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BEYOND 5G – OPTICAL NETWORK CONTINUUM
(H2020 – Grant Agreement № 101016663)

Deliverable D6.3

Year 3 report on communication, dissemination and standardisation activities

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Abstract

WP6 focuses on communication, dissemination, and standardization activities and it highlights project partners' research and development efforts. "Year 3 Report on Communication, Dissemination, and Standardisation Activities," as the report is called, offers a thorough summary of the activities carried out during the project's final year.

This report highlights the dissemination and standardization activities in several fora. The distribution efforts, the contributions to 5G-PPP, and the contributions on standardization are all covered in full in this publication. This report also highlights the exploitation plans from partners, collectively and individually.

This report presents the overall achievements of B5G-OPEN project over its lifespan showcasing the dedication of the project to disseminate the results of the research efforts and to translate these results into innovations and also into contribution to standards within the framework of the relevant international bodies.

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GLOSSARY

Abbreviations/Acronym	*Description*
5G-PPP	5G Infrastructure Public Private Partnership
AP	Access Point
CA	Consortium Agreement
DWDM	Dense Wavelength Division Multiplexing
DoW	Document of Work
ECOC	European Conference on Optical Communication
EuCNC	European Conference on Networks and Communication
ETSI	European Telecommunication Standards Institute
FDM/FDMA	Frequency Division Multiplexing/Frequency Division Multiple Access
GLOBECOM	Global Communications Conference
GUI	Graphical User Interface
ICTON	International Conference on Transparent Optical Networks
IETF	Internet Engineering Task Force
IPR	Intellectual Property Protection
ITNAC	International Telecommunication Networks and Applications Conference
ITU	International Telecommunication Union
JLT	IEEE/OSA Journal of Lightwave Technology
JOCN	IEEE/OSA Journal of Optical Communication and Networks
KPI	Key Performance Indicator
MOPA	Mobile Optical Pluggable Alliance
MSA	Multi-Source Agreement
NFV	Network Function Virtualization
NFV-SDN	Network Function Virtualization and Software Defined Networks
OECC	Opto-Electronics and Communications Conference
OFC	Optical Fiber Communications Conference and Exhibition
ONDM	Optical Network Design and Modelling
ONF	Open Networking Foundation
P2MP	Point-to-multipoint
PLI-aware RMSA	Physical Layer Impairment-aware Routing and Spectral Assignment Algorithm
QMR	Quarterly Management Report
QoE	Quality of Experience
RIA	Reference Implementation Agreements
RPC	Remote Procedure Calls
SB	Steering Board
SC	Steering Committee
SDN	Software Defined Networks

SDO	Standards Developing Organization
SME	Small and Medium-sized Enterprise
SONIC	Software for Open Networking in the Cloud
SUM	IEEE Photonics Society Summer Topicals
TAPI	Transport API
TB	Technical Board
TC	Technical Committee
TDM/TDMA	Time Division Multiplexing/Time Division Multiple Access
TIP	Telecom Infra Project
VIM	Virtual Infrastructure Management
WG	Working Group
WP	WorkPackage

EXECUTIVE SUMMARY

This report summarizes B5G-OPEN's Y3 efforts in the areas of internal coordination, organizational and communication exchanges, dissemination, and standardization.

Here, we outline our dissemination strategy, which involves utilizing communication and administration tools (such as our repository file system and MS Teams) for our internal communications, as well as external communication methods such as the project's website and targeted contributions on selected social media platforms, e.g., YouTube and LinkedIn. Moreover, B5G-OPEN has extensively leveraged dissemination through publications in top-tier journals and conferences, surpassing the DoW targets by more than twice. The latter showcases the consortium partners' efforts and the high calibre of the conducted research. Finally, the promotion of gender equality has made significant progress.

Last but not least, to make sure that our research is synchronized with industry standards and promotes more extensive industry improvements, B5G-OPEN actively participated in standardization fora, fostering progress in the broader telecommunications domain. These efforts are instrumental in advancing the project's objectives and promoting its research outcomes.

Document Structure

This document is structured as follows.

In the **introduction,** a short summary of the overall status of the project activities is presented.

Next, the B5G-OPEN **dissemination strategy** is recalled which includes dissemination coordination, final remarks regarding 5G-PPP activities, and data generation results.

Then, the **dissemination impact in year 3** is reported, including coordinated contributions to major conferences and workshops, the submission of joint publications in high-impact factor journals, the progress in gender representation and the participation in standardisation activities.

In the following section, the exploitation plan for both individual partner and a sub-group of partners have been briefly presented.

The last section summarises this document.

1 INTRODUCTION

Dissemination and standardization activities are key to communicate the important findings and the progress beyond the state-of-the-art that B5G-OPEN has made. Here, we summarize what has been achieved during Y3 in this respect. Moreover, standardization is a key enabler to transform the solid knowledge basis the project has developed into essential tool to fully rip the benefits of research by means of world competitive products.

To carry out the daily, weekly, and periodic internal administrative and communication needs, the project further capitalized and exploited the tools used in Y1 and Y2, i.e., our dedicated online repository (on MS SharePoint) and live communication platform, through which consortium members interact and communicate. Moreover, our mailing list remains an active channel for internal communication and collaboration.

Our project's website and social media channels continue to play an important role in promoting the activities and achievements of the B5G-OPEN project. The website continues to be an active forum for informing our consortium members and the general public about project updates, research results, and pertinent information. We maintained an active presence on social networking sites (e.g., LinkedIn and YouTube), boosting our presence in the international community. That gave the project the opportunity to interact with the many stakeholders, communicate our advancements, and promote dialogue in the industry.

B5G-OPEN is happy to announce that we have not only met the set goal in terms of publications and scientific events, but, in fact, we have exceeded it by more than twice. Last, but not least, to make sure that our research complies with industry standards and promotes more extensive industry improvements, B5G-OPEN actively participates in standardization fora.

The above achievements in the fields of internal communication and coordination between consortium members, dissemination of the scientific and technical results, and translation of the research outcome to standards reflect the dedication of this project to innovation, knowledge sharing, and collaboration and our goal to contribute to the challenging task of paving the way to the digital era.

2 Dissemination Strategy

2.1 Project website

Figure 1: Project website - homepage

The project website - https://www.b5g-open.eu/ - has been constantly updated. For example, the NEWS area includes pieces of news, informing the public audience about project events (e.g., plenary meetings), relevant publications (JOCN/JLT journals, OFC/ECOC conference papers), participation to workshops, and disseminations events targeting the broad community.

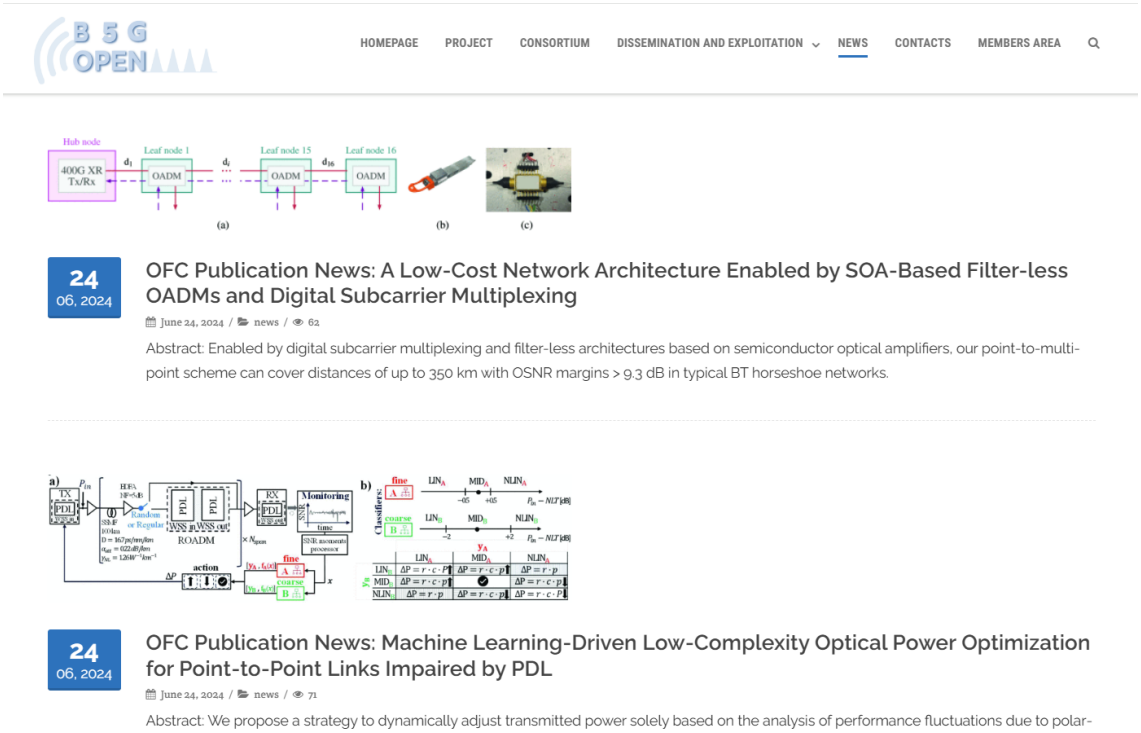


Figure 2: Project website – recent news

The B5G-OPEN Project website received 31.268 total visitors during the last 12 months (from 8/10/2023 to 6/10/2024), with 11.488 unique visits. Around half of the visits originated from USA and China, showing high impact of the B5G-OPEN Project also outside Europe.

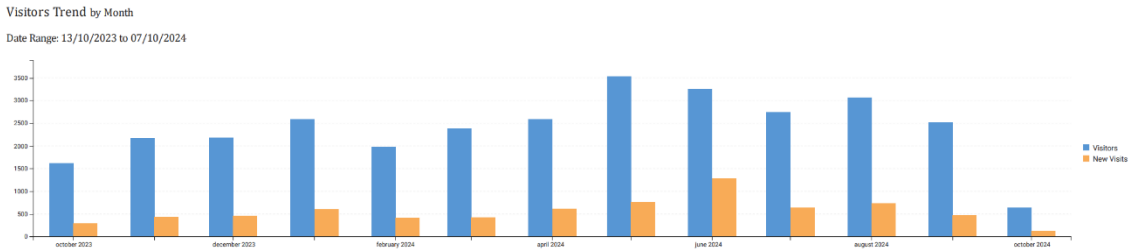
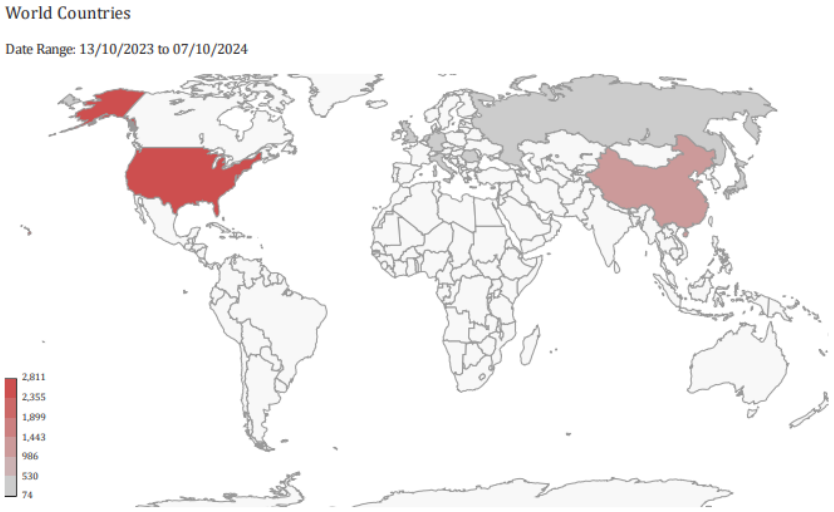


Figure 3: Project website – visitors



	Country	Page Views		Visits		Visitors		Hits		Bandwidth
1.	United States	21.104	34.60%	7.869	25.17%	2.811	38.72%	45.536	30.71%	1.215,8 MB
2.	Romania	10.760	17.64%	8.397	26.85%	104	1.43%	12.085	8.15%	101,5 MB
3.	China	8.080	13.25%	6.057	19.37%	1.119	15.41%	24.441	16.48%	1.730,5 MB
4.	N/A	7.029	11.53%	2.084	6.66%	898	12.37%	12.885	8.69%	465,7 MB
5.	Germany	1.877	3.08%	633	2.02%	231	3.18%	7.525	5.07%	305,9 MB
6.	Russian Federation	1.299	2.13%	1.036	3.31%	218	3.00%	2.904	1.96%	71,4 MB
7.	United Kingdom	1.273	2.09%	650	2.08%	238	3.28%	4.138	2.79%	115,7 MB
8.	Italy	913	1.50%	198	0.63%	88	1.21%	7.232	4.88%	307,9 MB
9.	Netherlands	911	1.49%	232	0.74%	74	1.02%	2.958	1.99%	91,6 MB
10.	Japan	785	1.29%	533	1.70%	177	2.44%	1.660	1.12%	75,3 MB
Other Items (90)		6.955		3.579		1.302		26.914		1.136,5 MB
Total		60.986		31.268		7.260		148.278		5.617,8 MB

Figure 4: Project website – visits by Country

2.2 Dissemination Coordination

2.2.1 Internal Dissemination Coordination

We maintained our periodical calls – the cadence depended on the individual WP – where the partners were able to catch-up and receive updates with regards to project advancements. Furthermore, we hold three face-to-face meetings over the last year: (i) in Pisa, in Nov. 2023; (ii) in Berlin (in May 2024); and (iii) the final meeting in Castelldefels in Oct. 2024 to discuss the final month of the project to ensure that all final documents and deliverables are properly completed on time.

These plenary sessions provided an opportunity for internal dissemination. During the sessions, project partners could meet personally and discuss in length the relevant topics. In addition to these sessions, online conference calls allowed partners to be periodically updated with regards to project advancements.

2.2.2 External Dissemination Coordination

Concerning dissemination to external channels, we disseminate the project results on multiple events and platforms, among them: (i) leading conferences, (ii) workshops (also organized at the main conferences), (iii) project website, (iv) blogs, (v) newsletters, (vi) news articles, (vii) press releases and (ix) social media platforms, so that we could reach a broader audience.

The published information provides updates based on the research output of the project partners. The coordinator and steering team encouraged partners to submit articles to any relevant scientific journals, peer-reviewed conferences, and workshop. As it will be showed in Sec. 3.1, the consortium has exceeded, by far, the targets set in the DoW in terms of the accepted refereed publications.

2.3 Activities related to 5G-PPP

In D6.1, we have reported the inauguration of B5G-OPEN to the 5G-PPP platform. Moreover, a dedicated email address was created for B5G-OPEN's communication with this platform. All partners were informed about their commitments to the 5G-PPP, acknowledging the roles of the European Commission, the 5G-PPP partnership board, and other governing bodies.

As reported in D6.2, B5G-OPEN representatives were actively participating in various 5G-PPP working groups (WGs) to align their research efforts with the goals of the 5G initiative. These WGs include Vision and Societal Challenges, KPIs Validation, Trials, Software Networks, 5G Architecture and Pre-Standardisation. Each WG focused on specific aspects such as consensus on 5G benefits, KPI evaluation, trial coordination, and development of Software Defined Networks (SDN). B5G-OPEN's work in these WGs is closely related to its objectives, ensuring active contributions to the 5G-PPP ecosystem. Additionally, the consortium maintained regular communication with the 5G-PPP governing bodies, participating in Steering Board and Technical Board meetings to ensure alignment and consistency across the program.

D6.2 was submitted to the Commission on October 30. From that date onwards the 5G-PPP WGs were slowly closing its activities with all mandates completed by end 2023/early 2024. With much of the foundational work for 5G already established and the technology being rolled out across various sectors, the European Commission decided to shift focus toward next-generation technologies and new strategic objectives. This shift led to the formation of the Smart Networks and Services Joint Undertaking (SNS-JU), which aims to further boost 5G adoption while setting the stage for 6G development

This situation created a gap, which led to some of the final projects funded under the 5G-PPP framework (such as B5G-OPEN) missing opportunities for potential contributions. Although B5G-OPEN might have aligned well with the original scope of 5G-PPP, it was no longer able to engage fully due to the shift in focus to the new SNS-JU structure.

As a result, while the transition to SNS-JU marks a crucial step towards future network evolution, it has also highlighted the challenges associated with shifting programmatic priorities, especially for projects like B5G-OPEN that were still poised to contribute under the previous 5G framework.

2.4 Y3 UPDATE RELATED TO DATA GENERATION TASKS

Following the description in D6.2. of the methodology of B5G-OPEN for data generation, a new set of experimentally available data by HHI is reported here.

Due to the scarcity of diverse and well-organized public datasets, individual research organizations are often forced to develop and utilize their own datasets. However, the utilization of machine learning (ML) models in optical communications and networks heavily depends on the existence of high-quality datasets, especially covering the various parameters to be optimized in wavelength-division-multiplexing (WDM) systems. In the framework of B5G-OPEN, HHI has generated a public dataset for developing and testing ML models. The dataset is developed in a laboratory environment and includes 12672 samples using several modulation formats, symbol rates, distances, WDM channel allocation profiles, etc. Each data point offers more than 60 features, revealing almost every aspect of the transmission setup. Moreover, the dataset provides optical spectra of the entire C-band as well as constellation diagram of the channel under test for all the data points. The diversity and extensiveness of the dataset alongside a well-structured document would allow plenty of use-cases and studies to be carried out covering Quality of Transmission (QoT) studies, optical spectrum analysis, constellation diagram modelling, digital twin evaluation, etc.

The presented dataset is a set of experimental traces generated in a laboratory testbed. All samples were collected from laboratory experiments carried out within the systems laboratory of the Photonic Networks and Systems Department at Fraunhofer HHI. Each sample is comprised of an experiment from a straight-line coherent optical setup, where the configuration is defined by a permutation of the parameters in Table 2.6.1. The dataset contains QoT information, constellation diagrams and other relevant data from the physical layer such as digital signal processing (DSP) results and spectral profiles for each distinct scenario.

The datasets are available at:

- https://www.hhi.fraunhofer.de/en/departments/pn/communication-and-measurement-instruments/experimental-dataset.html
- https://opg.optica.org/jocn/abstract.cfm?uri=jocn-16-11-G1

Table 1 – System parameters of the experimental data from HHI

Parameters	Values
Modulation Format	4-QAM and 16-QAM
Symbol Rate (GBd)	28 and 32
Distance (km)	back-to-back, 80, 160, and 240
Start Center Frequency of the WDM Grid (THz)	192.1
End Center Frequency of the WDM Grid (THz)	196.05
Maximum Number of WDM Channels	80
Channel Spacing (GHz)	50
Channel Under Test Number	1, 11,21, 31, 41, 51, 61, 71, 80
Distinct random channel allocation profiles	88

3 Dissemination Impact in Year 3

3.1 Dissemination by means of Publications

3.1.1 Summary

During Y3 B5G-OPEN has engaged in several dissemination activities. The number of publications has been significantly higher than the initial target. B5G-OPEN partners have published at top IEEE/OPTICA conferences and on the leading magazines. Many partners have been invited to talk at workshop, symposia, and various scientific collaborative events. The following compare the target over three years against what we achieved so far.

Table 2 –Dissemination Activity and Verification Plan

Dissemination Activity and Verification Plan	3 years (target)	Achieved
Publication in selected peer-reviewed Journals	25	46
Presentation and Publication at selected conferences	40	91
Organization of Workshops/Symposia	2	5
Participation at industry conference/workshops/events	3	17
Contribution to SDOs (different WG contributions)	4	6

3.1.2 Disseminations by Type

3.1.2.1 B5G-OPEN Presence in High-Profile Conferences

Table 3 (below) lists the major conferences where B5G-OPEN has been active, and it includes the results over the last three years.

Table 3 –List of Industry Conference with B5G-OPEN's Presence

Conference or Workshop Name	# Contributions
Optical Fiber Communications Conference and Exhibition (OFC 2023)	24
European Conference on Optical Communication (ECOC)	22
International Conference on Optical Network Design and Modelling (ONDM)	12
Other IEEE Conferences	7
Opto-Electronics and Communications Conference (OECC)	4
International Conference on Transparent Optical Networks (ICTON)	2

3.1.2.2 B5G-OPEN Publications in Archived Journals

The table below lists the two main scientific journals, where the consortium has published its results. The numbers are over three years.

Table 4 – Publications in Archived Journals

Magazine title	# Contributions
IEEE / OPTICAL J. of Optical Communications and Networking (JOCN)	27
IEEE / OPTICAL J. of Lightwave Technology (JLT)	11

3.2 B5G-OPEN GENDER RELATED ACTIVITIES

This section details the steps being made by B5G-OPEN to address the gender imbalance at all levels, reviewed on a regular basis, to ensure equal opportunities amongst all partners. It includes:

- Target gender workshops and outreach activities: Organization of at least 1 gender and diversity workshop to promote awareness and understanding of gender imbalances in research.
- Collect and gather gender disaggregated data including engagement with deliverables, B5G-OPEN representation and other relevant data.
- Promote the participation and enrolement of B5G-OPEN researchers in Women in Technology and Applied Research (WiTAR) SNS working group.
- Monitor and regularly review and update the dissemination plan based on participant feedback and event outcomes which will be shared to all B5G-OPEN partners within the different organized plenary meetings and conference calls.
- B5G-OPEN targeted fair and gender-balanced recruitment processes to ensure equal opportunities and equitable recruitment practices. Several partners (i.e. CTTC, Tu/e, UPC, UC3M, CNIT all of them available online) have organized gender equality plans and participated in gender and diversity workshops/events to raise awareness of the importance of inclusivity, foster understanding among diverse groups (i.e. B5G-OPEN consortium), and promote equitable practices.

As an output of the identified gender actions, B5G-OPEN has:

- Organized a gender and diversity Workshop (at CTTC premises): "Talent and career in research: The role of mentoring to foster diversity and inclusion" within IMOC 2023 conference (https://www.events.sbmo.org.br/imoc2023/pagina/33/workshops). Activity reported in section 3.5.
- Engagement to WiTAR SNS WG of B5G-OPEN researchers Sima Barzegar (UPC) and Laia Nadal (CTTC)
- Participation and outcomes of the gender events were shared to all B5G-OPEN partners in the plenary and regular project meetings.
- Gathered gender and project disaggregated data from B5G-OPEN as reported below.

The tables and figures below show the technical and administrative participants, classified by gender, in B5G-OPEN.

Table 5 – Technical participation in B5G-OPEN

Technical participation in B5G-OPEN		
Partner	**Female**	**Male**
TID	0	2
UC3M	0	3
TIM	3	3

BT	0	3
INF-D	0	2
INF-P	1	3
ADTRAN	0	1
NOKIA	2	2
CNIT	0	2
CTTC	2	4
UPC	2	5
HHI	0	2
OLC-E	0	3
ELIG	2	2
TU/E	0	1
PLF	0	4
Total	**12**	**42**

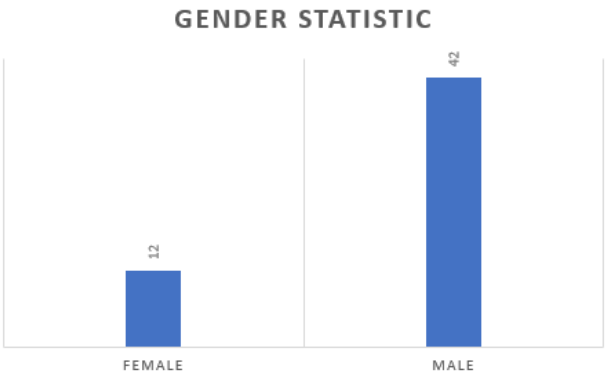


Figure 5: Gender statistic-researchers

Table 6 – Administrative participation in B5G-OPEN

Administrative participation in B5G-OPEN		
Partner	**Female**	**Male**
TID	2	2
TIM	0	1
BT	0	2
INF-G	0	2
INF-P	1	1
ADTRAN	1	2
NOKIA	0	3
CNIT	0	1
CTTC	2	0
UPC	0	2
HHI	1	1
OLC-E	0	1
ELIG	0	1
TU/E	2	3
PLF	1	2
Total	**10**	**24**

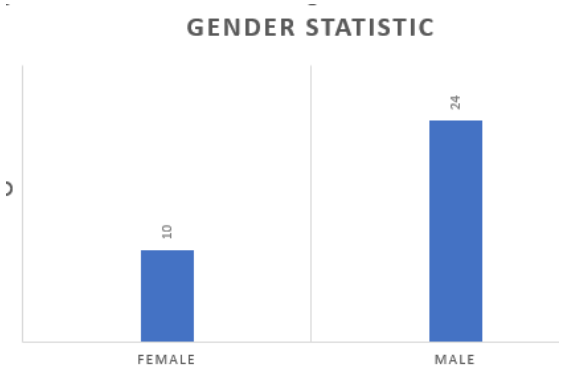


Figure 6: Gender statistic – administrative

The table below list the number of male and female researchers involved in the B5G-OPEN deliverables (technical participation):

Table 7 – Number of male and female reseachers

Field	Male	Female
D1.1	4	1
D1.2	3	0
D1.3	1	0
D1.4	33	3
D2.1	23	3
D6.1	24	2
D3.1	23	4
D4.1	28	3
D4.2	33	3
D3.2	24	5
D1.5	35	4
D6.2	28	4
D5.1	30	4
D3.3	26	5
D4.3	21	0
D4.4	28	3
D5.2	26	6
D5.3	28	1
D6.3	17	2
D6.4	4	0

3.3 Standardisation Activities

In this section, the standardization activities for Y3 are summarized per standardization body.

3.3.1 ETSI ISG F5G

Fraunhofer HHI participates regularly in the weekly meeting of the ETSI ISG F5G as well as the face-to-face meeting. During those meeting, HHI contributed to discussions on the specifications and use-cases reflecting the viewpoint of B5G-OPEN project.

3.3.2 ITU-T

An evolution of the Digital Subcarrier PON using burst mode technology has been introduced as a candidate for the upcoming series Very-High-Speed PON recommendations as part of the "Flexible Coherent PON Based on TFDM/TFDMA with Subcarrier Multiplexing/Multiple Access" variants, in the document ITU-T Q2/SG15 are preparing called G.SupVHSP. The intention of this document (a Supplement recommendation) is to list all the VHSP candidates before a due process to select the technology to be specified. The main contributor on this technology from B5G-OPEN consortium has been Infinera while BT will actively participate on the preparations for the selection process that is scheduled to start around the second half of 2025.

TIM participated in the ITU-T Q2/15 study group and until 2023 also in ITU-T Q6/15 and ITU-T Q11/15. The role was to inform the project on the progress of the standards, however apart from the general vision of the B5G-OPEN project, no specific contributions specifically referred to the project were submitted.

Adtran participated in the ITU-T Q6/15 meetings. A contribution was presented at the July 2024 plenary meeting to compare the estimation performance of different transmitter quality metrics (TQMs) under considerations in Q6/15 and how they relate to a given reference receiver definition. The definition of a suitable TQM and reference receiver for beyond 400G transceivers is an important activity towards the addition of 800G application codes in recommendation G.698.2 for next-generation high capacity links. As a follow-up to the contribution, a correspondence activity aiming to describe the reference receiver was started in Q6/15 and liaison letters were exchanged with IEEE 802.3 and OIF to coordinate the advancement of the activity across multiple SDOs which are actively working on the topic.

3.3.3 ONF TAPI North Bound Interface

During the duration of the project, CTTC has participated in the standardization activities related to the optical Controllers North Bound Interfaces (NBI). This interface has been implemented following the Open Networking Foundation (ONF) family on open data models and interfaces known as TAPI (Transport Application Programming Interface).

In this setting, Ramon Casellas (B5G-OPEN WP4 leader) has attended TAPI conference call, has served as editor of the TAPI Reference Implementation Agreement (RIA) and has contributed to the releases from 2.1 to 2.5 of the data models.

TAPI has been successfully used in several B5G-OPEN dissemination papers, used for tasks such as topology discovery, service provisioning or path computation. TAPI has been implemented by partners of the B5G-OPEN project and used in the main demos of Work Package WP5.

TAPI has recently moved as a project under the umbrella of the Linux Foundation (LF), and it is expected to have further development and consolidation under the ONMI subproject.

3.3.4 OpenROADM

TIM participates regularly on weekly calls leading for a period the group and contribute to discussions and specifications.

3.3.5 The Open XR Optics Forum

TIM, BT and TID participate regularly to forum meetings (five meetings per year) with interventions in the discussions and on some occasions presenting contributions on lab trials of XR. Several public presentations at the leading conferences have been hold as well.

On Sept. 12, 2024, BT presented to the Forum on the "Filter-less Metro-Access Network with XR optics" demonstration that was carried out in BT Labs between 29 Sept. and 1 Aug. 2024, and then between 2 – 5 Sept. 2024.

Several proof-of-concepts have been started within this forum.

3.3.6 Open-source Software

Optical Controller: ONOS version 3.0 has been forked at the beginning of the project. A version with all the software contributions developed during B5G-OPEN project (and all scripts utilized during experimental demonstrations) is currently available in the following public repository:

> https://github.com/Network-And-Services/onos-b5g-open
> Selected components the developed software have been contributed to the open-source ONOS community and are now part of the official ONOS distribution:
> https://gerrit.onosproject.org/c/onos/+/25681

https://gerrit.onosproject.org/c/onos/+/25616
https://gerrit.onosproject.org/c/onos/+/25596
https://gerrit.onosproject.org/c/onos/+/25594
https://gerrit.onosproject.org/c/onos/+/25593
https://gerrit.onosproject.org/c/onos/+/25168

3.4 Social Medias

3.4.1 LinkedIn

LinkedIn has been our main media platform within the WP6. The activity of B5G-OPEN, including project results and member activities, is updated on a regular basis on the corresponding LinkedIn profile. Indicatively, these activities include workshop organization initiatives, scientific achievements as well as other outreach initiatives.

B5G-OPEN has been publishing its scientific achievements, in terms of participation to conferences and publications of the results on the leading journals. On 16th of Oct. 2024, we counted.

Table 8 – LinkedIn visitors per year

Item	**Y1**	**Y2**	**Y3**
Page views	569	560	197
Unique visitors	168	236	92
Custom button clicks	53	6	3
Followers	87	189	321

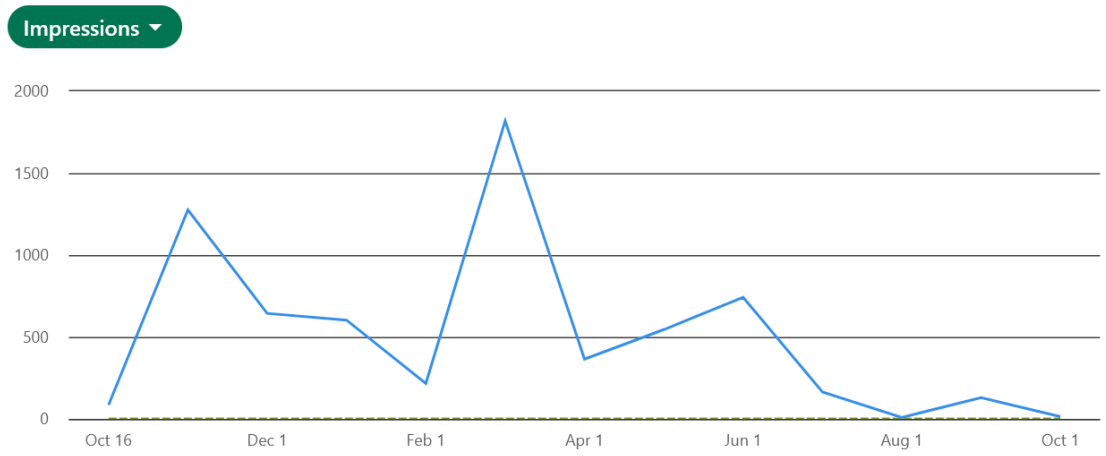


Figure 7: LinkedIn impression over the last twelve months.

3.4.2 YouTube Channel

YouTube remains the leading online video platform, and the B5G-OPEN project continues to utilize this resource for sharing multimedia content. The B5G-OPEN YouTube channel, available at https://www.youtube.com/channel/UCLnUWIHn1FWEHx2LIwMBHUQ and established in

QMR2, has expanded its offerings since its inception. At the time of this writing, we have four public playlists available with the following impact metrics:

Table 9 – B6G-Open YouTube playlists

Playlist	Video	Views	Likes
B5G-OPEN workshop	ICT 52 Workshop on 6G	357	4
B5G-OPEN plenary meetings	[B5G-OPEN] 3rd Plenary meeting Barcelona (UPC) 2022/10/18 (1)	72	2
	[B5G-OPEN] 3rd Plenary meeting Barcelona (UPC) 2022/10/18 (2)	143	5
OFC 2023	A talk with project coordinator at OFC 2023	39	4
	Telemetry Demo at OFC 2023	45	2
	Distributed Architecture Supporting Measurement Aggregation and Event Telemetry	14	1
EuCNC 2023	SDN Control of Multiband Optical Networks with externalized path computation exploiting device manifests.	16	4

Note: The previous hyperlinks redirect to B5G-OPEN videos in YouTube.

The global statistics of the project's YouTube channel are:

- Total views: 686 views (89 new ones in last year)
- 24 subscribers
- Average views per Month: 6.85 views
- Total view duration last year: 10.1 minutes
- Average view duration per Month: 0:47 min

Fig. 2.6. shows the YouTube channel views and average view duration over time.

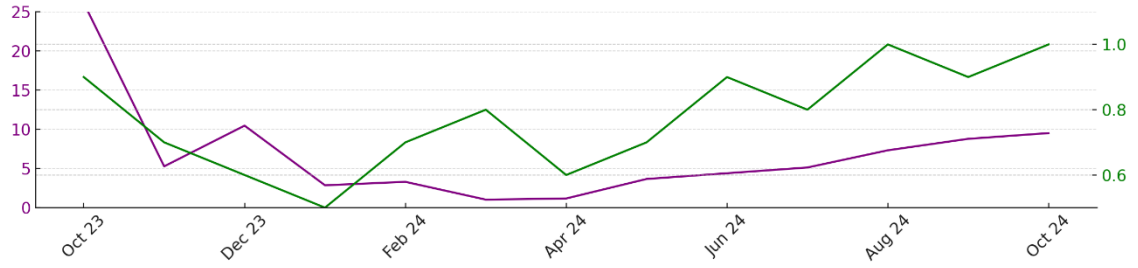


Figure 8: YouTube channel views and average view duration (Oct. 2023 – Oct. 2024)

3.5 WORKSHOP ORGANISATION

- Gender and diversity workshop within IMOC 2023
  The gender and diversity workshop "Talent and career in research: The role of mentoring to foster diversity and inclusion" organized in the framework of B5G-OPEN EU and co-located with the SBMO/IEEE MTT-S international microwave and optoelectronics conference (IMOC) was successfully held at the Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) on November 8, 2023. More details can be found in:

https://www.events.sbmo.org.br/imoc2023/pagina/33/workshops

The workshop was organized by Laia Nadal and Michela Svauto Moreolo both from CTTC (Spain), Marija Furdek from Chalmers University of Technology (Sweden) and Fatima Gunning from Tyndall National Institute (Ireland). The workshop had the format of invited talks and a panel session featuring speakers from academia and industry at various career stages, providing a broad range of perspectives on talent and career in research. The list of speakers was: Masab Iqbal (CTTC/CERCA, Spain), Maria Jose Pontes (Universidade Federal do Espírito Santo - Brazil), Vanesa Díaz (LuxQuanta, Spain) and Ben Puttnam (NICT, Japan). The importance and role of mentoring and its impact on empowering researchers' career development, while promoting diversity and inclusion was discussed. The speakers also provided best practices and insights to advance diversity and inclusion in research, highlighting challenges and barriers faced by women in their career development.

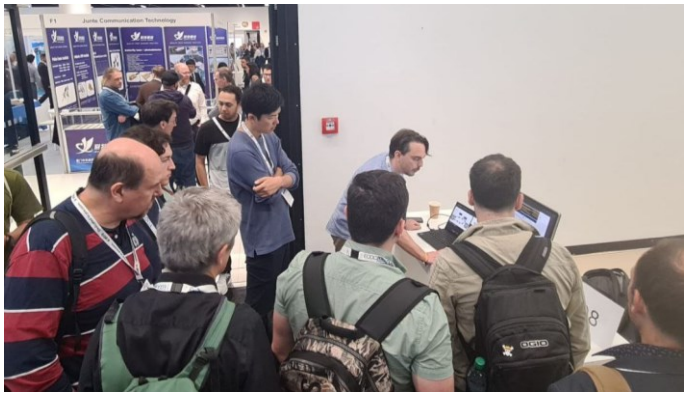
3.6 DEMOS

During the final year of the project, a joint demonstration between Nokia, Sant'Anna, CNIT and the University of Pisa was presented at ECOC 2024 conference, see pictures below. It aims to present self-healing optical networks by leveraging the longitudinal power profile monitoring solutions studied during the B5G-OPEN project. The novelty of the demonstration was the development of a standard-compliant telemetry system using openConfig and gNMI. The developed telemetry system was designed to minimize the sent information from the transponder to the control and management plane. This demonstration attracted a lot of visitors and a lot of very interesting questions and feedback.

Demo 8: Longitudinal Power Profile Monitoring telemetry enabling fault location-aware SDN controller

Alessandro Pacini[1], Fabien Boitier[2], Alix May[2], Vinod Bajaj[2], Andrea Sgambelluri[1], Alessio Giorgetti[3], Luca Valcarenghi[1], Patricia Layec[2]; [1]Scuola Superiore Sant'Anna, [2]Nokia Bell Labs, [3]University of Pisa

This demonstration showcases sharper optical network reconfigurations through a SDN controller, enhanced with longitudinal PPE monitoring to enable soft-failure location. We developed a standard-compliant implementation of an efficient telemetry using OpenConfig and gNMI while balancing the computational needs between the receiver and the SDN controller.



3.7 NEWSLETTERS

During the final year of the project the last newsletter was published. This marks the accomplishment of the goal within the communication plan of issuing periodic newsletters, which have been instrumental to share our main achievements, highlights, and technical contributions.

Newsletter 6: the objective of this newsletter was to provide a brief overview of two of the latest demonstrations conducted within the project. The two demonstrations conducted were *"Filter-less metro-access network"* with the involvement of partners INF, BT, OLC-E, CTTC, TuE, and E-LIG and "*Autonomous service provisioning and self-healing in multi-band multi-domain IPoWDM networks for live video traffic*" with the involvement of partners HHI, CNIT, CTTC, ELIG, TIM, PLF, OLC-E and UPC. It is worth to point out that the first demonstration was not planned in the DoW, but it was possible thanks to the good results of the consortium.

Figure 9: Newsletter 6

4 EXPLOITATION

4.1 INDIVIDUAL EXPLOITATION

This section briefly presents the exploitation plan for individual partner.

4.1.1 TID

Telefonica is a leading global telecommunications company that operates across 14 countries (Europe and Latin America) and serves approximately 384 million customers worldwide. In this sense, Telefonica provides a diverse range of services, including mobile and fixed-line communications, broadband internet, and digital solutions. The company is committed to advancing connectivity through innovative technologies and infrastructure development, ensuring that both urban and rural populations have access to reliable communication services. As the demand for high-speed internet and advanced telecommunications continues to grow, Telefonica is strategically positioned to meet these needs while contributing to the digital transformation of the regions it serves.

Telefonica's global networks demand continuous evolution focusing on diverse challenges, like managing exponential traffic growth, extending connectivity to remote areas (both fixed and mobile) and delivering premium broadband services at competitive prices. This strategic focus not only enhances Telefonica's market position but also contributes to broader economic development. Research has consistently demonstrated a strong correlation between improved broadband connectivity and GDP growth, underscoring the vital role Telefonica plays in fostering digital transformation and economic prosperity across its markets.

The data plane technologies developed within the B5G-OPEN project, including multiband transmission, filterless architectures, and point-to-multipoint (P2MP) dynamic systems, are set to be implemented in specific metro and backbone segments. These technologies aim to address the need for bandwidth upgrades, dynamic capacity allocation, and cost-effective transmission, both in terms of deployment and power consumption. Additionally, the widespread integration of measurement and telemetry systems, coupled with AI/ML-driven algorithms within a modern, intelligent, and reconfigurable software-based control plane, will enhance connectivity services. This approach promises more efficient management and troubleshooting operations, moving towards minimal human intervention and reduced manual processes. Ultimately, the coordination with software-based platforms is expected to lead to minimal operations and zero-touch intervention.

4.1.2 TIM

TIM's network, like that of other operators, requires transformations that respond on one hand to the traffic growth, on the other to the satisfaction of the stringent requirements of access technologies (5G-A, 6G and fixed Broadband) and services (coming both from consumer/mass-market and vertical-business). The multi-band and SDM systems developed and tested in B5G-OPEN, both for switching and transmission, will allow to satisfy the growing demand for traffic at a sustainable cost, as demonstrated in the technical-economic studies, in the metro core and backbone segments.

In the metro access and metro core segment, B5G-OPEN technologies can guarantee efficiency and capacity at the same time as demonstrated by feasibility studies, experiments (the one performed in BT laboratories for example) and also by economic evaluations. Same benefit can

be obtained in in the offshoots towards radio access (co-entity for RAN) and fixed (PON), solutions such as those that use P2MP transceivers based on DSCM and filterless or ONDM nodes based on wavelength blocker and SOA software.

Finally, integrated control and orchestration solutions between domains and levels such as can lead to both technical-functional and economic benefits, even if the latter are more difficult to evaluate.

4.1.3 BT

BT relies on network technologies specified in International SDOs such as ITU-T. BT is supporting the inclusion of some of the technologies investigated in B5G-OPEN to be considered for applications that favour the optical by-pass at the access central offices, such as the inclusion of Coherent Digital Subcarrier Multiplexing/Multiple Access in the candidate list to be specified as VHSP technology. Other technologies candidates include the S+C+L amplifiers for potential use in the most congested optical spans in BT's network.

4.1.4 INF-D & INF-P

INF-D has been considering various ways to exploit the many outcomes obtained within B5G-OPEN. These range from: (i) Preliminary studies on (ultra) wideband transmission to better understand the different options beyond existing C+L; (ii) The possibility of deploying filterless networks based on coherent point-to-multipoint transceivers. Here, we deepened our knowledge by improving our in-house tool for optical performance assessment; (iii) Techno-economic analysis for next-generation metro-access and metro-aggregation optical networks, also in terms of optimization of the placement of optical amplifiers and the optimization of the splitting and coupling ratio; and (iv) Several works carried out as part of the open XR optics forum MSA, in collaboration with operators involved in B5G-OPEN.

4.1.5 Nokia

Nokia Bell Labs is actively contributing towards the goal of massively monitoring the optical network infrastructure to see the health of the network, potentially in real-time. These monitored values are then leveraged through machine learning applications to optimize the point-to-point lightpath connection and to detect and localize anomalies. These activities are very helpful in designing the Nokia Wavesuite portfolio and in particular Wavesuite Health & Analytics and Wavesuite Optimizer software tools.

On the monitoring side, current commercial transponders mainly monitor the performance quality, chromatic dispersion, polarization mode dispersion and received power. In the B5G-OPEN project, we developed a monitoring technique capable of getting the power profile along the transmission (like an OTDR) from a single received point. This is very powerful and has a two-fold objective: (i) to detect and localize loss anomalies anywhere in the line, ii) to reduce the design margin.

We investigated several approaches to perform this power profile monitoring relying on SPM or XPM nonlinearities, we thoroughly assess accuracy of alternative implementation methods and will showcase a demo at ECOC 2024 conference. We also did a sensitivity analysis on the cost and power consumption of such "power profile" technique with respect to the traditional OTDR one. This will give guidelines for a future product implementation inside the Nokia 1830 PSS hardware platform.

On the machine learning side, we investigated several classification methods (e.g. random forest, support vector machine, etc.) to determine the regime of operation (i.e. linear, nonlinear). This is then used to automate the launch power optimization of a transmission link. We compare different alternatives with either 2-class or 3-class models. We also study how to compress the input features. This gives recommendations for a potential transfer into Nokia Wavesuite portfolio.

4.1.6 Adtran

The focus of the physical layer investigations of Adtran is on multi-band amplification in commercial environments. The results have been presented to customers and have been very well received. In particular, they are very helpful for developing strategies for upgrading their existing telecommunication network.

First, different amplifier technologies have been investigated in view of their potential deployment in upcoming transmission system. In addition to performance parameters, topics such as energy consumption, sustainability and reliability of the technologies have been taken into account. Further studies dealt with bandwidth extension based on the currently used and mature technology. The developed solutions are suitable for links with moderate increase of demand for capacity. It has been shown that the anticipated degradation of noise figure can be avoided by modifying the amplifier design. Furthermore, concepts for noise figure improvement and therefore reach increase in multi-band configurations have been analysed and presented. Finally, control concepts for multiband amplifier setup have been developed and system requirements have been identified.

On network level, Adtran will exploit the telemetry extension on streaming telemetry for multiband amplifiers for the development and improvement of Adtrans gNMI and NETCONF streaming solutions. The telemetry extensions and functionality of the Adtran FlexTelemetry agent developed and tested in the B5G-OPEN project will enhance the APIs of the network devices, as well as extend the functionality of the Mosaic Network Controller.

4.1.7 CNIT

CNIT, as a Research and Technical Organization (RTO), is using the project platform and the innovative white box solution enhanced with network programmability for promoting basic and applied research in the various fields of ICT, coordinating activities among the member universities with particular attention to the definition, promotion and implementation of innovative industrial projects of significant size.

For example, CNIT organized dedicated workshops with selected member Universities (e.g., Scuola Superiore Sant'Anna) to present and promote the project activities.

CNIT is also using this technical innovation and developed knowledge to strengthen the industrial collaboration and technology transfer particularly with Telecom Operators. TIM funded a PhD student co-supervised by CNIT on the B5G-OPEN project topics.

4.1.8 CTTC

CTTC, a Research institution located in Spain, has limited direct exploitation plans on the technologies developed in B5G-OPEN, mainly by means of bilateral agreements with industry actors. As continuation of B5G-OPEN activities, CTTC will address basic and applied research on the diverse technological topics. First, in the transmission and transport systems and devices, CTTC will explore the deployment of extended innovative capabilities and advanced features of

an available prototype for Sliceable Bandwidth/Bit-Rate Variable Transceivers (S-BVT) and further develop CTTC SDN controller to seamlessly support tailored autonomous control functions to manage connectivity services. In addition to contribute to the research community, these enhancements, experimentally validated, do constitute valuable outcomes to offer consultancy, contributing to standardization, teaching, etc. In this context, a key and strategic technical control aspect is to leverage the advantages brought by AI/ML mechanisms when managing the lifecycle of the connectivity services such as reducing the overall network power consumption, improve the throughput and resource utilization (e.g., spectrum).

4.1.9 UPC

UPC has included the developed telemetry platform and the control of point-to-multipoint connectivity, as well as the generated know-how for educational activities, like contribution to subjects and courses. Specifically, they have contributed to the Master in Innovation and Research in Informatics (MIRI) of the Facultad de Informatica de Barcelona (FIB). In addition, the several M.Sc. and PhD. students have gained expertise in these technologies, which has benefitted their research projects, thus training such students and working to prepare them to become expert researchers.

In addition, the UPC has used the achieved knowledge and gained leadership among the scientific community to participate in further research projects that are extending those technologies much beyond their state after the finalization of B5G-OPEN.

4.1.10 HHI

HHI contributions in the last year of the project include the programmable multi-band node prototype, multi-band transceiver, the publicly released experimental dataset, and the fully integrated testbed for the final demonstration. HHI, as a research organization, exploits the developed know-how and expertise to perform further research and IP developments and use them in future research projects. In addition, along the way of delivering its commitments, it has trained master's and PhD students and will continue to do so in terms of training highly skilled researchers.

4.1.11 OLC-E

OLC-E is actively engaged in two areas: The first is the derivation of critical s/w of an SDN-enabled optical multi-band PCE which is based on a multi-band routing engine that exploits a physical layer aware RMSA algorithm. Further simplifications of the initial prototype have been made to allow faster and a universal deployment of this s/w which is now business-ready. The second is the exploitation of the novel Access/Aggregation architectures developed in the context of B5G-OPEN that postulate the co-existence of dissimilar fixed-line technologies. In this direction OLC-E collaborated with BT to the implementation of an optical bypass scheme across the Access/Aggregation segments. OLC-E is poised to capitulate on these advances to exploit the fixed-wireless convergence in the 6G era.

4.1.12 ELIG

The SME E-Lighthouse Network Solutions (ELIG) has developed a comprehensive Individual Exploitation Plan centered on the B5G-ONP (Beyond 5G Open Network Planner). Validated through trials in collaboration with Telecom Italia (TIM) and demonstrated at Berlin's HHI demo, this innovative tool has gained significant recognition, including being highlighted by the European Commission's EU Innovation Radar for its market potential and technological advancement.

At the core of ELIG's strategy is the continued development and commercialization of the B5G-ONP, a powerful optical network planner that orchestrates both IT and network resources. Building on the outcomes of the B5G-OPEN project, ELIG aims to refine and expand the B5G-ONP's capabilities, providing a robust solution for telecom operators and service providers to optimize network services, manage resources efficiently, and reduce operational costs (OpEx). The tool, designed for integration into existing network management systems, enables telecom operators to enhance service provisioning and improve the overall performance of their networks.

ELIG is committed to translating research into practical, market-oriented solutions. The B5G-ONP, through its innovative multiband network planning features, offers telecom operators the ability to deploy and optimize network services with greater efficiency. ELIG's approach is customer-focused, with commercial offerings including software licenses and customization services tailored to the specific needs of operators and service providers. This ensures that the solution meets the dynamic demands of the telecommunications sector, providing both value and flexibility.

As part of its market expansion strategy, ELIG will leverage its strong academic connections and existing market presence across Europe. By forming strategic alliances with network operators and service providers, the company aims to increase the adoption of the B5G- OPEN solution. Participation in EU-funded programs will be a key avenue for promoting the technology further, particularly as the industry moves towards 6G and beyond.

In the long term, ELIG is committed to tracking the impact of B5G- OPEN on the telecommunications market. By collecting key performance indicators such as network efficiency improvements, customer satisfaction, and adoption rates, the company will continuously refine its offerings to maintain their relevance and efficacy in an evolving market landscape.

4.1.13 TUE

The expertise TUE gained from the B5G-OPEN project led to expand the scientific knowledge in multiband SOA-based OADM and N-degree ROADM architectures as well as photonic integrated circuits. The expertise gained from B5G-OPEN will be laid down in PhD graduates, who will subsequently deploy their skills to strengthen the industrial activities in Europe. The expertise will also lead to state-of-the-art educational programmes in Optical Communication courses preparing Master and PhD students for innovative R&D positions in Europe. Moreover, the unique expertise gained in B5G-OPEN consolidates TUE reputation in the international research community by offering unique and state of the art photonic switches. TUE was involved in several collaborations during the B5G-OPEN project such as the BT demo and TIM demo. Although this is still in a prototype stage, TUE has designed and characterized advanced PIC such as MCS and WSS, essential to achieve low cost and volume manufacture for very large deployment in cost sensitive to support beyond 5G networks and potentially also in data center networks.

Given such large market opportunities, we are considering the perspective of creation of a startup supported by the Gate. At Eindhoven University of Technology, the Gate is the platform for tech startups in the first stage of their existence. The Gate, business developers and IP-experts of Brainport Development and the Eindhoven University of Technology offer

independent advice. Together with venture partners and regional startup ecosystem, the business developers provide information and guidance on workspaces, financing, training and coaching to entrepreneurial tech starters for taking-off the new company. As exemplified by several cases in the recent past, bi-lateral relations mutually beneficial to industry and university are expected to emerge from the promising R&D area to be elaborated in B5G-OPEN.

4.1.14 PLF

Value Proposition Analysis

Within B5G-OPEN, the invention of Enhanced LiFi Connectivity for Network Integration introduces an advanced approach to integrating LiFi technology into broader network infrastructures. At its core, this development includes the creation of a LiFi Access Point (AP), a LiFi SDN agent, and a LiFi SDN controller, which together allow for the dynamic management and optimization of LiFi systems within complex, multi-band network environments. The innovation's primary value lies in its ability to offer seamless connectivity, real-time network management, and enhanced Quality of Service (QoS) without the need for additional hardware or increased energy consumption.

In comparison to current indoor network solutions, which often rely on a single technology and face challenges in providing consistent high-performance connectivity in environments like Industry 4.0 or smart buildings, this innovation stands out. It integrates multiple access technologies, ensuring seamless operation and flexibility in a variety of use cases. The LiFi SDN controller dynamically manages and configures LiFi APs, providing real-time adaptations based on user mobility and channel conditions. This capability is particularly valuable for ensuring uninterrupted connectivity in environments where users move frequently or where channel conditions are unstable.

This work offers a significant advantage in that it requires no additional hardware, leveraging existing infrastructure for data transmission through the lighting system, thereby reducing deployment costs and power consumption. Additionally, by integrating LiFi with other wireless access technologies, such as 5G and Wi-Fi, it provides high-accuracy, low-latency communication—ideal for environments that demand precise, high-speed, and reliable connectivity, such as industrial facilities and smart campuses.

Impact Creation

The impact is wide-ranging, addressing key demands for high-performance connectivity and positioning services in various sectors. By integrating LiFi APs with existing network architectures, the solution enhances both connectivity and positioning services, which are particularly relevant in use cases requiring real-time data transmission and management, such as manufacturing, healthcare, and enterprise networks. This development ensures the efficient delivery of high-throughput, low-latency communication and precise indoor positioning services, making it a valuable addition to smart infrastructure and Industry 4.0 environments.

The main stakeholders expected to benefit from this innovation include telecommunications operators and network planners responsible for the deployment of PON, 5G, and Wi-Fi infrastructures, as well as technology providers seeking to enhance their offerings with LiFi integration. For industries with high security and performance requirements, such as hospitals,

manufacturing facilities, and campuses, this solution provides a reliable, energy-efficient option for managing indoor networks with minimal disruption.

The development of the LiFi SDN controller and agent allows for real-time management and optimization of network resources, ensuring optimal performance in even the most dynamic environments. These components are key in achieving seamless handovers and maintaining QoS as users move through coverage areas.

Given that LiFi technology remains underutilized compared to radio-based wireless access technologies, this innovation seeks to address this gap by facilitating LiFi's integration with other technologies, thereby delivering a cohesive and optimized network experience. By combining LiFi with 5G and Wi-Fi, this solution offers a powerful tool for network operators and industrial stakeholders who seek to improve coverage, reduce latency, and enhance energy efficiency in their networks.

The engagement with stakeholders will occur primarily during the demonstration phase, with further outreach following the project's completion. The marketing team will play a crucial role in promoting the innovation to existing customers and potential partners, organizing demonstrations, and facilitating the dissemination of results to key industry players. Success will be measured by the uptake of the technology among network operators and industrial clients, as well as the increase in orders or collaborations following the successful deployment of pilot projects.

Exploitation of the result

The commercialization potential of the Enhanced LiFi Connectivity for Network Integration innovation is significant. The integration of LiFi with 5G and PON presents a unique opportunity to develop products that provide real-time management of indoor networks across multiple technologies. The LiFi SDN controller and agent can be developed into scalable, commercial solutions tailored to the needs of telecom operators, smart city planners, and industrial network operators.

Strategic partnerships with telecommunications providers and industrial operators will be essential in scaling the deployment of this technology. Pilot deployments in real-world environments, such as smart factories and industrial campuses, will showcase the operational benefits and validate the effectiveness of integrating LiFi into multi-RAT networks. Following these pilots, the technology can be promoted to broader markets, particularly in industries that require secure, high-performance indoor communication solutions, such as healthcare and smart infrastructure.

By offering a clear path from innovation to commercialization, this exploitation plan ensures that the benefits of LiFi technology can be realized in multiple sectors. The innovation's ability to provide seamless connectivity, reduce operational costs, and improve energy efficiency positions it as a key enabler for the next generation of indoor networks, offering substantial commercial and technological advantages over traditional solutions.

4.2 JOINT/GROUP EXPLOITATION PLAN

- Network and Service Operators
  - TIM funded a PhD student co-supervised by CNIT on the B5G-OPEN project topics related to IPoWDM. The technical work performed on this topic allowed TIM to further assess the potential benefits of the innovative IPoWDM technology in the specific deployment scenario of TIM Metro-Aggregation Network.
  - The final B5G-OPEN project demo focusing on disaggregated and transparent multi-band optical continuum across access, horseshoe aggregation, and metro IPoWDM networks (see D5.2) was hosted in TIM Lab and involved eight B5G-OPEN Partners. The proposed architecture and implementation are of high relevance for TIM future deployments in the aggregation-access since they enable improved scalability and flexibility by allowing operators to decouple hardware and software, thereby reducing vendor lock-in and fostering innovation. Transparent multi-band capabilities ensure efficient spectrum utilization, leading to enhanced network capacity and lower operational costs. The demo provided a proof-of-concept for real-world deployments, helping to de-risk investment decisions and accelerate time-to-market. Ultimately, this approach supports a future-ready network architecture that can meet the growing demand for high-speed, reliable connectivity.
- Network Equipment Manufacturers
  - Nokia collaborated with public research centres such as CTTC and HHI to investigate monitoring in multi-band transmission setups. It proved the feasibility of different monitoring techniques originally proposed in the C-band to additional bands. Therefore, it can be concluded that the investigated monitoring techniques (e.g. chromatic dispersion and longitudinal power profile monitoring) are band-agnostic.
  - INF collaborated with several partners (BT, OLC-E, CTTC, TU/e, and ELIG) to carry out the demo on metro-aggregation optical networks at BT labs. This demo might be part of future studies as it represents a possible solution to cope with the growing demand in this network segment.
- SMEs
  - OLC-E collaborated with BT to the implementation of an optical bypass scheme across the Access/Aggregation segments a collaboration that led to the additional B5G-OPEN demo that was not foreseen in the initial DoW.
  - ELIG collaborated with TID to investigate multi-domain network orchestration with external network planning support, a collaboration that led to the implementation of orchestration solutions across various network domains. ELIG's innovative solutions, combined with TID's commercial and operational expertise, resulted in works oriented to joint investigation and experiments that were not initially foreseen in the original project scope.
- Academic and Research Institutions
  - UC3M, as a third party of TID, has focused their activities on network models, simulators and open-source code for evaluating B5G-OPEN use cases and architecture from a techno-economic point of view, leading to publications in high-impact journals and conferences (i.e. JOCN, OFC, etc) with other WP2 partners (TIM, UPC). Also, other research activities in collaboration with manufacturers (INF-G) and research institutions (CNIT) have produced open-source code and publications.

5 SUMMARY

This report summarizes B5G-OPEN's Y3 efforts in the areas of internal coordination, organization and communication exchanges, dissemination, and standardization.

Our internal communication is implemented by means of two administrative tools, which are the repository and file system and MS Teams, to facilitate effective collaboration among project partners. For its external communication, B5G-OPEN is making use of the project's website, which serves as a dynamic hub for sharing updates and research findings, and the social media platforms. Through them, we connect with stakeholders, communicate project progress, and stimulate meaningful discussions.

Regarding publications and scientific events, B5G-OPEN has exceeded the targets set in the DoW by more than twice. Significant progress has been made to promote gender equality. Last but not least, to make sure that our research is synchronized with industry standards and promotes more extensive industry improvements, B5G-OPEN actively participated in standardization fora, fostering progress in the broader telecommunications domain.