.

On the exploitation front, covered in *Section 5* of this document: After establishing the project's IPR Council, the project solidified the exploitation strategy and the tools used (competitive analysis, application analysis, exploitation plan/map). Adopting innovation management best practices, the project analysed the strengths of its innovation potential, mapped the benefits & value it aims to create to the business model stakeholders, while continuously analysing the target market and the competitive landscape. Progress beyond the state of the art is already significant. This empowers the project partners to confidently revise their individual exploitation plans, while MonB5G as a whole further solidifies and refines its overall exploitation map.

As the project makes further progress with the technical work packages (WP2, WP3, WP4, WP5) and the PoC integration activities (WP6), we anticipate that project activities in all the above four areas will accelerate, further exceeding the goals and objectives that we have set at project inception. Future progress will be shared via the project communication channels and officially reported in upcoming deliverables (M24, M36).

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## Abbreviations

Acronym	Description
<b>3GPP</b>	3rd Generation Partnership Project
<b>5G IA</b>	5G Infrastructure Association
<b>5G PPP</b>	5G Infrastructure Public Private Partnership
<b>AI</b>	Artificial Intelligence
<b>CAGR</b>	Compound Annual Growth Rate
<b>CAPEX</b>	Capital Expenditure
<b>ENI</b>	(ETSI) Experiential Networked Intelligence
<b>ENISA</b>	European Union Agency for Cybersecurity
<b>ETSI</b>	European Telecommunications Standards Institute
<b>EuCNC</b>	European Conference on Networks and Communications
<b>GSM</b>	Global System for Mobile Communications
<b>GSMA</b>	GSM Association
<b>IEEE</b>	Institute of Electrical and Electronics Engineers

<b>IETF</b>	Internet Engineering Task Force
<b>IM</b>	Innovation Manager
<b>IPR</b>	Intellectual Property Rights
<b>IRTF</b>	Internet Research Task Force
<b>ISG</b>	Industry Specification Group
<b>ITU</b>	International Telecommunication Union
<b>LTE</b>	Long Term Evolution
<b>MANO</b>	Management and Orchestration
<b>MEC</b>	(ETSI) Multi-access Edge Computing
<b>ML</b>	Machine Learning
<b>MWC</b>	(GSMA) Mobile World Congress
<b>NFV</b>	Network Functions Virtualization
<b>NGMN</b>	Next Generation Mobile Networks (Alliance)
<b>NIST</b>	National Institute of Standards and Technology
<b>ONAP</b>	Open Network Automation Platform
<b>OPEX</b>	Operational Expenditure
<b>OSM</b>	Open Source MANO
<b>PTC</b>	Project Technical Committee
<b>QoS</b>	Quality of Service
<b>SDO</b>	Standards Developing Organization
<b>SDN</b>	Software Defined Networking
<b>SLA</b>	Service Level Agreement
<b>TRL</b>	Technology Readiness Level
<b>UAV</b>	Unmanned Aerial Vehicle
<b>V2X</b>	Vehicle to Everything
<b>VNF</b>	Virtual Network Function
<b>WG</b>	Working Group
<b>WP</b>	Work Package
<b>ZSM</b>	(ETSI) Zero touch network & Service Management



## 1 Introduction

MonB5G is a 5G PPP Phase 3 project that will provide a zero-touch management and orchestration solution, in the support of network slicing at massive scales for 5G LTE and beyond. It proposes a novel autonomic management and orchestration framework, heavily leveraging distribution of operations, together with state-of-the-art data-driven AI-based mechanisms. MonB5G is designed around a hierarchical approach that allows flexible and efficient management of network tasks, while introducing a diverse set of centralization levels through an optimal adaptive assignment of monitoring, analysis, and decision-making tasks.

Work Package 7: Dissemination, Communication, Standardization and Exploitation (WP7) of MonB5G project has the below objectives:

1. Contribute to standards, by addressing gaps and recommending measures with respect to 5G PPP vision
2. Identify the dissemination target groups and implement a dissemination strategy for the project's results
3. Adopt an extended and innovative communication plan
4. Establish a bidirectional active communication channel through the project's website and social media
5. Actively participate and contribute to the 5G PPP program

Execution of the work package activities involves the following tasks:

- Task 7.1: Dissemination and Communication Activities (M1-M36)
- Task 7.2: Standardization Activities (M1-M36)
- Task 7.3: Exploitation and IPR Management (M1-M36)

The work package aims at fulfilling Objective 8 of the project, which includes the following topics:

- Communication outreach to all stakeholders including the general public
- Dissemination to relevant industrial and academic communities
- Dissemination of results at 5G PPP relevant programme level and beyond
- Contributions to standardization bodies
- Cross fertilization with and contributions to relevant European WGs (such as 5G PPP and 5G IA)
- Contributions to top tier conferences and journals
- Generation of Intellectual Property Rights (IPR)

The specific measurable and verifiable targets of Objective 8 are:

- KPI – 8.1: At least 8 publications per year in top-tier scientific journals and international conferences
- KPI – 8.2: At least 4 contributions to SDOs such as ETSI MEC, ZSM, ENI
- KPI – 8.3: Organization of at least 2 workshops
- KPI – 8.4: At least one demonstration per year, including one at flagship events such as MWC or EuCNC
- KPI – 8.5: At least 5 patents in the context of MonB5G

### 1.1 Scope

This is a public deliverable that reports on the progress of the MonB5G project across all tasks of WP7, i.e. in relation to dissemination, communication, standardization and exploitation planning, for the M1-M15 period.

## 1.2 Target Audience

The target audience of this deliverable are partners within the project community, who are interested in exploiting project results, peers in the scientific community, industrial partners, professional organizations or policy makers, who have interest in potential use and uptake of project results, as well as stakeholders beyond the project community, including media and the general public, interested to learn about the MonB5G project and its results.

## 1.3 Structure

The overall structure of this deliverable can be summarized as follows:

- *Section 2* provides an update on the dissemination activities of the project;
- *Section 3* covers the activities of the project on the communication front;
- *Section 4* describes the objectives and future plans related to standardization;
- *Section 5* outlines the revised exploitation plans of each partner and overall;
- *Section 6* concludes the deliverable and sets expectations for next steps.

## 2 Dissemination

In distinction to communication activities (see *Section 3*), the dissemination and the relevant tools will focus on project's results only. Thus, the dissemination audience are quite different, where they will mostly consist of the project partners, research peers, industry, commercial actors, professional organizations, policymakers, and the scientific community in general. Their interest in the project results will be to direct uptake of results and their application to their work, field, and products.

### 2.1 Research Publications

#### 2.1.1 PUBLISHED AND ACCEPTED PAPERS

- **24x Publications (11x Journals, 13x Conferences)**
  - **15x published** (6x Journals, 9x Conferences)

Type	Title	Authors	Journal/Proc./Book
Journal	LACO: A Latency-Driven Network Slicing Orchestration in Beyond-5G Networks [1]	Lanfranco Zanzi, Vincenzo Sciancalepore, Andres Garcia-Saavedra, Hans Dieter Schotten, Xavier Costa-Perez	IEEE Transactions on Wireless Communications
Journal	ARENA: A Data-Driven Radio Access Networks Analysis of Football Events [2]	Lanfranco Zanzi, Vincenzo Sciancalepore, Andres Garcia-Saavedra, Xavier Costa-Perez, Georgios Agapiou, Hans Dieter Schotten	IEEE Transactions on Network and Service Management
Journal	AI for Beyond 5G Networks: A Cyber-Security Defense or Offense Enabler? [3]	Chafika Benzaid, Tarik Taleb	IEEE Network
Journal	Federated Deep Reinforcement Learning for Internet of Things With Decentralized Cooperative Edge Caching [4]	Xiaofei Wang, Chenyang Wang, Xiuhua Li, Victor C. M. Leung, Tarik Taleb	IEEE Internet of Things Journal
Journal	A Novel QoS Framework for Network Slicing in 5G and Beyond Networks Based on SDN and NFV [5]	Zhaogang Shu, Tarik Taleb	IEEE Network
Journal	The Road beyond 5G: A Vision and Insight of the Key Technologies [6]	Konstantinos Samdanis, Tarik Taleb	IEEE Network
Conference	Heuristic for Edge-enabled Network Slicing Optimization using the "Power of Two Choices" [7]	Jose Jurandir Alves Esteves, Amina Boubendir, Fabrice Guillemin, Pierre Sens	16th International Conference on Network and Service Management (CNSM) 2020
Conference	Optimized Network Slicing Proof-of-Concept with Interactive Gaming Use Case [8]	Jose Jurandir Alves Esteves, Amina Boubendir, Fabrice Guillemin, Pierre Sens	23rd Conference on Innovation in Clouds, Internet and Networks and Workshops (ICIN) 2020
Conference	Edge-enabled Optimized Network Slicing in Large Scale Networks [9]	Jose Jurandir Alves Esteves, Amina Boubendir, Fabrice Guillemin, Pierre Sens	11th International Conference on Network of the Future (NoF) 2020
Conference	Location-based Data Model for Optimized Network Slice Placement [10]	Jose Jurandir Alves Esteves, Amina Boubendir, Fabrice Guillemin, Pierre Sens	6th IEEE Conference on Network Softwarization (NetSoft) 2020
Conference	NSBchain: A Secure Blockchain Framework for Network Slicing Brokerage [11]	Lanfranco Zanzi, Antonio Albanese, Vincenzo Sciancalepore, Xavier Costa-Perez	IEEE ICC 2020

Conference	Latency-aware Service Placement and Live Migrations in 5G and Beyond Mobile Systems [12]	Badr Eddine Mada, Miloud Bagaa, Tarik Tale, Hannu Flinck	IEEE ICC 2020
Conference	On Predicting Service-oriented Network Slices Performances in 5G: A Federated Learning Approach [13]	Bouziane Brikz and Adlen Ksentini	IEEE 45th Conference on Local Computer Networks (LCN) 2020
Conference	Dynamic Resource Aware VNF Placement with Deep Reinforcement Learning for 5G Networks [14]	Anestis Dalgkitis, Prodromos-Vasileios Mekikis, Angelos Antonopoulos, Georgios Kormentzas, Christos Verikoukis	IEEE GlobeCom 2020
Conference	Continuous Multi-objective Zero-touch Network Slicing via Twin Delayed DDPG and OpenAI Gym [15]	Rezazadeh, Farhad; Chergui, Hatim; Alonso, Luis; Verikoukis, Christos	IEEE Globecom 2020

Table 1 Published papers

○ **9x accepted publications (5x Journals, 4x conferences)**

Type	Title	Authors	Journal/Proc./Book
Journal	MonB5G Project		European 5G Annual Journal (5th Edition)
Journal	Data Driven Service Orchestration for Vehicular Networks	Anestis Dalgkitis, Prodromos-Vasileios Mekikis, Angelos Antonopoulos, Christos Verikoukis	IEEE Transactions on Intelligent Transportation Systems
Journal	Service Function Chaining in Next-Generation networks: Challenges and Open Research Issues	H. Hantouti, N. Benamar, and T. Taleb	IEEE Network Magazine
Journal	On using reinforcement learning for network slice admission control in 5G: offline vs. online	Siheem Bakri, Bouziane Brik, Adlen Ksentini	Wiley International Journal of Communication Systems
Journal	MonB5G Project		5G PPP Annual Journal
Conference	$\pi$ -ROAD: a Learn-as-You-Go Framework for On-Demand Emergency Slices in V2X Scenarios	Armin Okic, Lanfranco Zanzi, Vincenzo Sciancalepore, Alessandro Redondi, and Xavier Costa-Perez	IEEE INFOCOM 2021
Conference	A Trust architecture for the SLA management in 5G networks	Sabra Ben Saad, Adlen Ksentini, Bouziane Brik	IEEE ICC 2021
Conference	CDF-Aware Federated Learning for Low SLA Violations in Beyond 5G Network Slicing	Hatim Chergui, Luis Blanco and Christos Verikoukis	IEEE ICC 2021
Conference	Actor-Critic-Based Learning for Zero-touch Joint Resource and Energy Control in Network Slicing	Farhad Rezazadeh, Hatim Chergui, Loizos Christofi, and Christos Verikoukis	IEEE ICC 2021

Table 2 Accepted papers

### 2.1.2 WHITE PAPER CONTRIBUTIONS

#### I. Edge Computing for 5G Networks (CTXS, ORA-PL, NEC)

##### **5G PPP Technology Board WG & 5G IA Trials WG, White Paper on "Edge Computing for 5G Networks", Version 1.0, December 8th 2020, DOI 10.5281/zenodo.3698117**

The above public white paper covers how 5G PPP projects have been using and enhancing Edge Computing for 5G and beyond systems. Before delving into that analysis, the white paper presents a rationale on why Edge Computing and 5G go hand-in-hand, and how the latter can benefit most from the former. MonB5G participated to the preparation and reviews of the white paper, with contributions relevant to the project, and as part of regular attendance to the 5G PPP Technology Board and 5G PPP Software Networks WGs.

#### II. AI/ML for 5G Networks (CTTC, NEC)

##### **5G PPP Technology Board WG, White Paper on "AI/ML – Point of Interests from XG Network View" (WIP)**

The aim of the above work-in-progress white paper is to discuss on a high-level the potential applications of AI and ML mechanisms in 5G and B5G/6G networks. It also presents in more detail, how EU-funded research projects, operating in the context of the 5G PPP Programme, have specified, developed, and tested specific AI & ML solutions. MonB5G has contributed material in an area of project interest (end-to-end slicing).

## 2.2 Workshops/Special Sessions

### Workshop on Orchestration of 5G Networks and Beyond

Title: **Network Slice Placement using user location – Interactive Gaming Case of Study Workshop**

Location: **Paris, France / Virtual**

By: **Dr. José Alves Esteves (ORA-FR)**

Date: 15 December 2020

<https://orch5g.roc.cnam.fr/>



Figure 1 Cover for Orchestration of 5G Networks and Beyond Workshop

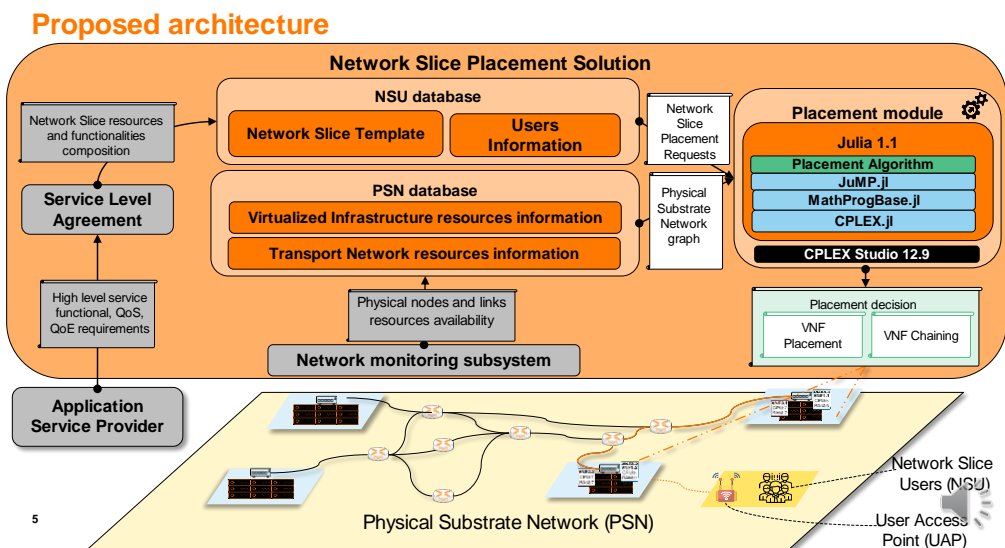


Figure 2 Screenshot from Orchestration of 5G Networks and Beyond Workshop

## 2.3 Tutorials/Seminars/Schools

### I. GDR RSD Cloud & Virtualization Seminar 2020

Title: A Deep Reinforcement Learning approach for Network Slice Placement Optimization in multi-domain networks

Location: Lyon, France / Virtual

By: Dr. José Alves Esteves (ORA-FR)

Date: 23-24 November 2020

<https://journescloud20.sciencesconf.org/>



Figure 3 Cover for Cloud & Virtualization Seminar

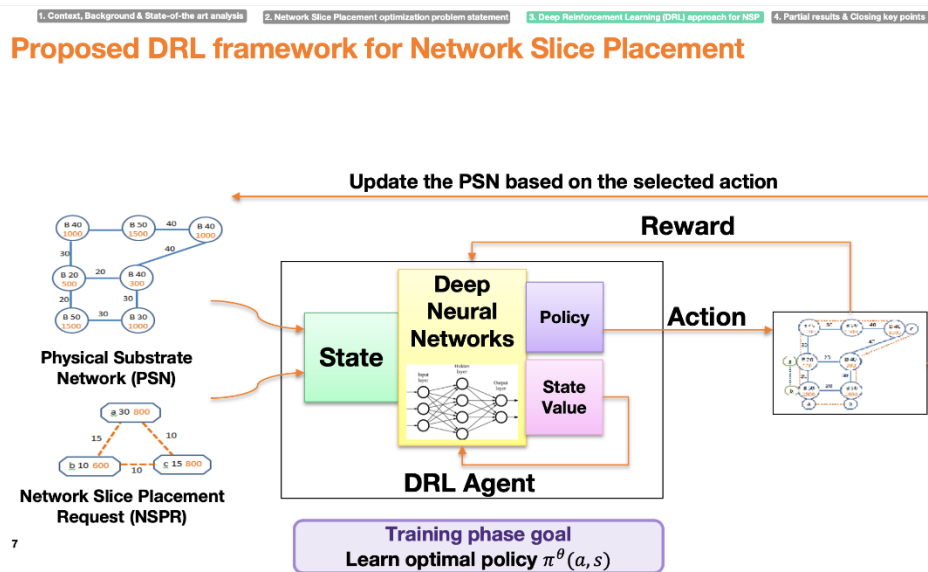


Figure 4 Screenshot from Cloud & Virtualization Seminar

## II. IEEE COMSOC Industrial Talk/Seminar

Title: **Network Slicing - Concepts, Standardization, Open Issues**

By: Dr. **Slawomir Kuklinski (ORA-PL)**

Date: 1 Dec 2020

<https://www.linkedin.com/in/ieee-comsoc-emea-region-2763801a3/3>

This talk mainly discussed:

- “In-slice” management concept
- MonB5G’s approach to slicing on the difference domain levels (OSS/BSS, Slice, NFV, Technological domain)
- Functional MonB5G Layer
- MLaaS, IDSM, Multi-Domain Slice
- MonB5G Architecture overview



Figure 5 Cover for ComSoc Industrial Talk



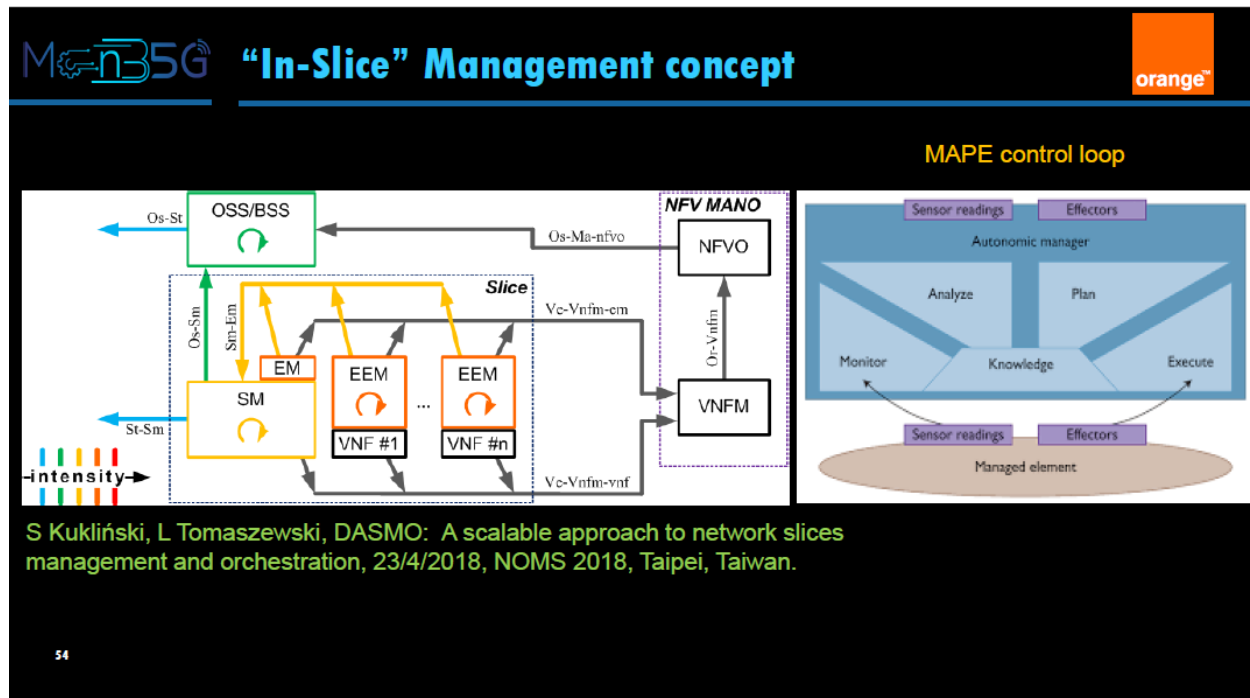


Figure 6 Screenshot from ComSoc Industrial Talk

## 2.4 Exhibitions/Booths

No activities to report in this period, largely due to the restrictions imposed by the COVID-2019 outbreak.

## 2.5 Events/Invited Talks

### I. 5G PPP Technology Board eWorkshop

Title: **Network Efficient Distributed AI for Beyond 5G Networks**

By: **Dr. Thrasyvoulos Spyropoulos (Eurecom)**

Date: 09 December 2020

This talk mainly discussed:

- End-to-End Optimization for 5G+/6G
- Jointly Optimizing 5G+ Functions
- Data-Driven Distributed Orchestration
- MonB5G Architecture and Implementation
- Distributed Deep Neural Networks



Figure 7 Cover for TB eWorkshop Talk

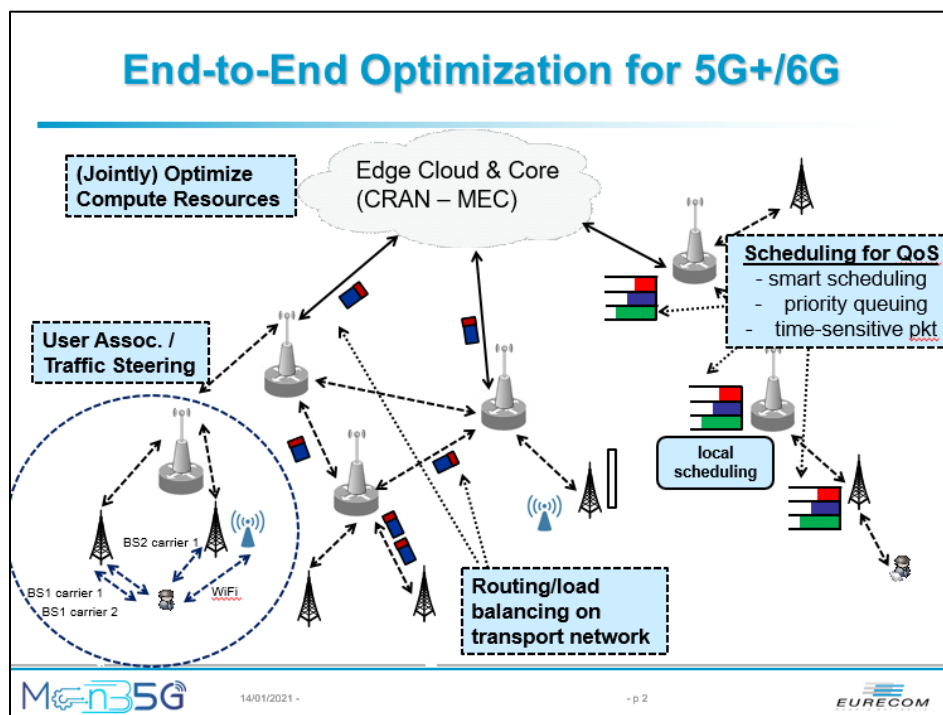


Figure 8 Screenshot from TB eWorkshop Talk

## II. 5GPPP Architecture WG

Title: **Distributed Management and Orchestration of the MonB5G Project**

By: Dr. Slawomir Kuklinski (ORA-PL)

Date: **27 November 2020**

# About the project

Project timeline (ICT-20 project):

- Duration: 42 months
- Start: 1<sup>st</sup> of November 2019
- End: 30<sup>th</sup> of May 2023

Project goals:

- Providing AI-based zero-touch management and orchestration to support of network slicing
- **Increasing scalability of management and orchestration by using AI and distribution of management functions**
- Extending network towards intent-based management

*MonB5G proposes a novel autonomic management and orchestration framework, heavily leveraging distribution of operations together with state-of-the-art data-driven AI-based mechanisms.*

27/11/20
Virtual meeting
3

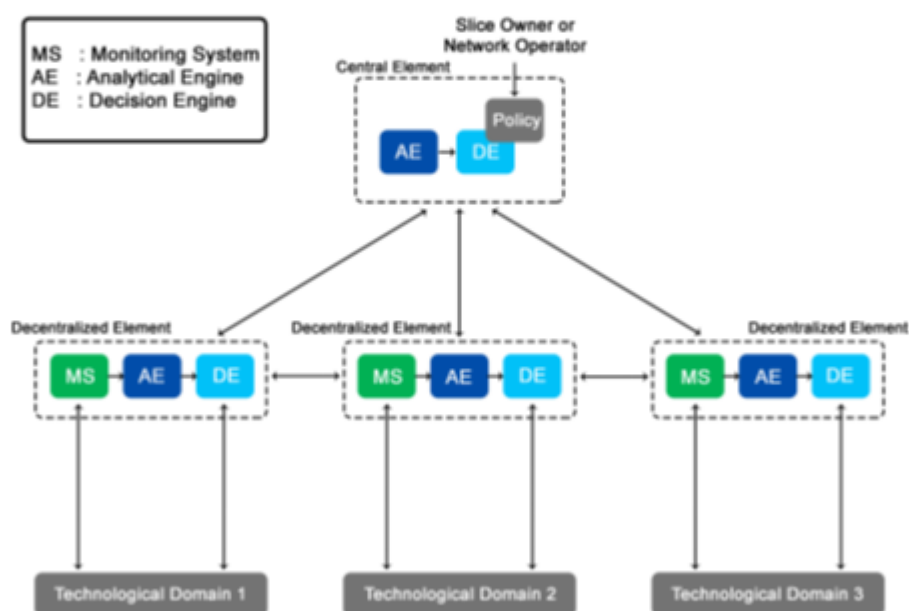
Figure 9 Screenshot from 5GPPP Architecture WG Presentation

### III. Infocom World Conference 2020 Transforming Greece: The 5G and Fiber Enablers – The Future is Now!

Title: **MonB5G: Distributed Management and Orchestration of 5G Networks with AI-based Mechanisms**

By: **Vasiliki Vlachodimitropoulou (OTE)**

Date: **6 November 2020**



6/11/2020

*The MonB5G vision of a decentralized management system for network slicing*

7

Figure 10 Screenshot from Infocom World Conference Presentation

### 3 Communication

Communication activities about the project and results, involve the use of available channels and tools by the project's partners to reach multiple audiences that include both the media and the public. With the aim to inform and reach out to society and show the benefits of the research work performed under the Horizon 2020 framework, and specifically within the MonB5G project.

The following channels were collectively and strategically chosen by the consortium in order to be effective, and proportionate in scale to the project's actions and goals.

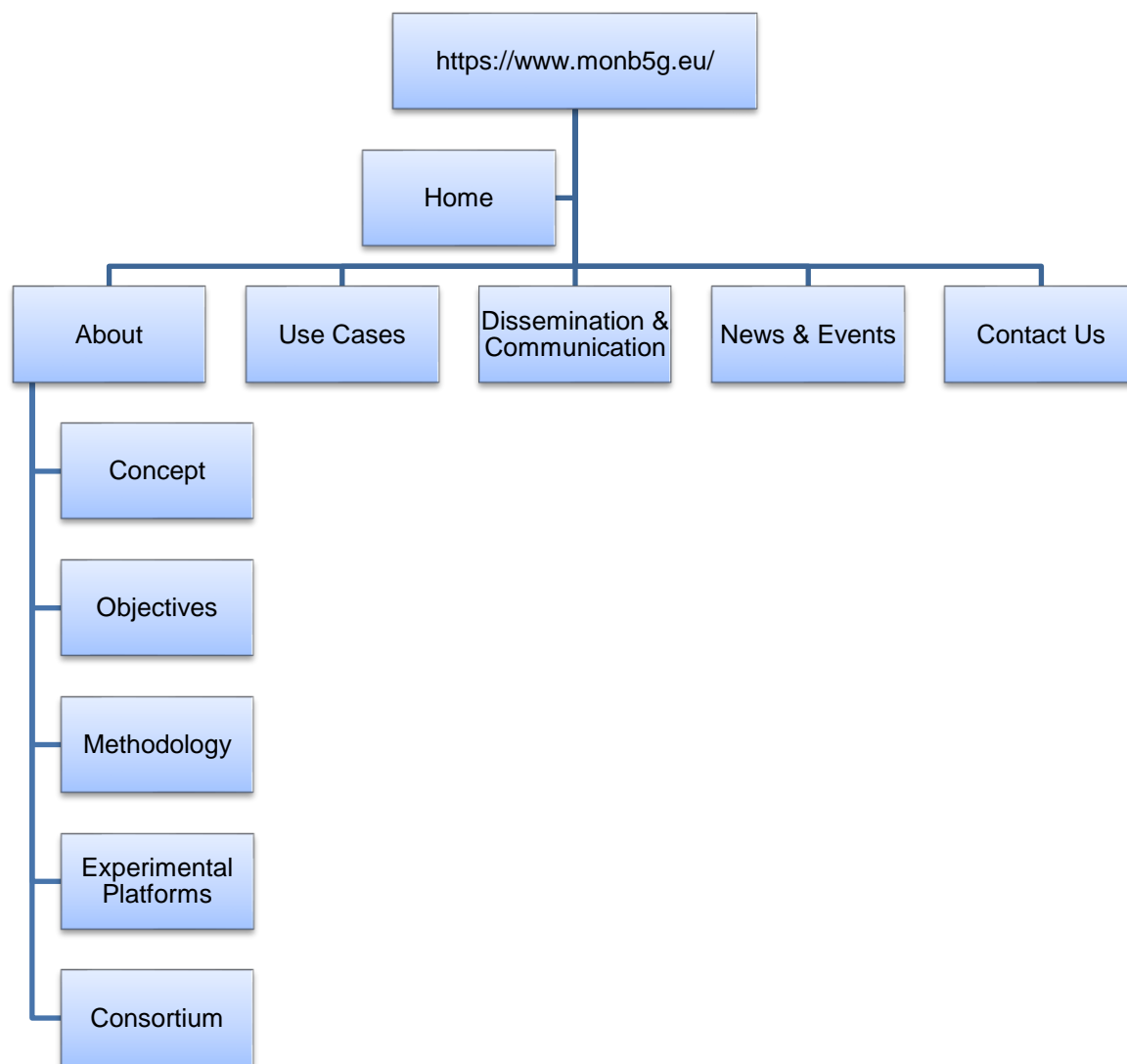
#### 3.1 Website

This section provides a description of the project's website, its structure, analytics, as well as the project social media pages which are considered as the main online presence of the project. The project website is live and has been publicly available since the project launch. Links to access the project website, as well as, the social media pages, have been shared with the Consortium during the Kick-Off Meeting (KOM) which took place at CTTC offices at Barcelona, Spain on 3rd and 4th December 2019.

The website and social media accounts were launched during M1 (November 2019) and will be continuously updated throughout the project's lifetime. The website was developed and will be maintained by eBOS Technologies Ltd., while the social media channels were created and will be updated by IQUADRAT.

### 3.1.1 WEBSITE STRUCTURE

The following structure was designed to best represent all of the project's information, and upcoming news and updates.



*Figure 11 MonB5G Website Structure*

### 3.1.2 WEBSITE ANALYTICS

For the purposes of tracking the activity of the website visitors, such as traffic, session duration, pages per session, bounces, and traffic sources in addition to others, we use Google's free web-analytics service. Through Google Analytics' dashboards (shown below), we have access to the aforementioned data and also further in-depth are available as report sets. These metrics will provide insight into the engagement on the website since January 2020 until January 2021.

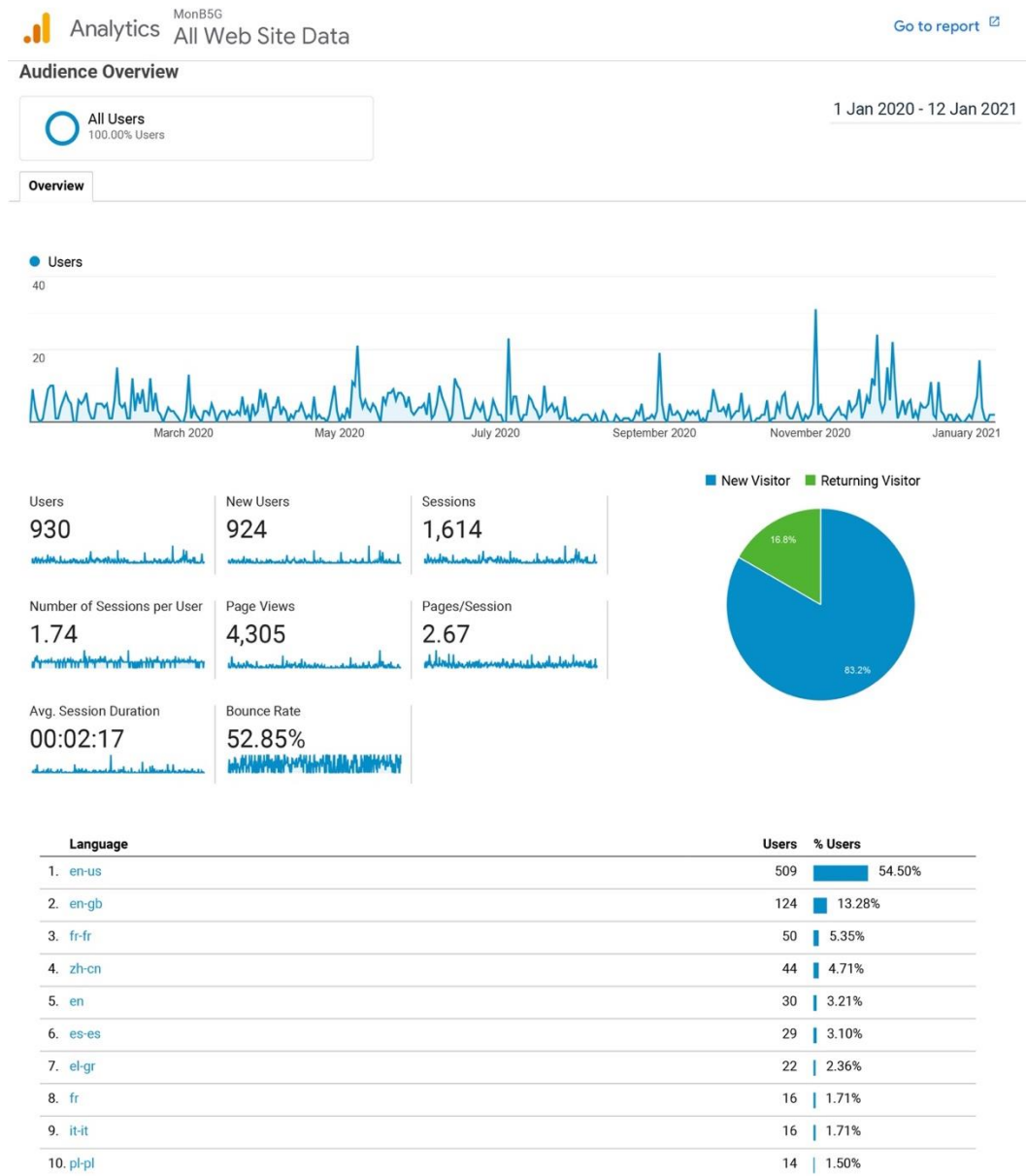


Figure 12 Website Analytics: Audience Overview

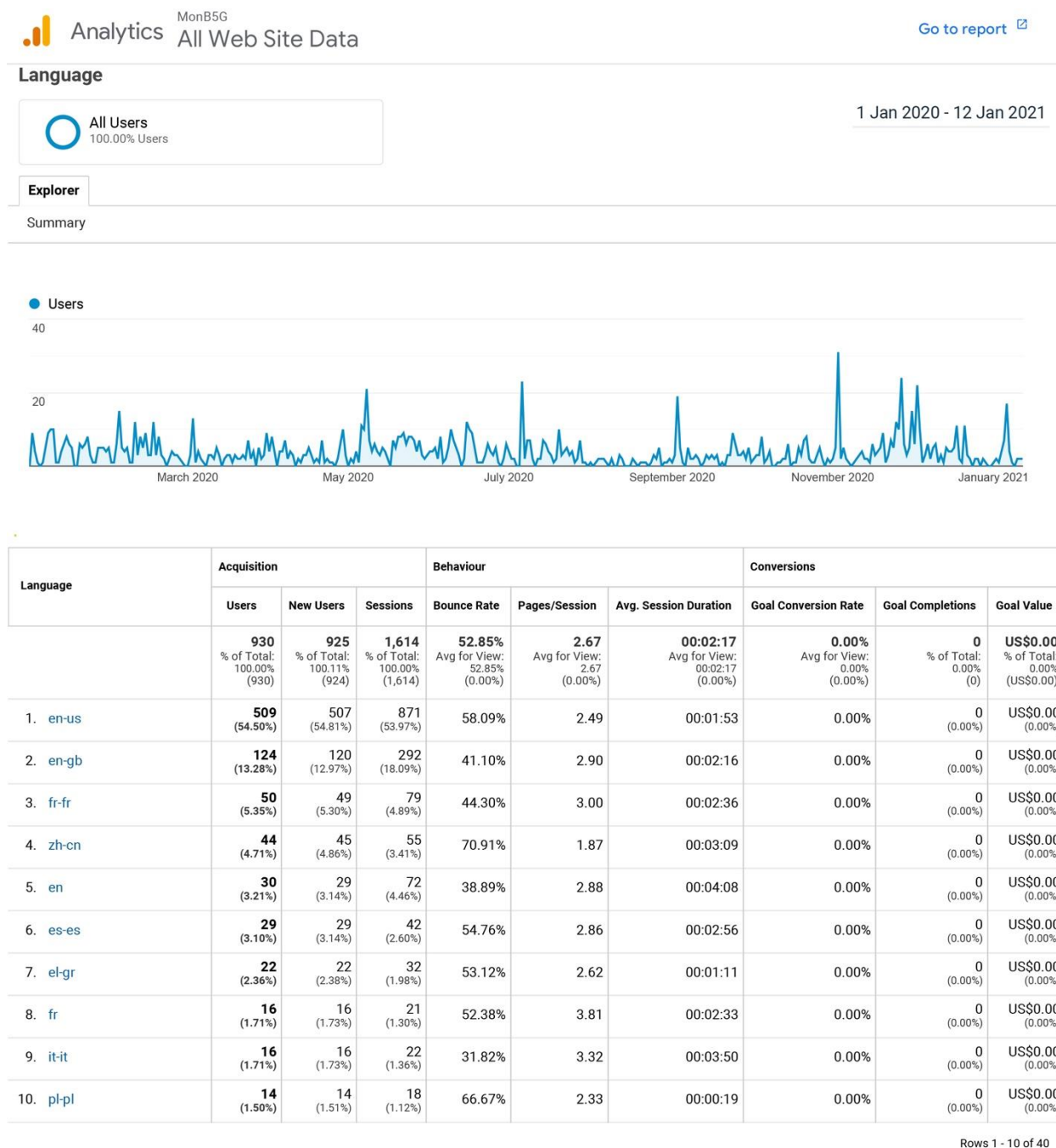


Figure 13 Website Analytics: Audience Behavior



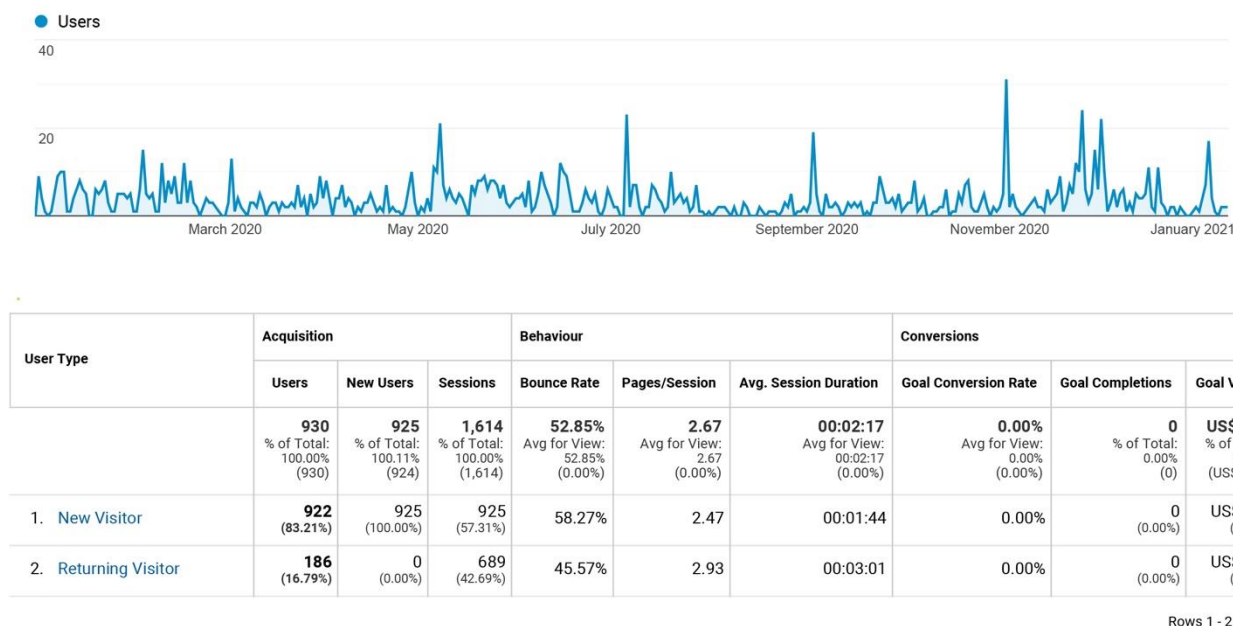


Figure 14 Website Analytics: New vs Returning Visitors

## Demographics: Overview

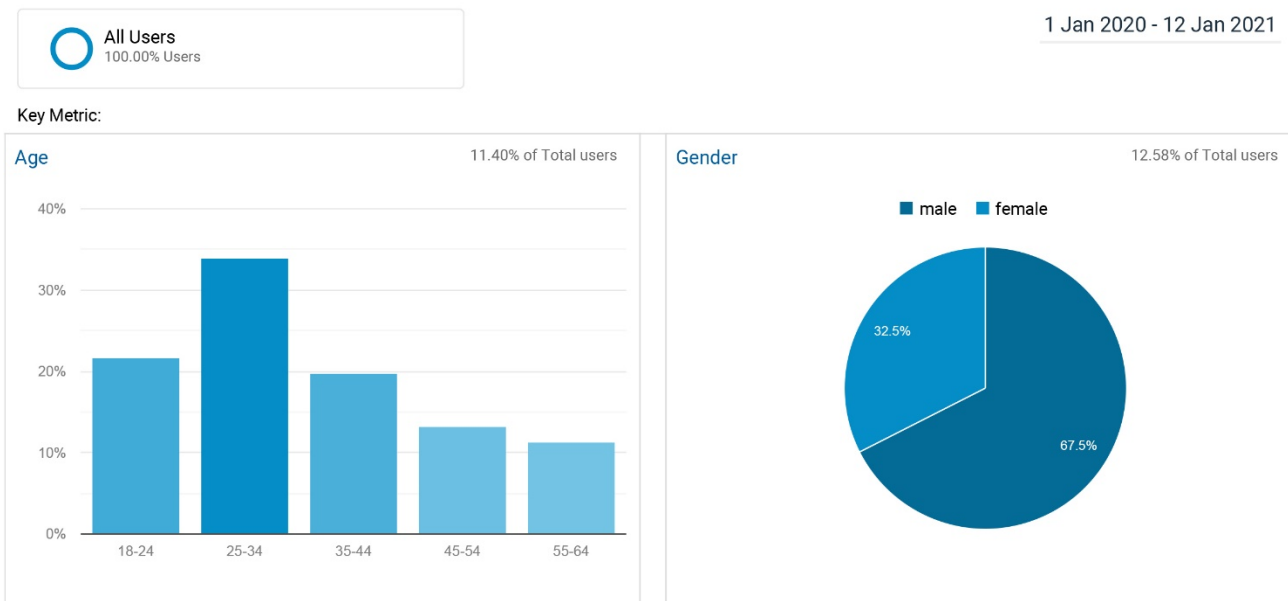


Figure 15 Website Analytics: Audience Demographics

Country ?	Users ? ↓
	<b>930</b> % of Total: 100.00% (930)
1.  United States	<b>112</b> (11.93%)
2.  Spain	<b>111</b> (11.82%)
3.  Cyprus	<b>99</b> (10.54%)
4.  Greece	<b>94</b> (10.01%)
5.  France	<b>82</b> (8.73%)
6.  Finland	<b>50</b> (5.32%)
7.  China	<b>47</b> (5.01%)
8.  Canada	<b>45</b> (4.79%)
9.  Germany	<b>34</b> (3.62%)
10.  United Arab Emirates	<b>33</b> (3.51%)

Figure 16 Website Analytics: Audience Overview by Top 10 Countries

## 3.2 Press Releases

Amongst the key communication outreach activities that target all various stakeholders, e.g., the research community, business community, and the public at large, are press releases, which will ensure that the public will be aware of the MonB5G project.

In this section, we present the first two press releases published in electronic newspapers.

The project partners eBOS and CTTC prepared and published two press releases for the research project MonB5G. The press releases were published in two popular Cypriot and Greek online newspapers, In Business News (Cyprus) on 20th May 2020, and Online News Fortune (Greece) on 31st May 2020 respectively.

The aforementioned press releases are presented in the following screenshots:

**Η eBOS Technologies Ltd πρωταγωνιστεί στις καινοτόμες τεχνολογίες 5G**

30/05/2020 14:58

Η eBOS Technologies Ltd ανακοινώνει την προώθηση δομών επικοινωνίας 5G σε παλάς βουλγανίας. Το έργο χρηματοδοτείται πλήρως από την Ευρωπαϊκή Επιτροπή με συνολικό προϋπολογισμό 14,3 εκατομμύρια ευρώ (χρηματοδοτούμενο από τον Ιούλιο 2019 και διαρκεί συνολικά τρία χρόνια). Το έργο στοχεύει να αποδείξει και να επικυρώσει ότι το 5G μπορεί να οδηγήσει κλάδους της βουλγανίας σε υψηλότερη παραγωγή σε ένα ευρύ φάσμα μελλοντικών υπηρεσιών με υψηλές ανάγκες, πολύ περισσότερες από αυτές που μπορεί να παρήγει ένα δικτύο 4G. Η έρευνα, έτσι το έργο, που διεξάγεται στο πλαίσιο της υλοποίησης, αλλά και επιταχύνει μέσω της διεξαγωγής προγραμμάτων και επίσημων δοκιμών κανονικών υπηρεσιών, χρήση, με την έλαση (εμπλοκή) και συμμετοχή πολλών χρηστών σε νέες υπηρεσίες κλάδους της βουλγανίας: Ενοικίαση του Μιλάνου, Ξύπνηση Γκαζ, Ξύπνηση Αλφάν, Μία & Ψυχαγωγία. Το έργο συντονίζεται από την Telecom Italia (TIM S.p.A.).

«Το έργο 5G-SOLUTIONS πραγματοποιείται για το 2ο έτος υλοποίησης του, ακολουθώντας το πρόγραμμα υλοποίησης των 5GPP (R16-2020) και 5G-PPH σύμφωνα με την εξέλιξη και τις αναζητήσεις των χρηστών 5G-ENR και 5G-VINNI ICT-17, και στοχεύει να ενισχύσει στους προγραμματισμένους κλάδους δομών. Έτσι ώστε να εξασφαλιστεί μια ομάδα και ευθυνοποιημένη εξέλιξη των βουλγανικών επιχειρήσεων. Η οργάνωση της αποστολής υποδομής, και οι δραστηριότητες επικοινωνίας που έχουν υλοποιηθεί κατά το 1ο έτος του έργου, καθώς και το σύστημα οπτικής παρακολούθησης των αποτελεσμάτων, στέλνουν στην επιχείρηση και στους πελάτες τους έναν πολύτιμο από την άποψη των έργων. Έχουμε ο Χρήστης Σκοπός: Υποδομής έργων στο πλαίσιο Έρευνας και Ανάπτυξης της eBOS Technologies Ltd και Υπερβολής Διασφάλισης Πολιτικής, και Εξέλιξης, Κόσμων και έργων 5G-SOLUTIONS.

Το έργο MonB5G στοχεύει στο σχεδιασμό και υλοποίηση μηχανισμών μηχανικής αφαίμαξης, ενσωμάτωση και υποστήριξη του δικτύου 5G LTE, καθώς και μελλοντικών τεχνολογιών. Χρηματοδοτούμενο πλήρως από την Ευρωπαϊκή Επιτροπή με συνολικό προϋπολογισμό 14,3 εκατομμύρια ευρώ. Το έργο έχει ξεκινήσει την 1η Ιανουάριο 2019 και θα διαρκέσει συνολικά τρία χρόνια. Κατά τη διάρκεια αυτών των τριών χρόνων, η κοινοπραξία του έργου θα αναπτύξει την αρχιτεκτονική και το περιεχόμενο ενός νέου πλατφόρμας κατασκευασμένης μηχανισμών μηχανικής αφαίμαξης, για τη διαχείριση και αυτοματισμένη σύστημα διαχείρισης δικτύου που θα ενσωματωθεί στην παρούσα και την παρούσα απόδοση. Το έργο συντονίζεται από το Τμήμα SMARTech του Telecommunications Technological Centre of Catalonia (TTCC). Η παρουσίαση των αποτελεσμάτων θα πραγματοποιηθεί σε δύο επιχειρηματικές ημερίδες: CTTCC 5G Techday στη Βαρκελώνη (Ισπανία) και Europe's 5G στη Σελία. Αντίστοιχο (Γ. Γαλιό).

«Επί του παρόντος, η κοινοπραξία του MonB5G ολοκληρώνει την συστηματική φάση του σχεδιασμού της αρχιτεκτονικής του συστήματος, συμπεριλαμβανομένων των τεχνικών υλοποίησης των μηχανισμών αφαίμαξης, κίνησης, αυτοματισμού καθώς και του συστήματος παρακολούθησης που θα επιτρέψουν την διαχείριση και αυτοματισμένη μηχανική αφαίμαξης. Επιπλέον, οι συνεργάτες καθορίζουν τους δικούς αποδοκίες, τις απαιτήσεις καθώς και τα στεγανά χρήσης, και ελέγχουν τον ορισμό θα χρησιμοποιηθούν στην επόμενη φάση δοκιμών και αξιολόγησης του συστήματος. Διευθυντής έργου στο Τμήμα Έρευνας και Ανάπτυξης της eBOS Technologies Ltd. Μηνιαίο έργο των 2 έργων, η eBOS Technologies Ltd συνεχίζει την συμπεριφορά της στο άνοιγμα του δρόμου για τη βουλγανική και ευρωπαϊκή εξέλιξη μέσω συνεργατικής έρευνας και καινοτομίας.

Για περισσότερες λεπτομέρειες, επισκεφθείτε τους ιστότοπους των έργων: [www.5g-solutionsproject.eu](http://www.5g-solutionsproject.eu) <https://www.monb5g.eu>

Figure 17 Press release in In-Business News

SMARTeCH: Η ομάδα με έδρα την Καταλονία και Έλληνα επικεφαλής που εξειδικεύεται στο 5G | FortuneGreece.com

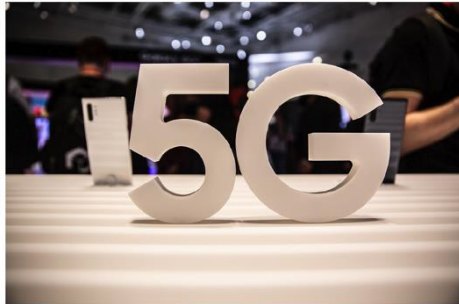
15/02/21, 22:07

SMARTeCH: Η ομάδα με έδρα την Καταλονία και Έλληνα επικεφαλής που εξειδικεύεται στο 5G | FortuneGreece.com

15/02/21, 22:07

## SMARTeCH: Η ομάδα με έδρα την Καταλονία και Έλληνα επικεφαλής που εξειδικεύεται στο 5G

ΚΕΙΜΕΝΟ: [FORTUNEGREECE.COM](https://www.fortunegreece.com/article/smartech-h-omada-me-edra-tin-katalonia-ke-ellina-epikefalis-pou-exidikευεται-sto-5g/)  
31/05/2020 18:59



ΑΠΕ-ΜΠΕ

Ο Δρ. Χρήστος Βερκοκούκης διευθύνει την ομάδα SMARTeCH στο Ερευνητικό Κέντρο Τηλεπικοινωνιών της Καταλονίας (CTTC). Ξεκίνησε τις σπουδές του στο Τμήμα Φυσικής του Αριστοτελείου Πανεπιστημίου της Θεσσαλονίκης όπου και συνέχισε με το Μεταπτυχιακό στη Ραδιοηλεκτρολογία με εξειδίκευση στις Τηλεπικοινωνίες. Εκτόνησε την

<https://www.fortunegreece.com/article/smartech-h-omada-me-edra-tin-katalonia-ke-ellina-epikefalis-pou-exidikευεται-sto-5g/>

Page 1 of 6

SMARTeCH: Η ομάδα με έδρα την Καταλονία και Έλληνα επικεφαλής που εξειδικεύεται στο 5G | FortuneGreece.com

15/02/21, 22:07

SMARTeCH: Η ομάδα με έδρα την Καταλονία και Έλληνα επικεφαλής που εξειδικεύεται στο 5G | FortuneGreece.com

15/02/21, 22:07

Telecom Italia αλλά και πολλές καινοτόμες μικρομεσαίες εταιρείες.

Οι λύσεις που προτείνουμε προσφέρονται στους τελικούς χρήστες/ πελάτες σαν υπηρεσίες για να ελέγξουν τις εφαρμογές τους σε περιβάλλοντα πραγματικών δικτύων.

Στο πλαίσιο αυτής της γενικής δράσης η ομάδα μου συμμετέχει σε πολλά ερευνητικά έργα και είναι συντονιστής του έργου MonB5G και τεχνικός υπεύθυνος του έργου 5GSTEPFWD.

**Πείτε μας περισσότερες λεπτομέρειες γι αυτά τα δύο projects.**

Το έργο MonB5G έχει διάρκεια τρία χρόνια και θα αναπτύξει μια καινοτόμα αρχιτεκτονική και το πρωτότυπο ενός νέου πλαισίου κατανομής μηχανισμού μηχανικής αφής, για τη διαχείριση και ενσυνείδητη των πόρων για τεχνολογίες κυψελωδών συστημάτων 5ης γενιάς και μετά.


<https://www.fortunegreece.com/article/smartech-h-omada-me-edra-tin-katalonia-ke-ellina-epikefalis-pou-exidikευεται-sto-5g/>

Page 3 of 6

Διδακτορική Διατριβή του στο Πολυτεχνείο της Καταλονίας.

Η ομάδα του συντονίζει και συμμετέχει σε δεκάδες ερευνητικά έργα στον τομέα της διαχείρισης και ανάθεσης πόρων σε ενεργειακά αποδοτικά δίκτυα επικοινωνιών και ο ίδιος με εκατοντάδες επιστημονικές δημοσιεύσεις σε έγκριτα ερευνητικά περιοδικά, δημοσιεύσεις σε επιστημονικά συνέδρια και ευρεσιτεχνίες θεωρείται ένας από τους πλέον ειδικούς της τεχνολογίας των δικτύων επόμενης γενιάς (5G and beyond).

**Κ. Βερκοκούκη ποιες οι δραστηριότητες της ομάδας σας;**

Όπως τα περισσότερα τεχνολογικά κέντρα το CTTC καλείται να καλύψει το κενό μεταξύ της βιομηχανικού και του ακαδημαϊκού περιβάλλοντος. Σε αυτό το πλαίσιο η ερευνητική μας ομάδα ασχολείται με θέματα διαχείρισης πόρων (τηλεπικοινωνιακών και υπολογιστικών) σε δίκτυα 5<sup>ης</sup> γενιάς και εξετάζει καινοτόμες λύσεις μέσω προσομοιώσεων και μαθηματικής ανάλυσης. Πέρα όμως από αλγορίθμους, στα εργαστήρια μας αναπτύσσουμε και πειράματα από πειραματικές πλατφόρμες και πρωτότυπα χαμηλού κόστους για διάφορες τεχνολογίες όπως 5G, Δίκτυο των Αντικειμένων (IoT), Δίκτυα Αισθητήρων κλπ. Στόχος μας είναι με τη βοήθεια της τεχνολογίας να βελτιστοποιήσουμε την απόδοση καθημερινών εφαρμογών, όπως για παράδειγμα τη φροντίδα υγείας από απόσταση, την εικονική πραγματικότητα, και άλλες που εντάσσονται στο πλαίσιο των εξυπνων πόρων. Ταυτόχρονα παρακολουθούμε την εξέλιξη των Standards και συμμετέχουμε σε διάφορες ομάδες εργασίας του Ευρωπαϊκού Ινστιτούτου Τηλεπικοινωνιακών Προτύπων, ETSI (European Telecommunications Standards Institute).

**Με ποιους συνεργάζεστε και τι λύσεις προσφέρετε;**

Ως ομάδα διατηρούμε συνεργασίες με τους μεγαλύτερους κατασκευαστές του τηλεπικοινωνιακού χώρου π.χ. Ericsson, Infineon, NEC, κ.α., τηλεπικοινωνιακούς παρόχους όπως τον ΟΤΕ, Orange Γαλλίας,

Το MonB5G θα συμβάλει στο μακροπρόθεσμο ευρωπαϊκό όραμα για δίκτυα 5G και πέραν αυτών. Η πρόκληση είναι να μετατραπούν τα μελλοντικά ασύρματα τηλεπικοινωνιακά δίκτυα, σε ασφαλή κατανομή δίκτυα (10 φορές ταχύτερη αναγνώριση της επίθεσης και αποκατάσταση της ομαλής λειτουργίας του δικτύου) με χαμηλή κατανάλωση ενέργειας (μείωση της κατανάλωσης ενέργειας κατά συντελεστή 10), όπου οι διαδικασίες και οι εφαρμογές ελέγχονται αυτόματα, χωρίς ανθρώπινη παρέμβαση, με χρήση αλγορίθμων βασισμένους σε Τεχνητή Νοημοσύνη, ανάλογα με τη ροή πληροφοριών και τις ανάγκες των τελικών χρηστών και όπου νέες εφαρμογές σε αυτοκίνητα, συνδεδεμένα αντικείμενα, έξυπνες συσκευές, γίνονται η βάση για την αλληλεπίδραση μεταξύ ανθρώπων και των συστημάτων.

**Ποιες θα δοκιμαστούν οι προτεινόμενες λύσεις του έργου;**

Οι προτεινόμενες λύσεις θα δοκιμαστούν κατά τη διάρκεια του έργου σε δύο πιλοτικές εφαρμογές: i) Εικονική Πραγματικότητα για την παρουσία εικονικών εκδηλώσεων. Θα επιτρέψει στους χρήστες να «δουν αυτό που βλέπουν οι άλλοι», μεταβαίνοντας από κυρίως προπεξεργασμένο περιεχόμενο, στην αύξηση δυναμικού περιεχομένου. ii) Τεχνητή Νοημοσύνη για υποστήριξη της ενσωμάτωσης εκατομμυρίων συσκευών στο δίκτυο, με την ασφάλεια της υποδομής και τη βέλτιστη χρήση των πόρων. Η παρουσίαση των αποτελεσμάτων θα πραγματοποιηθεί σε δύο πειραματικές πλατφόρμες: CTTC's 5G Testbed στη Βαρκελώνη (Ισπανία) και Eurecom's 5G στη Σοφία – Αντίπολις (Γαλλία).

Το έργο συντονίζεται από το Τμήμα SMARTeCH του Telecommunications Technological Centre of Catalonia (CTTC) στο οποίο είμαι επικεφαλής και είναι μια κοινοπραξία 14 εταιριών από οκτώ ευρωπαϊκές χώρες, ενώ χρηματοδοτείται πλήρως από την Ευρωπαϊκή Επιτροπή με συνολικό προϋπολογισμό 5,5 εκατομμύρια ευρώ.

**Το έργο 5G STEP FWD που επικεντρώνει;**

Figure 18 Press release in FORTUNE Greece



Full text of both press releases (originally published in Greek language) can be found in their respective links below:

- <https://www.fortunegreece.com/article/smartech-h-omada-me-edra-tin-katalonia-ke-ellina-epikefalis-pou-exidikevete-sto-5g/>
- <https://inbusinessnews.reporter.com.cy/business/ict918/article/247079/i-ebos-technologies-ltd-protagnistei-stis-kainotomes-technologies-5g>

### 3.3 Brochures/Flyers

The project's introductory flyer/factsheet was designed and produced by eBOS Technologies Ltd., for the purpose of summarizing the project's highlights and is intended to be used both in soft-copy, where it is shared on the website and social media, as well as printed versions, so as to attract and engage interested stakeholders (at events, exhibitions, etc.). The factsheet was created as a one-page overview of the project's important information, where key points (outlined below) are emphasized concisely. The purpose of the factsheet is to provide a summary of the project to any potential stakeholder that is possibly interested in the project's topics and/or outcomes, that is presented in a simple and clear design format.

The components of the factsheet are the following:

About MonB5G (including purpose, start date, budget, call, duration and number of partners), objectives, experimental platforms, consortium, project management board, and finally the project's website, and social media pages links.

For the design concept of the factsheet, it was modelled after the website. Utilizing the same colour scheme (as of 5G PPP), whilst using visual components from the website to preserve a harmonious and unified presentation of the concept and key data elements. Maximum font size, minimum text quantity and high contrast of background-to-text were used to ensure easy readability whether in an online or printed form.



Figure 19 MonB5G Flyer/Factsheet

### 3.4 Social Media

This chapter describes the MonB5G project social media accounts, which are Twitter and LinkedIn pages, as part of the dissemination activities undertaken for this project. The social media accounts were created and will be maintained by **IQUADRAT INFORMATICA SL**.

#### 3.4.1 LINKEDIN PAGE

The MonB5G Project LinkedIn Page <https://www.linkedin.com/company/monb5g> was created and launched during the first month of the project. LinkedIn is the platform of choice for researchers, companies, and industry professionals. Thus, it will be extensively used for communication and dissemination of the project's news, events, and outcomes. This platform also provides easy 'sharing' of the posts, by the project consortium's individual pages, which will in turn maximize the impact and the reach of the dissemination and communication activities.

The next Figure shows the LinkedIn page overview.

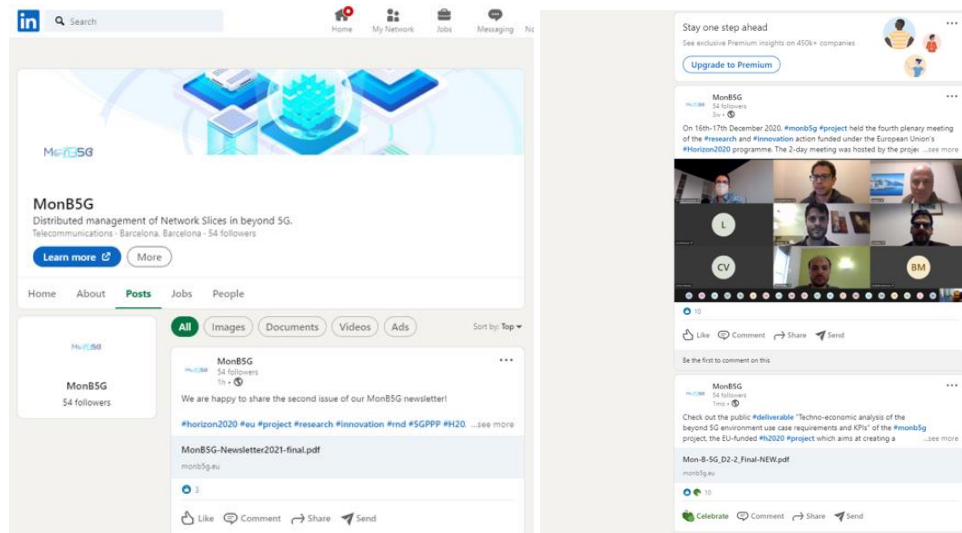


Figure 20 MonB5G LinkedIn Page

#### 3.4.2 TWITTER PAGE

The MonB5G Project Twitter Page <https://twitter.com/monb5g> was created and launched concurrently with the LinkedIn Page. With the same purpose to be utilized as a communication and dissemination tool, but the Twitter platform offers access to a different audience than LinkedIn, as it provides further reach by topics of interest using the various hashtags. Consequently, by using both platforms, we will maximize the engagement and response to potential interest in all the topics that will be covered by the project activities, events and outcomes.

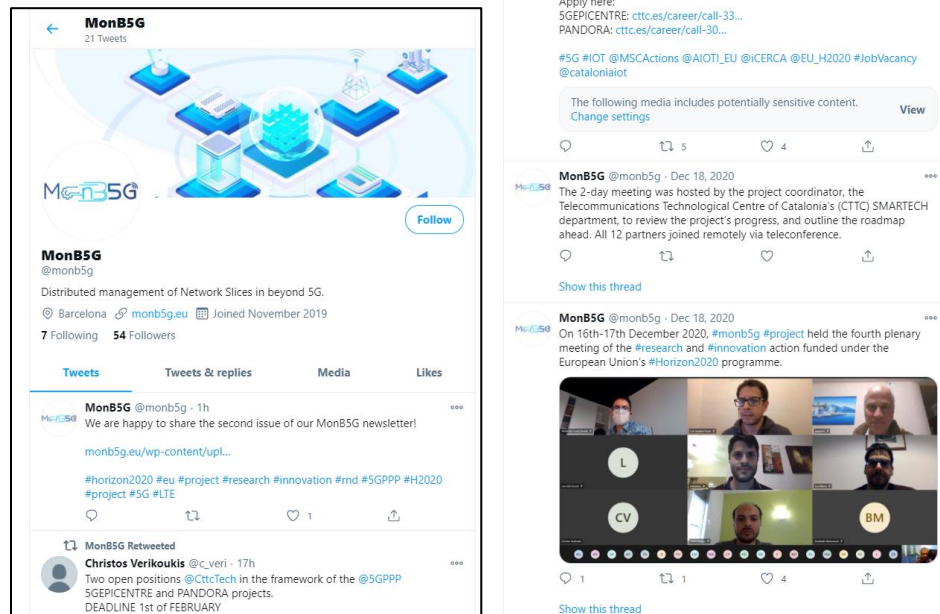


Figure 21 MonB5G Twitter Page

### 3.5 Video Clips

The first video clip scheduled for the first quarter of 2021, is in production phase and will aim to present an overview of the project's concepts, innovations and goals. It will be detailed in its own *Deliverable D7.4* (Project Video Presentation) that will be submitted in Month 17.

### 3.6 Newsletters

Like the project flyer/factsheet, the newsletter aims to keep the stakeholders informed about the project progress and developments within a given period. As originally planned, two newsletters will be issued per year and shared on all of the project channels.

The first newsletter was issued and published on May 2020, while the second was issued on January 2021. The latter shown in screenshots below, while the full versions are available in the following link:

<https://www.monb5g.eu/newsletters/>

Contents:

1. MonB5G Overview
2. Meetings
3. Publications
4. Invited Talks
5. 5G PPP Participation
6. White Papers Contributions
7. Contact Information



Figure 22 Newsletter #2 Pages 1-2

MonB5G Newsletter #2, Jan 2021					
PUBLICATIONS					
Type	#	Publications	Title	Partners	Authors
Journals	1	European 5G Annual Journal (5th Edition)	MonB5G Project	CTTC	
	2	Transactions on Intelligent Transportation Systems (IEEE)	Data Driven Service Orchestration for Vehicular Networks	IQU, CTTC	Anestis Dalgikitis, Prodromos Vasileios Makris, Angelos Antonopoulos, Christos Verikoukis
	3	IEEE Network Magazine	A novel QoS framework for network slicing in 5G and beyond networks based on SDN and NFV	AALTO	S. Zhaoqiang and T. Taleb
	4	IEEE IoT Journal	Federated Deep Reinforcement Learning for Internet of Things with Decentralized Cooperative Edge Caching	AALTO	X. Wang, C. Wang, X. Li, V. C. M. Leung, and T. Taleb
	5	IEEE Trans on Wireless Communications	On SDN-driven Network Optimization and QoS-aware Routing using Multiple Paths	AALTO	M. Bagaa, D.L.C. Dutra, T. Taleb and K. Samdanis
	6	IEEE Network Magazine	A Service-Based Architecture for enabling UAV enhanced Network Services	AALTO	Oussama Bekkouche, Konstantinos Samdanis, Miloud Bagaa, Tarik Taleb
	7	IEEE Network Magazine	The Road beyond 5G: A Vision and Insight of the Key Technologies	AALTO	K. Samdanis and T. Taleb
	8	IEEE Network Magazine	Towards ML/AI-based Prediction of Mobile Service Usage in Next-Generation Networks	AALTO	T. Taleb, A. Laghrissi, and D.E. Bensalem
	9	IEEE Network Magazine	AI for Beyond 5G Networks: A Cybersecurity Defense or Offense Enabler?	AALTO	C. Benzaïd and T. Taleb
	10	IEEE Network Magazine	Service Function Chaining in Next-Generation networks: Challenges and Open Research Issues	AALTO	H. Hantout, N. Benamar, and T. Taleb
	11	IEEE Transactions on Mobile Computing	QoS and Resource-aware Security Orchestration and Life Cycle Management	AALTO	M. Bagaa, Tarik Taleb, Jorge Bernal Bernabe, Antonio Stamata
	12	IEEE Transaction on Wireless Communications	LACQ: A Latency-Driven Network Slicing Orchestration in Beyond-5G Networks	NEC	Lafranco Zanzi, Vincenzo Sciancalepore, Andres Garcia-Saavedra, Hans D. Schotten, Xavier Costa-Perez
Conferences	13	IEEE Transaction on Network and Service Management	ARENA: A Data-driven Radio Access Networks Analysis of Football Events	NEC, OTE	Lafranco Zanzi, Vincenzo Sciancalepore, Andres Garcia-Saavedra, Xavier Costa-Perez, George Agapiou, Hans D. Schotten
	14	IEEE International Conference on Communications (ICC) 2020	NSRchain: A Secure Blockchain Framework for Network Slicing Brokerage	NEC	Lafranco Zanzi, Antonio Albanese, Vincenzo Sciancalepore, Xavier Costa-Perez
	15	IEEE Global Communications Conference (GlobeCom)	Dynamic Resource Aware VNF Placement with Deep Reinforcement Learning for 5G Networks	IQU, CTTC	Anestis Dalgikitis, Prodromos Vasileios Makris, Angelos Antonopoulos, George Kormetziou, Christos Verikoukis
	16	IEEE ICC'20	Latency-aware Service Placement and Live Migrations in 5G and Beyond Mobile Systems	AALTO	B. Mada, M. Bagaa, T. Taleb, and H. Flinck
	17	16th International Conference on Network and Service Management (CNSM 2020)	Heuristic for Edge-enabled Network Slicing Optimization using the "Power of Two Choices"	ORA-FR	José Jurandir Alves Esteves, Amina Bouabdiz, Fabrice Guillemin, Pierre Sens
	18	IEEE LCN 2020 conference	On Predicting Service-oriented Network Slices Performances in 5G: A Federated Learning Approach	EUR	Boutiane Brilz and Adlen Ksentini
	19	11th International Conference on Networks of the Future (NetF 2020)	Edge-enabled Optimized Network Slicing in Large Scale Networks	ORA-FR	José Jurandir Alves Esteves, Amina Bouabdiz, Fabrice Guillemin, Pierre Sens
	20	2020 4th IEEE International Conference on Network Softwarization (NetSoft)	Location-based Data Model for Optimized Network Slice Placement	ORA-FR	José Jurandir Alves Esteves, Amina Bouabdiz, Fabrice Guillemin, Pierre Sens
	21	23rd Conference on Innovation in Clouds, Internet and Networks (CIN 2020)	Optimized Network Slicing Proof-of-Concept with Interactive Gaming Use Case	ORA-FR	José Jurandir Alves Esteves, Amina Bouabdiz, Fabrice Guillemin, Pierre Sens
	22	IEEE INFOCOM 2021	n-ROAD: a Learn-as-you-go Framework for On-Demand Emergency Slices in V2X Scenarios	NEC	Armin Okic, Lafranco Zanzi, Vincenzo Sciancalepore, Alessandro Redondi, and Xavier Costa-Perez

Figure 23 Newsletter #2 Pages 3-4





Figure 24 Newsletter #2 Pages 5-6

## 4 Standardization

Aligned with the objectives of WP7 (Task 7.2), MonB5G aims to participate to standardization activities and submit contributions relevant to the project to various standards bodies. At project inception, the following SDOs and ISGs/WGs were identified, for the purpose of reviewing and monitoring their activities of interest:

- ETSI (ISG NFV, ISG ZSM, ISG ENI, ISG NGP, ISG CIM, ISG MEC, OSM)
- IETF/IRTF, such as the TEAS WG
- TM Forum
- IEEE (P1903 WG, P1917.1 WG, P1914.1 WG)
- NGMN
- 5G PPP Pre-Standardization WG

Indeed, in *Deliverable D2.2* (Techno-economic analysis of the beyond 5G environment, use case requirements and KPIs), we analysed the broad range of 5G use cases specified by NGMN, ITU-R (IMT-2020), 3GPP (TS 28.554), as well as 5G PPP.

In *Deliverable D2.3* (Trust Model and Trust Management Approaches), we analysed and adopted the network slice orchestration standards of 3GPP (TS 28.530, TR 28.801) and of the IETF TEAS WG, the reference points and network service templates of ETSI NFV (MAN 001, IFA 005, IFA 013, IFA 014), while also reviewing how network slicing applies to ETSI MEC (003).

In terms of security standards and guidelines, we reviewed the security architecture of 5G per 3GPP (TS 33.501), the network security standards by IETF (Security Area), we looked at ETSI NFV Security (SEC 003), the “consume services via APIs” initiatives by TM Forum and GSMA, as well as the security guidelines by ENISA (5G Threat Landscape), NIST (Zero Trust Architecture) and ISO/IEC 27001.

Finally (pending further work in WP3, WP4, WP5), in *Deliverable D2.1* (1st release of the MonB5G zero touch slice management and orchestration architecture), we covered in detail the standardization of network slices management and orchestration by NGMN (Network Slicing and 5G E2E Architecture WPs), 3GPP (TS 22.261, TS 23.501), ITU-T (SG 13) and ETSI NFV/MANO, in the latter case also looking at the security (NFV-SEC 001/003/005/006/013/014) and cloud-native/PaaS aspects (NFV-IFA 029). We also analyzed very extensively the relevance of ETSI ZSM (001, 002), ETSI ENI (005, 007) and ETSI GANA (AFI 002) with MonB5G.

Below are specific opportunities we have identified so far, but more will arise, as MonB5G progresses further:

- ITU-T SG13: ITU-T has started its effort devoted to the incorporation of AI support into international standardisation. Within the Study Group 13 (Future networks, with focus on IMT-2020, cloud computing and trusted network infrastructures), two Questions (Q20 and Q21, i.e. “IMT-2020: Network requirements and functional architecture” and “Network softwarization including software-defined networking, network slicing and orchestration”) work on AI-related documents. The mentioned works are in-line with the scope of the MonB5G project, and most of them are still at the very early stage.
- IETF/IRTF: Since the BOF meeting on Network Slicing at IETF’99 and the Network Slicing Architecture Internet Draft, IETF has been working on relevant Internet Drafts as part of the TEAS WG, focusing on the transport network (TN) aspects, as well as the abstraction and control aspects (ACTN). To attract interest, we are considering to present the management and orchestration concept and architecture of MonB5G to one of the IRTF RGs relevant to the project, such as NMRG, in one of the upcoming IETF conferences.

## 5 Exploitation

The activities relevant to the exploitation of the outcomes of the project are executed under Task 7.3: Exploitation and IPR Management (M1-M36). At a high level:

- Substantial know-how and original intellectual property (IP) will be generated during the development of MonB5G
- The consortium will use all possible means to protect generated IP with focus on post-project commercial exploitation
- The consortium includes a number of industrial partners, which can directly exploit the project results to develop commercial products/services
- Academic partners will greatly benefit, applying their experience to the development of novel concepts for production of high-quality prototypes, test methods, numerical modeling, and experimental validation in support of developments leading to qualified products
- Innovation management will be also carried out in this task to ensure quality of highest possible standards and identify potential market opportunities

At the beginning of the project, an **IPR Council** was established, comprising by one representative from each MonB5G beneficiary, who will continuously monitor the generated knowledge in the relevant MonB5G fields worldwide and ensure that IPR protection strategies will be activated before publishing.

Participant No.	Partner Short Name	Member
1	CTTC	Christos Verikoukis
2	EUR	Adlen Ksentini
3	OTE	Vasiliki Vlachodimitropoulou
4	LMI	Jimmy O'Meara
5	CTXS	George Tsolis
6	ORA-FR	Amina Boubendir
7	ORA-PL	Slawomir Kulinski
8	AAL	Tarik Taleb
9	BCOM	Eric Gatel
10	IQU	Luis A. Garrido Platero
11	NEC	Zhao Xu
12	EBOS	George Guirgis

*Table 3 MonB5G IPR Council Membership*

## 5.1 Exploitation Strategy

The innovative solutions proposed in MonB5G, which answer directly to market needs and future roadmaps, and the strong commitment of the consortium's industrial members are the key elements of MonB5G quest for success. In order to protect and maximize the project's exploitation potential, the MonB5G consortium has agreed on a "first exploit, then disseminate" exploitation strategy. All results generated within the project are monitored by the Innovation Manager (IM) and Project Technical Committee (PTC) and, at the general assembly's decision, are characterized either commercially exploitable, or available for dissemination. The results that fall into the first category are incorporated in the project's exploitation plan that will quantify their exploitation potential. The set of tools that MonB5G uses for its exploitation strategy are:

- **Competitive analysis:** MonB5G members perform a continuous market and research watch, in order to promptly identify relevant new works on targeted scientific fields, new market/research trends in 5G, and the roadmaps of large industrials and international organizations. The most frequent means of competition monitoring are market intelligence, scientific and technical publications, press notices and other sources. Each partner is responsible for monitoring the competition form that is more relevant to its interest, i.e. academic partners focus more on scientific publications, while market/patent watch and standardization tracking is handled mostly by industrial partners.
- **Application analysis and exploitation plan:** MonB5G recognizes the necessity to have a clear view of the trends, standards and roadmaps that shape the 5G sector that will allow its consortium to better position MonB5G in its likely market and better align the targeted specifications of the developed technology platform. In this effort, the industrial partners collaborate on application analysis and exploitation plan, which serves to provide a rationale for the continuing work program, or propose changes of direction where this is indicated by market/commercial forces, and the emergence of new product opportunities.
- **Current exploitation map:** MonB5G presents huge exploitation potentials for its consortium members, already identified before the project start. *Section 5.4.1* presents the updated exploitation map of the innovation actions that the industrial partners of MonB5G have qualified as commercially exploitable.

## 5.2 Expected Impact of Exploitation Strategy

Through the upgrade of existing platforms for the full support of multiple services and the demonstration of the beyond 5G capabilities to meet the requirements of the considered use-cases, MonB5G is expected to have a significant impact to the currently shaping 5G/6G landscape. In order to maximize its exploitation potential, aligned with the exploitation strategy, constant monitoring and in depth evaluation is carried out to gauge its effectiveness. The exploitation KPIs refer to i) the number of patent applications or awarded patents (MonB5G targets to submit at least 5 patents) and ii) the percentage of participating SMEs introducing innovations to the company or the market (covering the period of the project plus three years).

## 5.3 Innovation Management

Innovation management aims at identifying and implementing new creative ideas and introducing new services, processes or products to the market.

### 5.3.1 PROCESS AND STRUCTURE

The innovation collection process is managed by the consortium in the relevant WPs and is continuously integrated in the overall project results. Innovation management is thus pervasive throughout the execution of the project, as also reflected by the project's management structure:

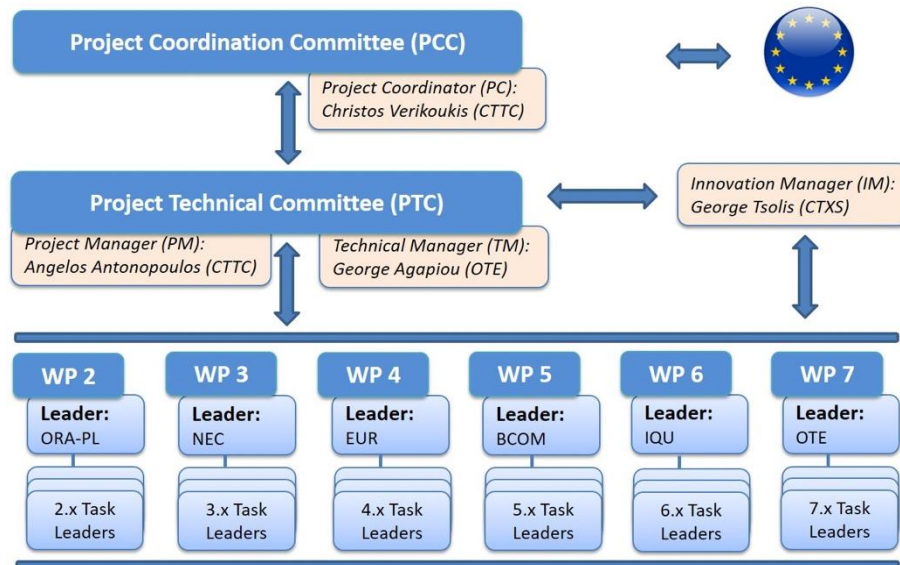


Figure 25 MonB5G Management Structure

The **Innovation Manager (IM)** role is to support the innovation driven research and to amplify the project's impact. In this context, The IM will assist the WP leaders and the Project Manager (PM) in handling all matters concerning IP protection for the produced innovations, as well as their inclusion in the exploitation plans.

### 5.3.2 INHIBITORS AND MITIGATING MEASURES

The MonB5G impact on innovation will be a function of the adopted methodology regarding the protection of the partners' legitimate interests regarding the know-how and IPR protection with respect to global competition. The consortium follows all the governance procedures specified by the Consortium Agreement and IPR management procedure, in addition to the reliable innovation management procedure.

Beyond the above provisions, the consortium has proactively identified potential innovation and commercial exploitation inhibitors, in and between the work packages, during the course of the technical activities. For each such inhibitor that we analyse below, we also cover corresponding measures we are implementing, towards addressing or alleviating those:

1. **No Shared Vision:** Vision is the spark of innovation. MonB5G's vision and ambitions are highly ranked, but ratifying and sharing them across a project with many partners is not straightforward.

**Measures:** The project vision was discussed with all partners in the kick-off meeting and was refined, in parts, in the first few plenary meetings.

2. **Closed-ness:** Exploitation may be an individual objective of each partner, but, in collaborative projects like MonB5G, innovation maximises its potential when it is open and unconstrained.

Measures: The formal agreements signed by all partners govern information sharing between them, setting a framework that encourages openness in the exchange of innovative ideas. Mailing lists, document repositories, meetings and calls are open to all partners, allowing the free exchange of thoughts and making certain that all opinions are heard and respected.

3. Stalemates: The inability of reaching a joint decision, when it involves pursuing a research direction, an innovation pathway, or a joint exploitation plan, can slow progress to a halt, and create contention.

Measures: Fortunately, the project has not run into such a situation. But the management structure (see *Section 5.3.1*) has adequate provisions for breaking this type of stalemates, if they ever occur.

4. High Complexity: An ambitious project, like MonB5G, involves high complexity. This may introduce challenges, in terms of focusing innovation generation activities on items that really matter.

Measures: The project has clearly identified the areas where innovation creation will concentrate on (see *Section 5.3.3*). To maintain focus during the remainder of the project, activities will continue to be tracked by the Innovation Manager, in terms of maintaining alignment with the vision of the project.

5. Lack of Initiative: Innovation cannot be someone else's job. Innovation thrives, when it is part of everyone's responsibilities.

Measures: The project does not put any constraints whatsoever in terms of who can participate to innovation activities.

6. No Clear Ownership: This is a side-effect of the above. Not making innovation someone's job, creates confusion on who owns the responsibility of driving it forward.

Measures: When a research direction or innovative idea is identified, the project will follow the best practice of identifying a champion, who will be responsible for driving it forward, involving others as required.

7. Limited Opportunities: When focused on short-term project obligations, partners may not be encouraged or incentivized to invest sufficient time on exploring new ideas or disseminate results.

Measures: Through anticipating the integration activities, partners are offered more opportunities to collaborate to well-defined common objectives that produce innovative results. Also, targeting high-profile scientific conferences or journal publications "persuade" partners to drive research work to completion and, moreover, to generate high-quality research publications.

8. Low Visibility: Encouraging work towards advancing the state of the art sometimes requires making it more visible, not only within the project, but also in the individual organizations of each partner.

Measures: The project communication and dissemination activities aim to address this specific need. Broader visibility of outcomes is also achieved through the web site and social networking channels.

9. Not Being Part of the Community: Collaboration becomes even stronger if it expands beyond the ranks of the project. Sharing with the community is a powerful form of exploiting project results.

Measures: Contributing to standardisation activities and open source projects aims to this direction. Working together with 5G PPP, in the context of the various working groups, and (eventually) with the other projects of the 5G PPP Programme, aligns project outcomes with the overall 5G vision, objectives and KPIs.

10. Ignoring the Ecosystem: A common mistake is to look at opportunities through internal lenses. Exploitation plans must be aligned with customer needs and adapt to the usual ecosystem shifts.

Measures: MonB5G partners play a vital role in the European and Worldwide CSP market and ecosystem. Along with the Innovation Manager, they communicate any notable news, events, etc. to the project in a continuous basis.

### 5.3.3 POTENTIAL AND COMPETITIVE ANALYSIS

MonB5G is a highly ambitious project, that aspires to contribute numerous beyond SotA algorithms, system architectures, design concepts and technologies. The MonB5G innovation potential lies in different levels:

- **Algorithmic innovation**, stemming from the development of new ML/AI-based techniques in different domains, i.e., network management, energy efficiency, security provisioning
- **Network and system innovation**, stemming from the design and implementation of a dynamic slicing framework along with the required interfaces
- **Data innovation**, stemming from the design of advanced novel techniques for data generation based on ground-truth real/realistic data extracted from mobile operators, online databases and testbed statistics

The specific innovations below were identified at project inception, but more are being actively developed, as part of the technical WPs of the project:

- Scalable, hierarchical, distributed and recursive beyond 5G network slicing management and orchestration architecture
- Cutting-edge, data-driven, distributed artificial intelligence mechanisms to drive the operation of all its core components
- Distributing the layers of DNNs between local components (e.g., AEs running at MEC level) and central components, and introducing local exit points
- Complementing all local AE/DE decisions with confidence/uncertainty measures based on (deep) Bayesian networks and Gaussian processes
- Auto-encoder based compression/feature extraction at the local/edge AEs
- Network-aware training and inference
- Multi-agent reinforcement learning for distributed DE tasks

### Market Analysis

Since project inception, products & projects relevant to MonB5G technologies that were identified included:

- Commercial 5G Platforms from telecom equipment vendors (i.e., Ericsson, Nokia, and Huawei), back then at a pre-production stage.
- Open Source MANO frameworks with wide industry adoption, such as ETSI OSM and ONAP, promised policy-based service Lifecycle Management automation.
- AI-based managed network services and operations offerings, such as the Ericsson Operations Engine, which project partner LMI has launched back then.
- Apache Spot IDS used ML as a filter for anomaly detection and separating malicious from benign traffic.

The market has apparently evolved since. *Section 5 of Deliverable D2.2* (Techno-economic analysis of the beyond 5G environment, use case requirements and KPIs) captures progress of our further analysis of the



market, including an update on the open source projects & products (in *Section 5.2* of that deliverable), as well as creation of end-user value through the adoption of AI/ML techniques (*Section 5.3* of that deliverable).

We based our market analysis on a clear definition all stakeholders in the slice lifecycle business model, as well as their roles and interrelations. The outcome of this analysis is summarized on the following figure.

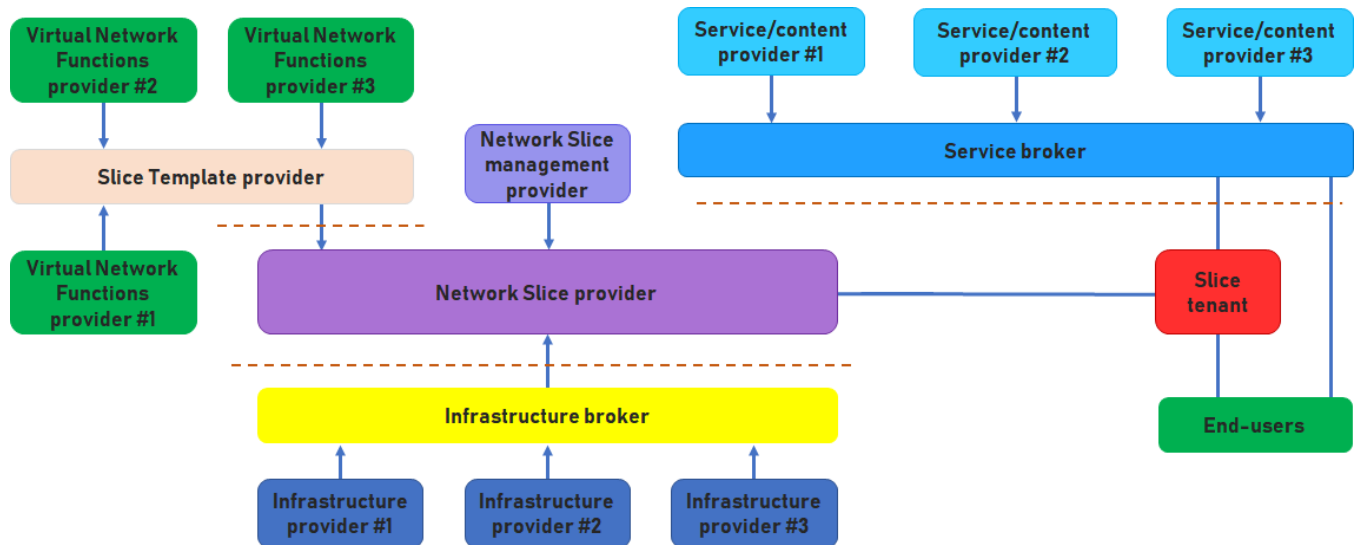


Figure 26 MonB5G Slice Lifecycle Business Model

Different stakeholders map to different segments of the market and respective products are positioned to fulfil their requirements. Also, their interrelations form chains MonB5G can create benefits and value for. The summary of the value chain that MonB5G brings to the stakeholders is captured by the figure below.

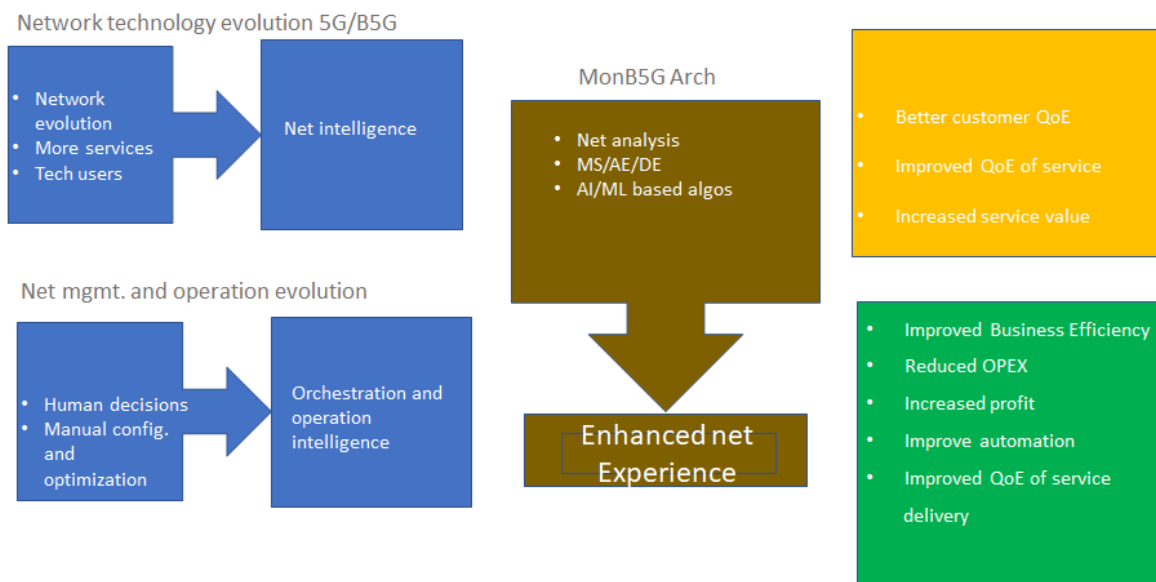


Figure 27 Value chain that MonB5G brings to the stakeholders



## Competitive Landscape

If we would like to have a fresh look at the competitive landscape, we would highlight that many vendors, established and emerging ones, promote portfolio solutions that aim at managing network slices:

- Ericsson's Network Slicing portfolio (<https://www.ericsson.com/en/network-slicing>), including the recently announced Ericsson 5G RAN Slicing (<https://www.ericsson.com/en/network-slicing/ran-slicing>)
- Nokia's Network Slicing portfolio (<https://www.nokia.com/about-us/newsroom/articles/network-slicing-explained/>), including the automated solution for 4G/5G network slicing across RAN, transport and core network (<https://www.nokia.com/about-us/news/releases/2020/10/01/nokia-offers-worlds-first-automated-4g5g-network-slicing-within-ran-transport-and-core-domains/>)
- Huawei's Network Slicing portfolio
- ZTE's 5G E2E Network Slicing Solution (<https://www.zte.com.cn/global/solutions/201905201709/201906050910/5G-E2E-Network-Slicing-Solution>)
- Samsung's Network Slicing Solution (<https://www.samsung.com/global/business/networks/solutions/network-slicing/>)
- Cisco's Network Services Orchestrator (<https://www.cisco.com/c/dam/en/us/products/collateral/cloud-systems-management/network-services-orchestrator/white-paper-sp-5g-network-slicing.pdf>)
- Amdocs 5G Slice Manager (<https://www.amdocs.com/media-room/amdocs-launches-5g-slice-manager-automation-5g-network-slicing>)
- Blue Planet 5G Automation Solution (<https://www.blueplanet.com/solutions/5g-automation.html>)
- Parallel Wireless Network Slicing Solution (<https://www.parallelwireless.com/products/network-slicing/>)
- Affirmed Networks (now acquired by Microsoft) Network Slicing Solution (<https://www.affirmednetworks.com/products-solutions/network-slicing/>)
- and even implementing 5G network slices with Cloudify on Amazon Web Services (<https://aws.amazon.com/blogs/industries/implementing-5g-network-slicing-with-cloudify-on-aws/>)

Also, Ericsson and Nokia (just to focus on the established vendors) increasingly embrace AI in the solutions they offer, while also enhancing their management and orchestration with zero-touch service automation:

- Ericsson Embracing AI: <https://www.ericsson.com/en/ai>
- Ericsson Next Generation Management and Orchestration: <https://www.ericsson.com/en/blog/2020/11/next-generation-cloud-ran-management-and-orchestration>
- Ericsson Zero-touch with Service Automation: <https://www.ericsson.com/en/blog/2020/11/next-generation-cloud-ran-management-and-orchestration>
- Nokia Self-organizing networks: <https://www.nokia.com/networks/portfolio/self-organizing-networks/>
- Nokia Digital Operations Center: <https://www.nokia.com/networks/solutions/digital-operations-center/>
- Nokia AVA AI Edge: <https://www.nokia.com/about-us/news/releases/2020/11/11/nokia-brings-ai-to-network-edge-for-superior-5g-experience/>
- Nokia AI 5G RAN: <https://www.sdxcentral.com/articles/news/nokia-claims-ai-5g-ran-triumph-with-china-mobile/2021/01/>

Last but not least, they provide complete 5G cyber security solutions

- Ericsson 5G Cyber Network Security: <https://www.ericsson.com/en/public-policy-and-government-affairs/cyber-network-security>
- Nokia 5G Cyber Security: <https://www.nokia.com/networks/portfolio/cyber-security/>

### Market Opportunity

As evidenced by the proliferation of relevant products, the network slicing, zero-touch service management and 5G cyber security market is forecasted to thrive. In terms of estimating the market opportunity, it is not straightforward to find relevant analyst reports, but the network slicing market is estimated to grow to:

- 921M USD by 2027 with Compound Annual Growth Rate (CAGR) of 23.7% between 2020-2027  
Allied Markets Research: <https://www.alliedmarketresearch.com/network-slicing-market-A07916>
- or an even more optimistic 1,284M USD by 2025, with CAGR of 51.5% between 2020-2025  
Markets & Markets: <https://www.marketsandmarkets.com/Market-Reports/network-slicing-market-120515704.html>

With regards to the 5G security market, it is estimated to grow to:

- 5,226M USD by 2026 with CAGR of 44.3% between 2020-2026  
Markets & Markets: <https://www.marketsandmarkets.com/Market-Reports/5g-security-market-261636732.html>

If we include adjacent markets (vertical industries), in a recently released report, ABI Research predicts that industrial manufacturing, C-V2X, and logistics alone will potentially generate cumulative revenues of US\$12 billion by 2026, representing a significant portion of an overall 5G slicing market that will likely exceed the US\$20 billion mark (<https://www.abiresearch.com/press/5g-network-slicing-will-generate-revenue-excess-us20-billion-2026/>)

With respect to cloud-edges, the broader AI industry is witnessing a migration of AI to the edge. For example, the edge AI training and inference market for chipset sales is expected to grow from US\$2.6 billion in 2020 to US\$10.7 billion in 2025, at a CAGR of 35% (“AI and Operations Automation in 5G Networks”, <https://www.abiresearch.com/press/bid-capture-new-growth-telcos-turn-ai-and-operations-automation-5g-networks/>).

## 5.4 Exploitation Planning

The sections that follow provide the updated exploitation map of the innovation actions that the industrial and academic partners of MonB5G have qualified as exploitable, commercially or for academic research.

The project KPIs relevant to exploitation are:

- i) the number of patent applications or awarded patents
- ii) the percentage of participating subject matter experts introducing innovations to the company or the market (covering the period of the project plus three years)

MonB5G targets to submit at least 5 patents.

### 5.4.1 INDIVIDUAL PARTNERS

The updated exploitation plan of each partner individually is provided in the sections/tables that follow.

## 5.4.1.1 OTE

Innovation			TRL M01	TRL M36
ML and DE enabling improvement of network performance			2	5
Type of exploitation		Exploitation potential		Conflicting IP
Enhance our knowledge of ML and DE for network Improvement		High		No
Competition	Strengths	Weaknesses	Risks	
Other Operators	Leading Operator	Strong Competition	No adoption by Standards yet	
Targeted market	Time to market estimate	Expected ROI		
End users	~3 years	Increase customer base by improving QoE, Reduce energy consumption (OPEX)		
Path to market				
OTE will exploit the results of MonB5G with regards to the exploitation of ML and DE to assess their efficiency by implementing them in the network for testing its performance. The R&D labs of OTE belong to the Strategy and Development Department and always the deliverables and milestones of the projects provide useful results to the upper management. In addition, every year a workshop is organized in which the results and the milestones of the projects are presented to OTE’s staff and in general to the Deutsche Telecom group since OTE is part of it. The results are surely used for future initiatives and for the establishment of new technologies and services. With the synergy and cooperation of OTE with Deutsche Telecom AG, as part of its group, the project results and the dissemination plans will be even more beneficial for bringing new ideas and propositions to the planning and strategy managerial staff.				

## 5.4.1.2 LMI

Innovation			TRL M01	TRL M36
Enhancements on advanced analytics and ML for insights for 5G management			3	5
Type of exploitation		Exploitation potential		Conflicting IP
Strengthen the understanding and knowledge of advanced ML for 5G management, which will influence product decisions in the future		High		No
Competition	Strengths	Weaknesses	Risks	
Other telecom providers, open source	Very important step needed for the development of	If 5G standards evolve, algorithms need to evolve too	Algorithms too specific for the specified use cases	

	intelligent 5G management systems		
Targeted market	Time to market estimate	Expected ROI	
Internal to Ericsson 5G Customers (Operators & Verticals)	2 years	Increase knowledge in this area, which will ripple down into internal decisions, discussions with customers, and further collaborations	
Path to market			
LMI is actively involved in the advancement of 5G end-to-end deployments and their role for vertical industries. LMI is therefore interested in further understanding the technical implications of such deployments and their usability in various scenarios. The results coming from MonB5G will be internally & externally disseminated, with the goal of increasing the know-how of LMI’s engineers, managers and product development leaders, and also of furthering the discussions on 5G that we have with our partners. Furthermore, LMI’s participation in MonB5G will also enable to strengthen and enlarge LMI’s collaborations within the EU. The knowledge that will be gained is envisioned to ripple into our current and future collaborations and influence internal and customer discussions on 5G management.			

## 5.4.1.3 CTXS

Innovation			TRL M01	TRL M36
Citrix Application Delivery Controller (ADC)			5	7
Type of exploitation		Exploitation potential		Conflicting IP
Product development		High		No
Competition	Strengths	Weaknesses	Risks	
F5, Radware, A10	Market leader in enterprise and cloud	Lower penetration of telecom operator market	Competitive solutions by traditional telecom vendors	
Targeted market	Time to market estimate	Expected ROI		
Telecom operators, System integrators	1-2 years	Extend applicability of product to 5G networks. Enable deployment at the 5G network edge. Increase relevance to IoT/mMTC applications		
Path to market				
CTXS will exploit the lessons learnt from integrating parts of the Citrix Networking product suite (ADC, ADM and potentially SD-WAN) with the facilities of MonB5G, to expand their applicability to 5G networks and improve their alignment with the 5G services architecture. The evolution of the products will be funded internally, as per the company’s roadmap.				

Innovation			TRL M01	TRL M36
Citrix Application Delivery Management (ADM)			5	7
Type of exploitation		Exploitation potential		Conflicting IP
Product and cloud-service development		High		No
Competition	Strengths	Weaknesses	Risks	
Same as above (Citrix ADM is an attachment to Citrix ADC)				
Targeted market	Time to market estimate	Expected ROI		
Telecom operators, System integrators	1-2 years	Improve management & orchestration capabilities for better alignment with 5G services architecture		
Path to market				
Same as above (Citrix ADM is an attachment to Citrix ADC)				

## 5.4.1.4 ORA-FR, ORA-PL

Innovation			TRL M01	TRL M36
Slice management			2	6
Type of exploitation		Exploitation potential		Conflicting IP
Orange Group is working to offering slices to vertical markets. Orange is already offering SDN-based VPNs (EasyGo Networks). The results of the project can help Orange offering services to verticals.		High		No
Competition	Strengths	Weaknesses	Risks	
The slice market may be very competitive in the forthcoming years to meet requirements by verticals	Methods of improving services offered by Orange in terms of customization and resource usage	The network elements need to rely on intermediate functions to support the ad-hoc analytics computation and export	The ML based techniques may be complicated to integrate into existing network operation systems	
Targeted market	Time to market estimate	Expected ROI		
Operational network services of Orange (notably Orange Business Services and wholesale) towards	3-4 years	Thanks to virtualization and automation:  - Faster TTM: reduced dev. & deployment cycles  - Significant savings in CAPEX and OPEX: reuse of infrastructures and smart allocation of resources,		

vertical market requirements		move (gradually) from the configuration of networks to automation of LCM.
<b>Path to market</b>		
<p>The Network Slicing technology is a key area for Orange Group. Orange Business Services is already offering SDN based services (e.g., EasyGo Networks, SD-WAN) and is going very fast to offer slices to vertical markets (industry, automotive, health, etc.) based on 5G SA by 2023. The need for carrier-grade scalable, automated and intelligent solutions for slice orchestration will become critical very soon. Moreover, the AI-based algorithms for proactive root-cause analysis and early detection of problems during run-time of slices are needed. The objective of ORA-FR and ORA-PL with the project is to promote the solutions proposed by MonB5G in Orange and especially Orange Business Services and Orange Wholesale.</p>		

## 5.4.1.5 BCOM

Innovation			TRL M01	TRL M36
Slice Manager			4	6
Type of exploitation		Exploitation potential		Conflicting IP
Product development		Medium		No
Competition	Strengths	Weaknesses	Risks	
4G LTE solutions	Dynamic and adaptable	TRL level to address Verticals	Market access for a new entrant	
Targeted market	Time to market estimate	Expected ROI		
Private wireless network integrators for Verticals	1-2 years	Add features relevant to private 5G network infrastructures		
Path to market				
BCOM is already bringing solutions to the market like the “Wireless Edge Factory”, a 5G Mobile Edge private connectivity enabler. This set of VNFs can already be orchestrated by a VNF orchestrator. BCOM would like to enhance its offer with a slice manager and security orchestrator to deploy on-demand 5G private network slices with the highest level of security for Verticals. With MONB5G project, BCOM aims to reach a TRL compatible demonstration and Proof-of-Concept in order to test market interest.				

## 5.4.1.6 IQU

<b>Innovation</b>	<b>TRL M01</b>	<b>TRL M36</b>
Dynamic slicing protocols	2	6

Type of exploitation			Exploitation potential	Conflicting IP
Product development			Medium	No
Competition	Strengths	Weaknesses	Risks	
Nokia, Huawei	Ethernet friendly solution	Strong competition	Full features non adopted by standards	
Targeted market	Time to market estimate	Expected ROI		
Telecom operators, System vendors, Verticals	2-3 years	IoT nodes controlled by slicing upgrade targeting new contracts with telecom operators		
Path to market				
MonB5G solutions for dynamic slicing will be embedded in the company’s evaluation tools for enhancing the existing product’s portfolio and testing platforms for 5G wireless networks. Therefore, IQU will strengthen its capability to test different applications and will sell the existing solutions as a service to different vertical providers. The required resources required for the development that will take place after the end of the project will come from own resources.				

## 5.4.1.7 NEC

Innovation			TRL M01	TRL M36
Graph AI for network analysis			2	5
Type of exploitation		Exploitation potential		Conflicting IP
Product development		High		No
Competition	Strengths	Weaknesses	Risks	
Other telecom providers, open source	Very important step needed for the development of intelligent 5G management systems	If 5G standards evolve, algorithms need to evolve too	Algorithms too specific for the specified use cases	
Targeted market	Time to market estimate	Expected ROI		
5G Customers (Operators & Verticals)	3 years	Intelligent data analysis systems able to understand the status of the network slices.		
Path to market				
Please refer to item below				



Innovation			TRL M01	TRL M36
Smart network Slicing			3	5
Type of exploitation		Exploitation potential		Conflicting IP
Influence NEC’s Networks Slicing Solutions Product development		High		No
Competition	Strengths	Weaknesses	Risks	
Other telecom providers, open source	Required to attract Industry Verticals as customer	Increases significantly the complexity of 5G systems	Industry Verticals option for Private Networks	
Targeted market	Time to market estimate	Expected ROI		
5G Customers (Operators & Verticals)	3 years	Development of key differentiation technologies for achieving a cost-efficient Network Slicing solution		
Path to market				
NEC counts with a big portfolio of 5G products and that are deployed by operators worldwide. The advances obtained by MonB5G will improve the existing products placing NEC at a vantage point with respect to the competence by providing smart network slicing. Moreover, the newly created line of AI technologies “NEC the Wise”, devoted to the creation and commercialization of advanced AI solutions will incorporate to its portfolio the different algorithms developed in the project.				

## 5.4.1.8 EBOS

Innovation			TRL M01	TRL M36
ML algorithms for anomaly detection in networks			2	4
Type of exploitation		Exploitation potential		Conflicting IP
Enhance our knowledge of ML for anomaly detection		Medium		No
Competition	Strengths	Weaknesses	Risks	
Open source	Short time to market	Resources for support depending on demand, Data limitations	Uptake by industry	
Targeted market	Time to market estimate	Expected ROI		
Telecom operators, System vendors, Verticals	2-3 years	Increase revenue and security of the company's products and services		

<b>Path to market</b>
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Advance knowledge and reinforce understanding of security in 5G technologies extending the company's R&D activities. Apply the results in the company's product portfolio for developing new innovative applications and solutions with classification capabilities, and expanding their customer base.
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#### 5.4.1.9 CTTC

CTTC's participation in this project is expected to stimulate a number of technology transfer and IPR generation activities, which are at the true core of its mission. From participation in MonB5G, CTTC staff will acquire new knowledge in enhancing the capabilities of an existing 5G platform. The results of the project will be integrated in the 5GBarcelona initiative in order to enhance the collaboration with other companies. As a member of the standardisation bodies ETSI LTE, 3GPP, ONF, CTTC will actively participate in these standardisation fora. Moreover, as a member of 5GIA and 5G Vision 2020, CTTC will exploit the project's results to the 5G industrial community in Europe.

#### 5.4.1.10 EUR

Through MonB5G, EUR will continue to promote the use of open-architecture radio systems. The equipment and software developed by EUR in the context of the MonB5G project will be made available in the public-domain for future use in collaborative initiatives. In particular, the software generated during the project along with the measurement methodology will be contributed to the OAI Software Alliance community to allow for its use in future collaborative projects around the world. Through its presence at 3GPP starting in 2019, EUR will also contribute any appropriate IPR related to extensions for PPDR systems to 3GPP TSG RAN either in the form of study items or actual layer1 or layer2 procedures. EUR will promote the use of the facility and integration with vertical partners in Linux Networking Foundation projects such as OPNFV.

#### 5.4.1.11 AAL

Defines an ambitious plan to support the exploitation of the main findings and outputs arising from MonB5G. As an academic institution, AAL is aiming to enrich its teaching activities at different levels. Incorporating different technological aspects of the project in the teaching content will allow exposing students to real-world technologies. The project results will be also exploited as a catalyzer for further research projects in relevant scientific and technological areas. Moreover, AAL will leverage the research findings from MonB5G to continuously evolve its network facility. The project will make use of the X-Networks site. We plan to explore the output of the project for enhancing the network automation and orchestration in the X-Networks site. The Aalto Center for Entrepreneurship of Aalto university ensures the connection to the surrounding ecosystem of incubators, accelerators, and investors. The co-working space of the Startup Sauna accelerator program is situated at the university's campus and provides excellent opportunities for startup ambitions. The center also deals with the management of technology transfer and the coordination of activities related to intellectual propriety, ensuring the suitable environment for innovation. MonB5G considers emerging 5G use cases with less coverage that AAL will promote for business creation.

#### 5.4.2 MONB5G AS A WHOLE

The expected impact of the MonB5G project is provided below. This is the basis for the exploitation plan of the MonB5G platform as a whole, which we will be solidifying and reporting on in upcoming deliverables.

- **Evolution of networks towards OTT like platforms integrating connectivity, storage and computing resources opening for new service models to telecom/ISP providers:** Being in line with the ETSI ZSM vision, MonB5G will demonstrate several use cases where computing, storage and networking resources of Tactile Internet applications will be hosted in different domains under the control of local NFVOs and Decision Engines while covering i) cross-domain end-to-end SLA and ii) elastic end-to-end slice lifecycle management.
- **Network scalability towards high number of resource constrained devices, multiplicity of service requirements, and new connectivity paradigms (user controlled):** MonB5G is developing i) a scalable monitoring system (MS) that enables to analyse a massive set of running slices while minimizing the measurement overhead ii) sophisticated data-driven methods for optimal slice configuration per device- and application-type for massive number of devices iii) Distributed architecture where local MS/AD/DE can be instantiated in edge domain reducing reaction times and thus improving device performance iv) local security orchestrator for autonomic threat identification and fast, local response.
- **Characterisation and availability of secure and trusted environments for software based virtualised networks, enabling trusted multi-tenancy:** MonB5G is developing a Trust Management and a Security Orchestrator by leveraging AI techniques (such as federated learning and blockchain) and emerging technologies, including TPM, TEE, SECaaS, SDN, NFV, and VNF security, for enhancing the infrastructure and service management trust and creating a trustworthy environment for running different virtual services while ensuring isolation between different tenants and enhancing the timely identification/detection and mitigation of security threats.
- **Dynamic scalability of network capabilities through availability of managed and enhanced resources:** MonB5G is proposing a zero-touch slicing design featuring autonomic, cognitive (data- and AI-driven), and closed-loop management and orchestration by enhancing e.g., the OSS/BSS, MANO, and MEC orchestration with analytics and decisions entities embedded inside domain and inter-domain managers. Slice-level resources are automatically assigned, scaled, migrated and while simultaneously optimizing (i) slice operation, (ii) managerial overhead, and (iii) slice coexistence with performance guarantees.
- **Network energy consumption reduction, a factor of at least 10 is targeted:** MonB5G will leverage the aforementioned developments and achieve the ambitious goal of 10-times reduction in the network power consumption by extending and developing new energy-aware AI-based techniques for end-to-end slice-level resource allocation as well as VNF placement so that to enable the deactivation of the non-utilized network elements.
- **Impact on the telecommunications industry:** MonB5G will help keep the telecom industry at the forefront of this strategic technology by providing research which will support partners who have products and services in the network management, SDN and NFV market.
- **Impact on European economy:** MonB5G impact on the European economy will be to contribute to accelerate 5G and beyond deployment in Europe, through its capabilities to provision new innovative services that demand 5G capabilities in a faster and a more secure way.

- **Reducing the financial costs of cyber-attacks - impact on enterprises and SMEs:** By effectively protecting 5G infrastructures, networks and network management systems and increasing their resilience to cyber threats, MonB5G will contribute to reducing and preventing the financial consequences of cyber-attacks and data breaches, achieving a high impact on telecom and service providers.
- **Impact on consumers and society:** MonB5G will go beyond traditional monolithic approaches that focus only on the radio spectrum optimisation, orchestrating a multitude of network components and resources across different domains. The decentralized autonomic network management and orchestration proposed by MonB5G, will enable telecom and service providers to optimize their resource usage thus reducing both CAPEX and OPEX paves the way to offer new innovative 5G services at lower costs to consumers.

## 5.5 Innovation and Exploitation Activities

Partners have already engaged in early innovation and exploitation activities. For example, LMI disseminated MonB5G internally by delivering a relevant presentation at Ericsson Tech Day 2020 and OTE presented MonB5G to an industry audience at Infocom World Conference (please refer to *Section 2.5* for more details). Many more such activities will be reported in the future, as the project makes further progress on all fronts.

## 6 Conclusions and Next Steps

In this deliverable we reported the progress of the MonB5G project as relevant to the WP7 dissemination, communication, standardization and exploitation activities, for the time period from M1 to M15.

As the project makes further progress with the technical work packages (WP2, WP3, WP4, WP5) and the PoC integration activities (WP6), we anticipate that project activities in these areas will accelerate, further exceeding the goals and objectives that we have set at project inception.

Further progress will be reported in:

- Deliverable D7.6: 2nd Report on dissemination; standardization & exploitation plans (M24)
- Deliverable D7.7: Final Report on dissemination; standardization & exploitation plans (M36)



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