SEASON

Self-Managed Sustainable High-Capacity Optical Networks

Deliverable D6.2

Year 2 report on standardization, communication, and dissemination activities

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DISCLAIMER

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0.1	*Oct 20, 2024*	*S Pryor (ACC)* *K. Vlachos (CNIT)*	*First version from D1.1*
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EXECUTIVE SUMMARY

SEASON as a collaborative project involving educational, research, and industrial partners, emphasizes effective communication and dissemination to maximize its impact. The project employs a diverse range of channels, including scientific publications, workshops, demo exhibitions, and engagement in standardization activities.

In this document, which supersedes D6.1, we outline all the communication, dissemination and standardization activities carried out during the 1st and 2nd years of the project.

TABLE OF CONTENTS

1. INTRODUCTION

The SEASON project is a collaborative endeavour involving a consortium of educational, research, and industrial partners that embarks on a transformative journey at the forefront of technological innovation. This comprehensive report encapsulates the efforts and accomplishments of SEASON during the first two years of the project, namely 2023 and 2024. It focuses on the areas of communication, dissemination, and standardization.

This deliverable reports on the planning and execution of communication and dissemination strategies, illustrating how SEASON maximizes its influence by effectively reaching diverse target audiences. The project's dedication to transparency, collaboration, and knowledge-sharing is evident in its involvement with scientific publications, workshops, and demo exhibitions.

Moreover, SEASON acknowledges the importance of standardization in ensuring interoperability and fostering a unified ecosystem. The report navigates through the project's active engagement with prominent Specification Developing Organizations (SDOs), outlining its objectives, achievements in the first and second years, and plans for ongoing standardization activities.

The deliverable is organized as follows. First, it reports the initial planning of activities - as documented in the Description of Work - and then, it summarizes the activities of the 1st year (previously reported in D6.1) and 2nd year of the SEASON project. This structure is repeated for Dissemination, Communication and Standardization activities.

Dissemination Level	SEN (Sensitive - limited under the conditions of the Grant Agreement)

2. COMMUNICATION AND DISSEMINATION - INITIAL PLAN AND ACTIVITIES

2.1. DISSEMINATION -INITIAL PLAN AND ACTIVITIES

Scientific publications in peer-reviewed conferences and journals are the primary channel to reach the scientific community and publish SEASON results. In addition, in conferences with technical exhibition forums, it is also possible to reach specific target groups from industry. The overall project dissemination plan is presented in Figure 1.

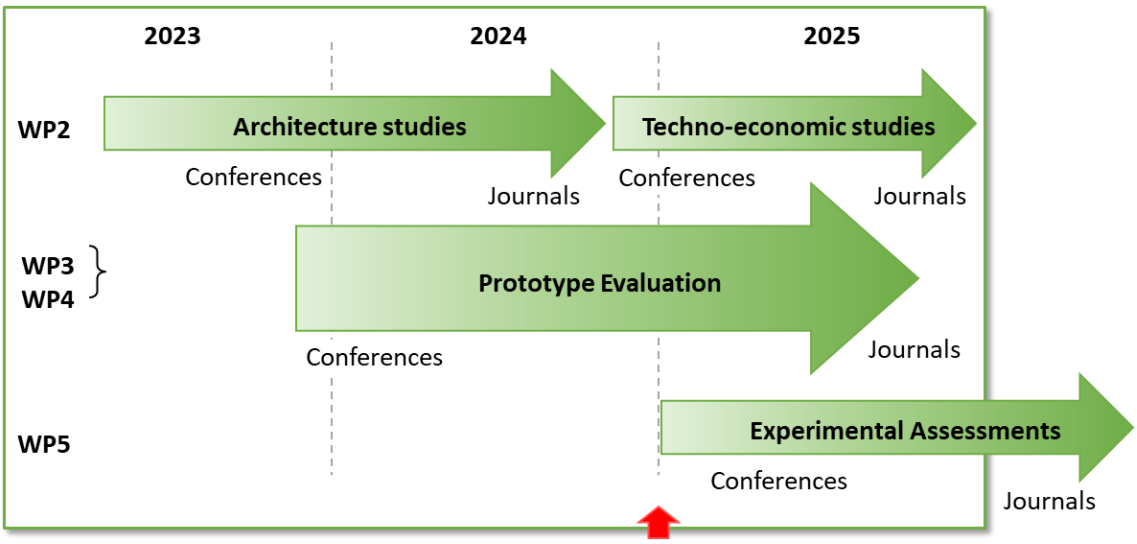

Figure 1 SEASON Dissemination Plan

As planned, during the 1st year, dissemination activities were mainly concentrated on demonstrating the SEASON concept, its impact on optical networking, as well as raising the awareness of these target groups about the objectives and expected results of the project. Starting from the second year onwards, the dissemination activities evolved to publish concrete scientific results, with a special focus on results relating to technological innovation.

Major Targeted Conferences: OSA Conference on Optical Fiber Communication (OFC), European Conference on Optical Communication (ECOC), IEEE International Conference on Transparent Optical Networks (ICTON), IEEE International Conference on Optical Network Design and Modelling (ONDM), IEEE International Conference on Communications (ICC), Global Communications Conference (GLOBECOM), and European Conference on Networks and Communications (EuCNC).

Major Targeted Journals: IEEE J. on Selected Areas of Communications, IEEE/OSA J. of Optical Communications and Networking; IEEE/OSA J. of Lightwave Technology; IEEE Trans. on Signal and Inf. Processing over Networks; IEEE Comm. Magazine.

Major target is to publish over 25 journals, articles, magazines, whitepapers, specifications, and standards.

Table 1: Dissemination activities and KPI

Dissemination Activity and Verification Plan	Y1 Achieved (KPI)	Y2 Achieved (KPI)	Y1+Y2 Achieved (KPI)	Y3 KPI
Publication in selected peer-reviewed Journals	5 (5)	19 (10)	24(15)	10
Presentation and publication at selected scientific conferences/workshops	27 (10)	37 (15)	64 (25)	15
Participation at industry conference/workshops/events	0 (0)	6 (1)	6 (1)	2

2.1.1. Scientific Publications (Year 1 and Year 2)

The following papers were published, presented, or received acceptance for publication. Because of the long list of publications and their large lifecycle from the time they are submitted, accepted, presented/published, publications are consolidated into one single list for years 1 and 2, so the references listed below contain the last available data, e.g., after the final publication.

Open access

SEASON uses Zenodo to deposit accepted scientific publications to comply with the Open Access policy for publications. To that end, the HORIZON SNS SEASON community has been created (https://zenodo.org/communities/horizon_sns_season/).

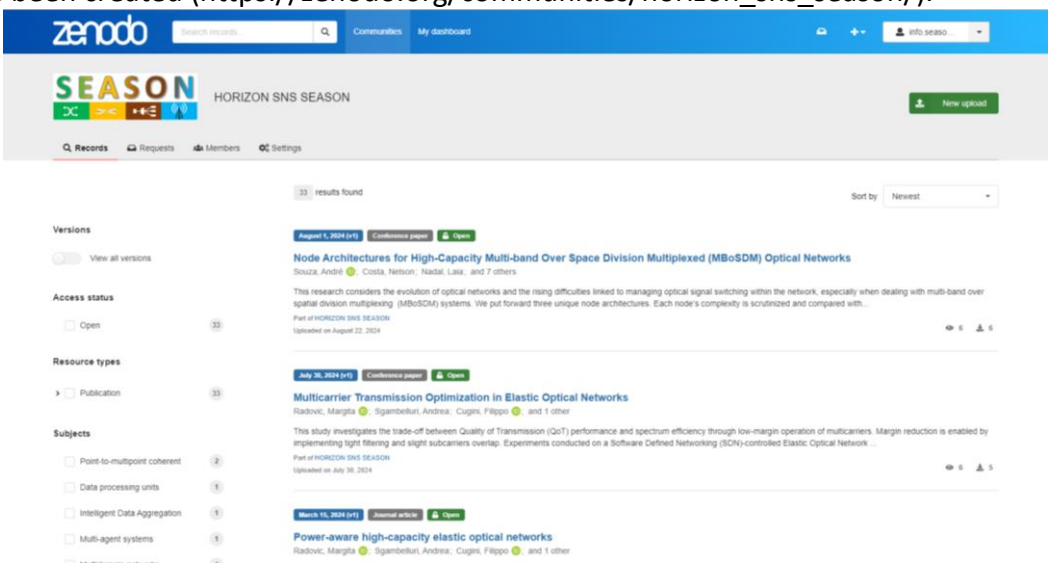

Figure 2: SEASON community in Zenodo

Dissemination Level	SEN (Sensitive - limited under the conditions of the Grant Agreement)

2.1.1.1. *Publications in Journals*

1. M. Devigili, M. Ruiz, N. Costa, C. Castro, A. Napoli, J. Pedro, and L. Velasco, “Applications of the OCATA Time Domain Digital Twin: from QoT Estimation to Failure Management,” IEEE/OPTICA Journal of Optical Communications and Networking (JOCN), vol. 16, pp. 221-232, 2024.
2. L. Velasco, P. González, and M. Ruiz, "Distributed Intelligence for Pervasive Optical Network Telemetry," IEEE/OPTICA Journal of Optical Communications and Networking (JOCN), vol. 15, pp. 676-686, 2023.
3. Margita Radovic; Andrea Sgambelluri; Filippo Cugini; Nicola Sambo, “Super-channel spectrum saving optimization procedure in elastic optical networks”, Journal of Optical Communications and Networking, Volume 15, Issue 2, 2023
4. Nadal, L.; Ali, M.; Vílchez, F.J.; Fàbrega, J.M.; Svaluto Moreolo, M., “The Multiband over Spatial Division Multiplexing Sliceable Transceiver for Future Optical Networks”, *Future Internet* 2023, *15*, 381. https://doi.org/10.3390/fi15120381.
5. H. Shakespear-Miles, Q. Lin, S. Barzegar M. Ruiz, X. Chen, L. Velasco, “Centralized and Distributed Approaches to Control Optical Point-to-Multipoint Systems Near-Real-Time,” submitted to IEEE/OPTICA Journal of Optical Communications and Networking (JOCN), vol. 16, pp. 565-576, 2024
6. S. Wang, M. Ruiz, and L. Velasco. “Context-based e2e Autonomous Operation in B5G Networks” (Sensors), Sensors 2024, 24(5), 1625, https://doi.org/10.3390/s24051625
7. L. Nadal, R. Martínez, M. Ali, F. J. Vílchez, J. M. Fàbrega, M. Svaluto Moreolo, and R. Casellas. “Advanced Optical Transceiver and Switching Solutions” (JOCN), accepted in June, 2024, Vol. 16 No. 8,
8. Margita Radovic, Andrea Sgambelluri, Filippo Cugini, Nicola Sambo. “Power-aware high-capacity elastic optical networks” (JOCN), March-24, https://doi.org/10.1364/JOCN.514067
9. A. Souza, N. Costa, J. Pedro, J. Pires. “Raman Amplifier Design and Launch Power Optimisation in Multi-band Optical Systems” (JOCN), 16, D64-D75 (2024), https://cnitit.sharepoint.com/:b:/r/sites/SEASON/Documenti%20condivisi/General/WP6/Papers/LNadal_IMOC-JOCN24-final.pdf?csf=1&web=1&e=hEfmWO
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11. Mahdieh Mehrabi, Hamzeh Beyranvand, Mohammad Javad Emadi, and Farhad Arpanaei. “Efficient statistical QoT-aware resource allocation in EONs over the C+L-band: a multi-period and low-margin perspective” (JOCN) May-24. https://ieeexplore.ieee.org/document/10513424
12. Farhad Arpanaei, Mahdi Ranjbar Zefreh, Carlos Natalino, Piotr Lechowicz, Shuangyi Yan, José M. Rivas-Moscoso, Óscar González De Dios, Juan Pedro Fernández-Palacios, Hami Rabbani, Maite Brandt-Pearce, Alfonso Sánchez-Macián, José Alberto Hernández, David Larrabeiti, and Paulo Monti. “Ultra High-

Capacity Band and Space Division Multiplexing Backbone EONs: Multi-core vs. Multi-fiber" (JOCN), Dec-24.
13. Carlos Natalino, Talles MagalhIães, Farhad Arpanaei, Fabricio R. L. Lobato, João C. W. A. Costa, José Alberto Hernández, and Paolo Monti. "Optical Networking Gym: An Open-Source Toolkit for Benchmarking Resource Assignment Problems in Optical Networks" (JOCN) July-24.
14. Abdennour Ben Terki, Joao Pedro, Antonio Eira, Antonio Napoli, Nicola Sambo. "Routing and Spectrum Assignment Empowered by Reinforcement Learning in Multi-Band Optical Networks" (JLT)
15. M. Hosseini, Joao Pedro, Nelson Costa, Carlos Castro, Antonio Napoli. "Optimized Design of Horseshoe-and-Spur Filterless Networks Leveraging Point-to-Multipoint Coherent Pluggable Transceivers" (JOCN)
16. Joao Pedro, M. Hosseini, Antonio Napoli. "Extended Network Applications of Coherent Pluggable Transceivers" (JOCN)
17. Mariano Devigili, Diogo Sequeira, Pablo Torres-Ferrera, Sasipim Srivallapanondh, Nelson Costa, Marc Ruiz, Carlos Castro, Antonio Napoli, João Pedro, and Luis Velasco. "Twining Digital Subcarrier Multiplexed Optical Signals with OCATA for Lightpath Provisioning" (JLT)
18. L. Zar Khan, et al., "Model and Data-centric Machine Learning Algorithms to Address Data Scarcity for Failure Identification", JOCN 2024
19. P. González, F. Alhamed, H. Shakespear-Miles, S. Barzegar, F. Paolucci, A. Sgambelluri, J. J. Vegas Olmos, M. Ruiz, And L. Velasco. "Near-Real-Time 6G Service Operation Enabled by Distributed Intelligence and In-Band Telemetry", (JOCN)
20. Carlo Centofanti, Walter Tiberti, Andrea Marotta, Fabio Graziosi, Dajana Cassioli. "Taming latency at the edge: A user-aware service placement approach", Computer Networks, Volume 247, 2024, 110444, ISSN 1389-1286
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23. F. Cugini, K. Vlachos, E. Riccardi, M. Quagliotti, L. Serra, A. Piat, M. Agus, A. Rossaro, J. Pedro, N. Costa, C. Pinho, A. Nunes, J.M. Rivas-Moscoso, A. Melgar, Ó. González, J. Hernández, D. Larrabeiti, A. Macián, R. Casellas, L. Nadal, R. Martínez, C. Antonelli, S. Tennina, A. Marotta, C. Centofanti, S. Barmpounakis, V. Tsekenis, V. Karunakaran, A. Autenrieth, R. Magri, G. Gambari, L. Velasco, M. Ruiz, J. Comellas, S. Barzegar, J. Prat, S. Ghasrizadeh, A. Napoli, C. Castro, G. Dooms, R. Berozashvili. "Node design in Self-Managed Sustainable High-Capacity Optical Networks (SEASON)", FOAN 2024
24. S. Ghasrizadeh, et al. "Digital Twin -Assisted Lightpath Provisioning in C+L+S

Multiband Optical Networks", (SENSORS)

2.1.1.2. Publications in scientific conferences

1. Q. Wang, H. Shakespear-Miles, X. Chen, M. Ruiz, Z. Li, and L. Velasco, "On Real-time Optical Subcarrier Management in P2MP Networks with Mixed-strategy Gaming," in Proc. Optical Fiber Communication Conference (OFC), 2023.
2. L. Velasco, S. Barzegar, and M. Ruiz, "Is Intelligence the Answer to Deal with the 5 V's of Telemetry Data?" in Proc. Optical Fiber Communication Conference (OFC), 2023.
3. L. Velasco, M. Devigili, and M. Ruiz, "Applications of Digital Twin for Autonomous Zero-Touch Optical Networking [Invited]," in International Conference on Optical Network Design and Modeling (ONDM), 2023.
4. S. Barzegar, M. Richart, S. Wang, A. Castro, M. Ruiz, and Luis Velasco, "Coordination of Radio Access and Optical Transport," in International Conference on Optical Network Design and Modeling (ONDM), 2023.
5. H. Shakespear-Miles, M. Ruiz, and L. Velasco, "Dynamic Subcarrier Allocation for P2MP Connections," in IEEE International Conference on Transparent Optical Networks (ICTON), 2023.
6. S. Wang, M. Ruiz, and L. Velasco, "Optical network traffic analysis under B5G/6G RAN operation," in IEEE International Conference on Transparent Optical Networks (ICTON), 2023.
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8. P. Khare, N. Costa, J. Pedro, A. Napoli, F. Arpanaei, J. Comellas, M. Ruiz and L. Velasco, "SSMS: A Split Step MultiBand Simulation Software," in IEEE International Conference on Transparent Optical Networks (ICTON), 2023.
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15. Filippo Cugini, Mauro Agus, Marco Quagliotti, Emilio Riccardi, Carlos Castro, Bernhard Spinnler, Antonio Napoli, “Point-to-Multi-Point Coherent Optics on Data Processing Units (DPUs) for beyond-5G Low-Latency Applications”, IEEE International Conference on Transparent Optical Networks (ICTON), 2023
16. Carlo Cavazzoni, Marco Caretti, Alessandro Percelsi, Mauro Agus, “Open RAN Mobile Access: The View of an Operator on an End-To-End Implementation” invited talk at Optical Fiber Communication Conference (OFC), 2023.
17. A. Souza, B. Correia, A. Napoli, V. Curri, N. Costa, J. Pedro, J. Pires, "Leveraging Raman Amplification to Improve and Equalize the Performance of a 20-THz Multi-band Optical System," 2023 European Conference on Optical Communication (ECOC), Glasgow, Scotland, 2023, pp. 1-4.
18. C. Centofanti, W. Tiberti, A. Marotta, F. Graziosi and D. Cassioli, "Latency-Aware Kubernetes Scheduling for Microservices Orchestration at the Edge," 2023 IEEE 9th International Conference on Network Softwarization (NetSoft), Madrid, Spain, 2023, pp. 426-431, doi: 10.1109/NetSoft57336.2023.10175431.
19. A. Marotta, C. Rinaldi, C. Centofanti, K. Kondepu, D. Cassioli and F. Graziosi, "O-RAN Neutral Hosting as a Viable Solution for First Responders Seamless Connectivity," 2023 International Conference on Information and Communication Technologies for Disaster Management (ICT-DM), Cosenza, Italy, 2023.
20. L. Valcarenghi, A. Marotta, C. Centofanti, F. Graziosi and K. Kondepu, "A Cooperative Energy Saving Scheme for NG-PON2-Based 5G X-Haul," 2023 International Conference on Photonics in Switching and Computing (PSC), Mantova, Italy, 2023.
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23. A. B. Terki, J. Pedro, A. Eira, A. Napoli and N. Sambo, "Routing and Spectrum Assignment Based on Reinforcement Learning in Multi-Band Optical Networks," 2023 International Conference on Photonics in Switching and Computing (PSC), Mantova, Italy, 2023, pp. 1-3, doi: 10.1109/PSC57974.2023.10297291.
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29. A. Souza, N. Costa, J. Pedro, J. Pires. “Comparative Assessment of S+C+L-band and E+C+L-band Systems with Hybrid Amplification” (OFC) pp. 1-3, March 2024
30. J. Pedro. “Networking Benefits of Coherent Pluggable Optics” (OFC) pp. 1-3, March 2024
31. A. Marotta, C. Centofanti, A. Pagano, N. Sambo. “Dynamic Spatial Aggregation for Energy-Efficient Passive Optical Networks” (ONDM 2024)
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33. Fabien Boitier, Laia Nadal, F. Javier Vílchez, Petros Ramantanis, Josep M. Fàbrega, Alix May, Michela Svaluto Moreolo, Ramón Casellas, Patricia Layec. “Monitoring of Chromatic Dispersion in Multi-Domain Optical Transmission Systems” (ECOC) Sept 2024. https://cnitit.sharepoint.com/:b:/r/sites/SEASON/Documenti%20condivisi/General/WP6/Papers/LN-ecoc2024.pdf?csf=1&web=1&e=e1kf6x
34. C. Hernandez-Chulde, R. Casellas, R. Martınez, R. Vilalta, R. Munoz. “Exploiting GNN and DRL for online service provisioning over Elastic Optical Networks” (ONDM 2024) May, 2024.
35. R. Martínez, C. Hernández-Chulde, R. Casellas, R. Vilalta, R. Muñoz. “Improving Energy Efficiency in Elastic Optical Networks through Deep Reinforcement Learning” (OFC)
36. R. Martínez, C. Hernández-Chulde, R. Casellas, R. Vilalta, R. Muñoz, O. González de Dios, J. P. Fernández-Palacios. “Enhancing Network Performance and Reducing Power Consumption in Elastic Optical Networks with Deep Reinforcement Learning” (ONDM 2024) May, 2024
37. D. Schneider, L. Rapp, C. Ament. “Anomaly Detection in Time Series of EDFA Pump Currents to Monitor Degeneration Processes using Fuzzy Clustering” (IEEE ComSoc) May, 2024
38. N. Koneva, A. Sánchez-Macián, J. A. Hernández, O. González de Dios “On optimizing Inband Telemetry systems for accurate latency-based service

deployments" (ONDM 2024) mag-24, https://ondm2024.uc3m.es/program/workshops
39. A. L. García Navarro, N. Koneva, A. Sánchez-Macián, J. A. Hernández, O. González de Dios, J. M. Rivas Moscoso. "Reinforcement-Learning based routing for packet-optical networks with hybrid telemetry" (ONDM 2024) mag-24, https://ondm2024.uc3m.es/program/workshops
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42. Carlos Hernández-Chulde, Ramon Casellas, Ricardo Martínez, Ricard Vilalta and Raul Muñoz. "Experimental Validation of an Efficient DRL-based Routing and Spectrum Assignment for Optical Network Automation" (IEEE ICTON 2024) lug-24, https://icton2024.fbk.eu/home
43. C. de Quinto, A. Navarro, G. Otero, N. Koneva, J. A. Hernández, M. Quagliotti, A. Sánchez-Macián, F. Arpanaei, P. Reviriego, O. Gonzalez de Dios, J. M. Rivas-Moscoso, E. Riccardi, D. Larrabeiti. "On the impact of VR/AR applications on optical transport networks: First experiments with Meta Quest 3 gaming and conferencing applications" (IEEE ICTON 2024) lug-24, https://icton2024.fbk.eu/home
44. F. Arpanaei, C. Natalino, M. Ranjbar Zefreh, S. Yan, H. Rabbani, Maite Brandt-Pearce, J.P. Fernandez-Palacios, J.M. Rivas-Moscoso, O. Gonzalez de Dios, J.A. Hernandez, A. Sanchez-Macián, D. Larrabeiti, P. Monti. "Analyzing Ultra-Low Inter-Core Crosstalk Fibers in Band and Space Division Multiplexing EONs" (NOF 2024) ott-24, https://nof.dnac.org/
45. Piero Castoldi, Filippo Cugini, Alessio Giorgetti, Francesco Paolucci, Anna Lina Ruscelli, Nicola Sambo, Andrea Sgambelluri, Luca Valcarenghi. "Control of Optical Networks: a Reality Check and Future Perspective" (ECOC) Sept 2024.
46. Filippo Cugini, Rana Abu Bakar, Andrea Sgambelluri, Nicola Sambo, Lorenzo De Marinis, Alessio Giorgetti, Piero Castoldi, Juan Jose Vegas Olmos, Francesco Paolucci. "Data Processing Unit (DPU) and P4 Programmability in Support of the Edge Continuum" (ECOC) Sept 2024.
47. N. Sambo, F. Cugini, L. De Marinis, P. Castoldi. "Solutions to Increase Energy Efficiency of Optical Networks" (OFC 2024)
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49. Margita Radovic, Andrea Sgambelluri, Filippo Cugini, Nicola Sambo. "Multicarrier Transmission Optimization in Elastic Optical Networks" (ICTON 2024) July-24, https://icton2024.fbk.eu/home

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51. M. Hosseini, J. Pedro, and A. Napoli. “Design of Horseshoe Networks with Low-Loss Filterless Nodes and Point-to-Multipoint Transceivers” (IEEE Summer Topical)
52. Carlos Castro, Jacqueline Sime, Tobias Eriksson, M. Sezer Erkilinc, Mario Porrega, Joao Pedro, Marco Quagliotti, Emilio Riccardi, Chris Fludger, Antonio Napoli."Power and Spectral Savings in Metro-Aggregation Networks Exploiting Coherent Point-to-Multipoint Transceivers" (ECOC) Sept 2024.
53. André Souza, Nelson Costa, Laia Nadal, Ramon Casellas, Antonio Melgar, José Manuel Rivas-Moscoso, Marco Quagliotti, Emilio Riccardi, Antonio Napoli, João Pedro. “Node Architectures for High-Capacity Multi-band Over Space Division Multiplexed (MBoSDM) Optical Networks” (ICTON 2024) July-24.
54. Matheus Ribeiro Sena, Robert Emmerich, Behnam Shariati, Ralf-Peter Braun, Marc Geitz, Johannes Karl Fischer, Ronald Freund. “Link Tomography: A Tool for Monitoring Optical Network and Designing Digital Twins” (ECOC) Sept 2024.
55. Ehsan Etezadi, Farhad Arpanaei, Carlos Natalino, Erik Agrell, Lena Wosinska, Paolo Monti, David Larrabeiti, Marija Furdek. “Joint Fragmentation-and QoT-Aware RBMSA in Dynamic Multi-Band Elastic Optical Networks” (ICTON 2024) July -24, https://ieeexplore.ieee.org/abstract/document/10648045
56. M. Hosseini, Joao Pedro, Antonio Napoli. “Availability Analysis of Filterless P2MP Horseshoe Networks under Load Shedding” (HPSR).
57. M. Hosseini, Joao Pedro, Carlos Castro, Antonio Napoli. “Design of Scalable Filterless Horseshoe-and-Spur Networks” (ICTON).
58. M. Hosseini, Joao Pedro, Johan Back, Ronald Moorcroft, Antonio Napoli. “Load Shedding Resilient Filterless Horseshoe Networks with Point-to-Multipoint Transceivers” (IEEE Globecom)
59. M. Hosseini, Joao Pedro, Antonio Napoli. “Launch Power Control for Digital Subcarrier Equalization in Filterless Optical Networks” (softCOM).
60. M. Mehrabi, F. Arpanaei, M. Ranjbar Zefreh, H. Beyranvand, M. Javad Emadi, P. Mahdizadeh, C. Natalino, José M. Rivas-Moscoso, O. Gonzalez de Dios, Juan P. Fernández-Palacios, D. Larrabeiti, and J.Alberto Hernandez. “Comparative Analysis of EGGN vs. GGN Models for Hybrid Raman/DFA Amplified Ultra-Wideband Optical Networks” (OFC 2025)
61. João Pedro, André Souza. “Impact of Channel Provisioning Strategies in the Transient Resiliency of SuperC+L-band Networks” () Nov-24.
62. S. Ghasrizadeh, P. Khare, M. Ruiz, L. Velasco. “Using the OCATA Digital Twin to Improve QoT of Optical Connections in Multiband Optical Networks” Proc. International Conference on Optical Network Design and Modelling
63. A. Pacini et al. "Hierarchical Software-Defined Control for coordinated RAN and PON-based Transport Scaling", (NOMS-2024) IEEE Network Operations and Management Symposium, Seoul, Korea, Republic of, 2024

2.1.2. Organization of events: Workshops, tutorials, summer schools and demos

SEASON also organizes various events to complement the project's dissemination activities. Yearly workshops have been organized either co-located at well-known conference venues (e.g., ECOC, OFC, EuCNC) or organized as separate events. Tutorials and summer schools were organized to reach out to early-stage researchers as well as the scientific community.

Table 2: Planning of events

Planned organizational events	Month	Goal of the event
Publication in selected peer-reviewed Journals	M10, M22, M32	Communicating SEASON's concepts, goals, and ambitions
Presentation and publication at selected scientific conferences/workshops	M12, M24, M36	Educating the scientific community with technological development within SEASON.
Participation at industry conference/workshops/events	M28, M36	Real-time demonstration of SEASON's technology.

2.1.2.1. Year 1

During the project's initial year, the following events were organized.

Organization of workshops:

- Workshop on Women in Telecommunications (WeInTel), collocated with the IEEE International Conference on Transparent Optical Networks (ICTON) 2023.

Figure 3: WeInTel Workshop 2023

- Workshop on Beyond-5G Network Operation (B5GNeO) collocated with the IEEE

International Conference on Transparent Optical Networks (ICTON) 2023

- Co-organization of EUCNC Special Session, “Novel technologies in disaggregated packet-optical networks to support 6G”, Gothenburg June 2023

2.1.2.2. Year 2

During the project's second year, the following events were organized.

- Workshop on Women in Telecommunications (WeInTel), collocated with the IEEE International Conference on Transparent Optical Networks (ICTON) 2024.

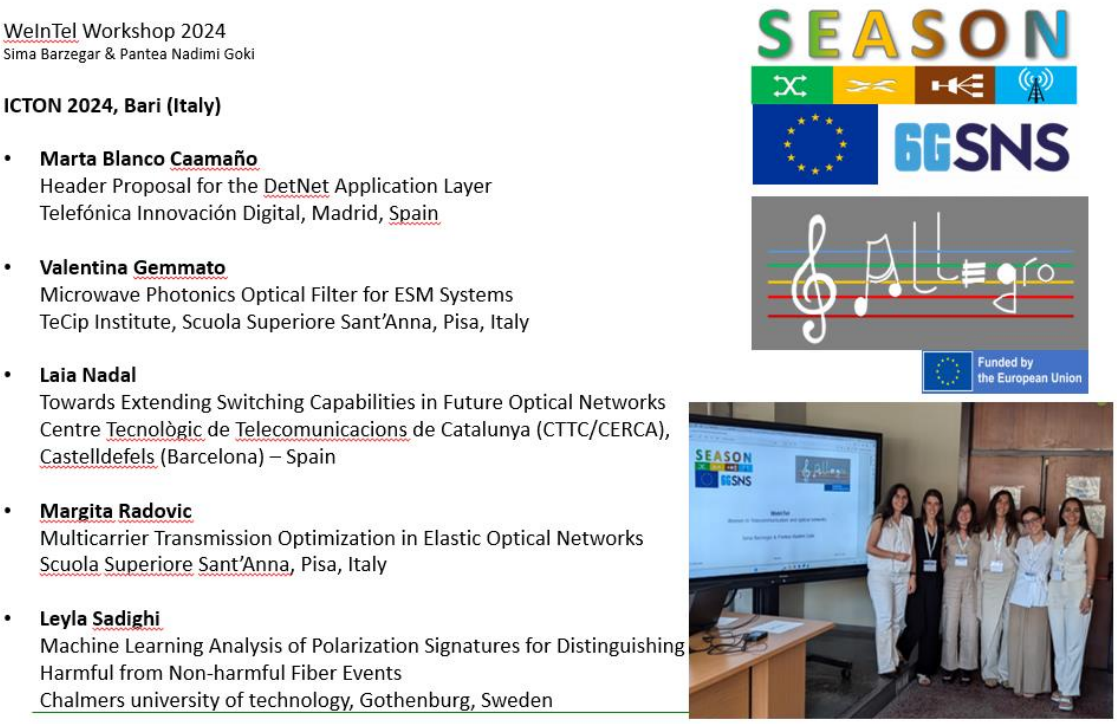


Figure 4: WeInTel Workshop 2024

- Luis Velasco, Ramon Casellas, Francesco Paolucci. (ICTON Demo Zone) July 2024, https://icton2024.fbk.eu/icton-demo-zone
- Luis Velasco, Workshop on 6G Network Operation (6GNeO) collocated with the IEEE International Conference on Transparent Optical Networks (ICTON) 2024
- Luis Velasco, “Security in Classical Optical Communications and Quantum technologies” (ONDM 2024) may-24, https://ondm2024.uc3m.es/program/workshops
- Lecture at Seasonal School “ARTIST - Pervasive ARTIficial Intelligence for Next-G Softwarized neTworks”, by F. Cugini (CNIT) on Disaggregated Optical Networks, 4 march 2024
- Ramon Casellas, Ricardo Martinez, Ricard Vilalta, Raul Muñoz, “SDN Control of Multi-band over SDM Optical Networks with physical impairments” TUTORIAL at OFC’24 in San Diego, 2024

- Behnam Shariati, "What Can Digital Twins Fueled with Generative AI Offer to Optical Networks." WS5 at ECOC 2024

2.1.3. Coordination with other projects

SEASON participates actively in the following SNS JU Coordination WGs:

- Steering Board (SB)
- Technical Board (TB)
- Communication Task Force

Participation in the following SNS JU WGs:

- Pre-Standardization
- Women in Telecommunications and Research (WiTaR)
- Hardware Technologies WG
- SME
- Vision and Societal Challenges
- 6G Architecture
- Test, Measurement and KPIs
- Participation in the Open SNS WG
- Sustainability
- Software Network

Specific activities:

- Phase 1 Projects questionnaire
- AI/ML questionnaire
- Sustainability questionnaire
- Vertical Engagement Tracker

Figure 5: SEASON in JU 6GSNS

Dissemination Level	SEN (Sensitive - limited under the conditions of the Grant Agreement)

2.1.3.1. Year 1

- Joint meeting between SEASON and FLEX-SCALE projects, 2hours, Pisa, June 2023
- ALLEGRO: Co-organization of Women In telecommunication (WInTel) workshop during ICTON 2023

2.1.3.2. Year 2

- DESIRE-6G: Common experimental for RAN and Transport
- ALLEGRO: Comparison of OCATA and GNPy Optical layer Digital Twins
- ALLEGRO: Co-organization of Women In telecommunication (WInTel) workshop during ICTON 2024
- B5G-OPEN: Joint experiments

2.2. COMMUNICATION ACTIVITIES

Communication activities in SEASON were initiated early in the project in order to promote the project findings to relevant audiences. Based on the impact of the communication activities, the partners regularly update their strategy as appropriate.

Table 3: Planning of communication activities

Activity	Results
Project website https://www.season-project.eu/	Published. Project website is populated with the basic information of SEASON project such as its concept, technical objectives, communication leaflets, public deliverables and consortium info.
Project Portfolio	MS TEAMS repository, project logo and templates for deliverables and milestones have been created. Quality management procedures have been defined (see Milestone MS1.1, Task 1.3)
Social media	Project accounts at Twitter, and Instagram have been created. (See Milestone MS1.1, Task1.3]

Table 4: Communication KPIs

Communication Activity	KPIs	Achieved Year 1	Achieved Year 2
Project website	>10,000 unique visitors, ~2 minutes average duration of visit, >20,000-page views.	3,828 unique visitors, 10,521 views	4,812 unique visitors, 50,946 page views

Socials	>1000 accumulative followers, >250 interactions, >1000 accumulative posts, >10 videos, >6 news on EC events.	120 followers 1400 iterations 90 posts 6931 impressions 12 videos	220 followers 2100 iterations 193 posts 15,228 impressions 18 videos

2.2.1. Project logo

Figure 6 shows the SEASON Project logo.

Figure 6: SEASON logo

2.2.2. Project website and social media

Figure 7, below, shows the SEASON Project website. Figure 8 (page views) and *Figure 9* (new visits) show the SEASON website statistics during Year 2.

The project has created its own account in the major social media portals:

- LinkedIn: horizon-sns-season (https://www.linkedin.com/company/horizon-sns-season/)
- X: @HorizonSeason (https://x.com/HorizonSeason)
- Instagram: @horizonsnsseason (https://www.instagram.com/horizonsnsseason/)
- YouTube: @Horizon SNS Season (https://www.youtube.com/@SNS_Season/videos)

Figure 10 shows the SEASON YouTube Channel, where partners explain their activities in the project.

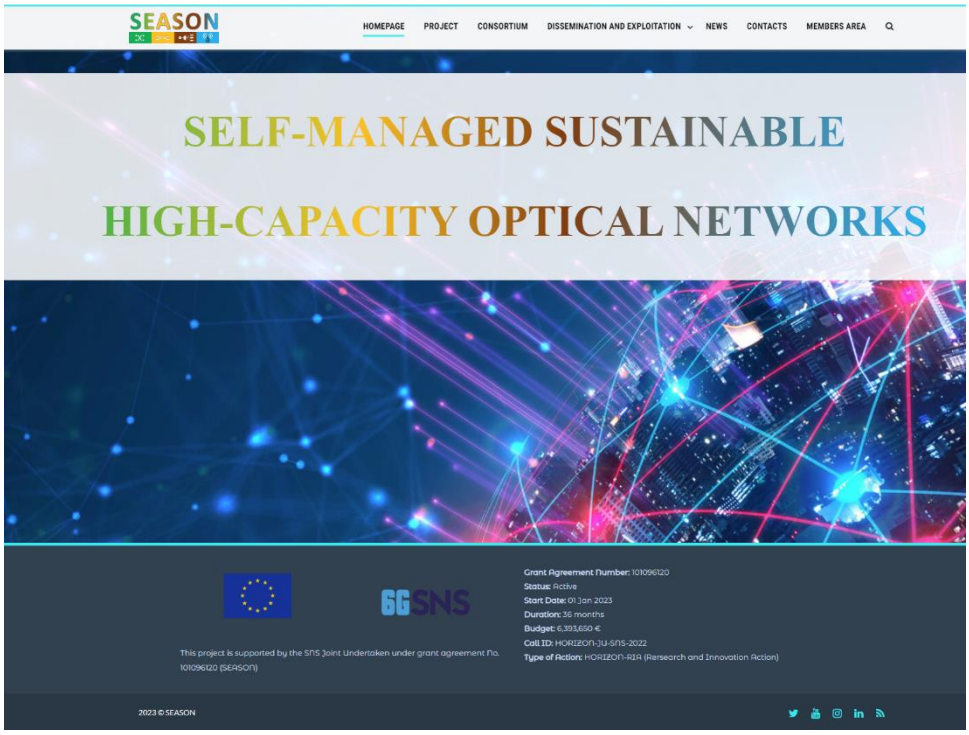


Figure 7: Home page of the SEASON website https://www.season-project.eu/

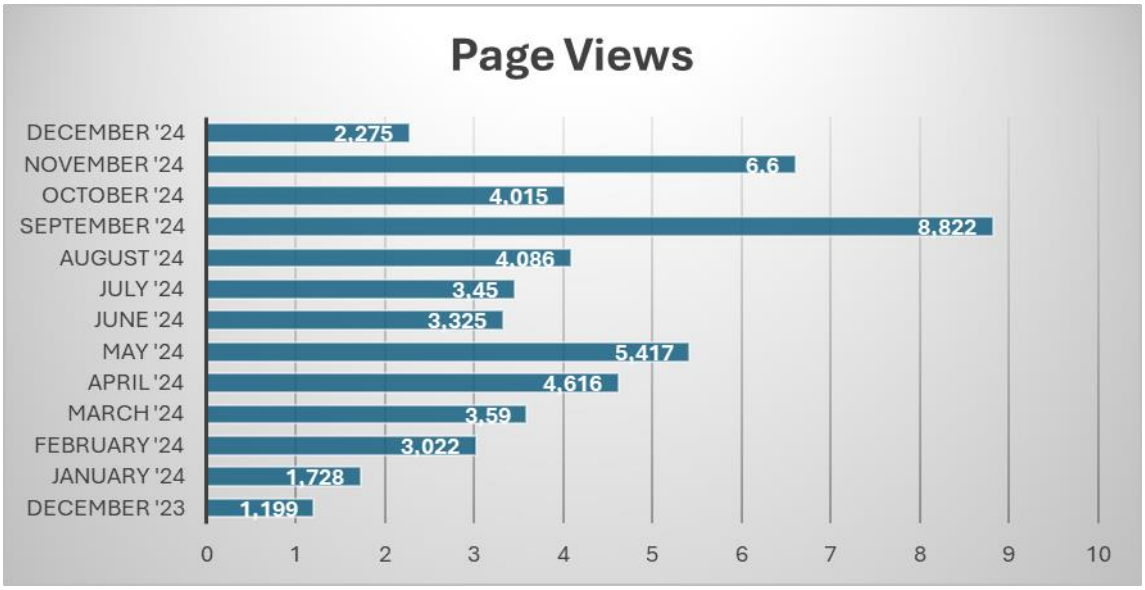


Figure 8: SEASON website statistics during Year 2 (page views)

Dissemination Level	SEN (Sensitive - limited under the conditions of the Grant Agreement)

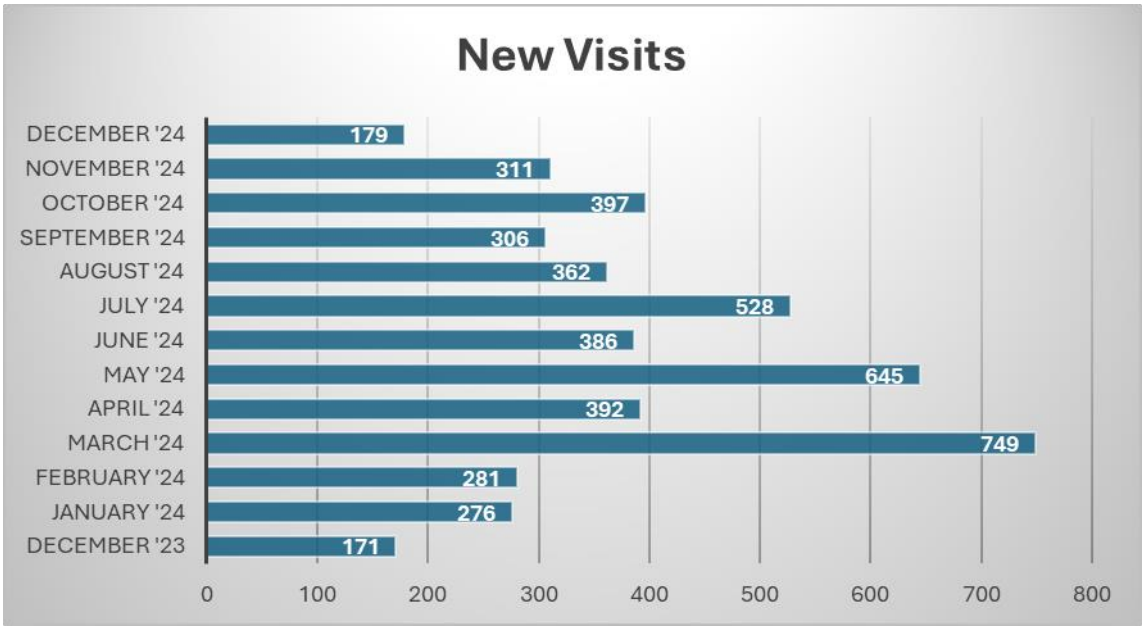


Figure 9: SEASON website statistics during Year 2 (new visits).

Dissemination Level	SEN (Sensitive - limited under the conditions of the Grant Agreement)

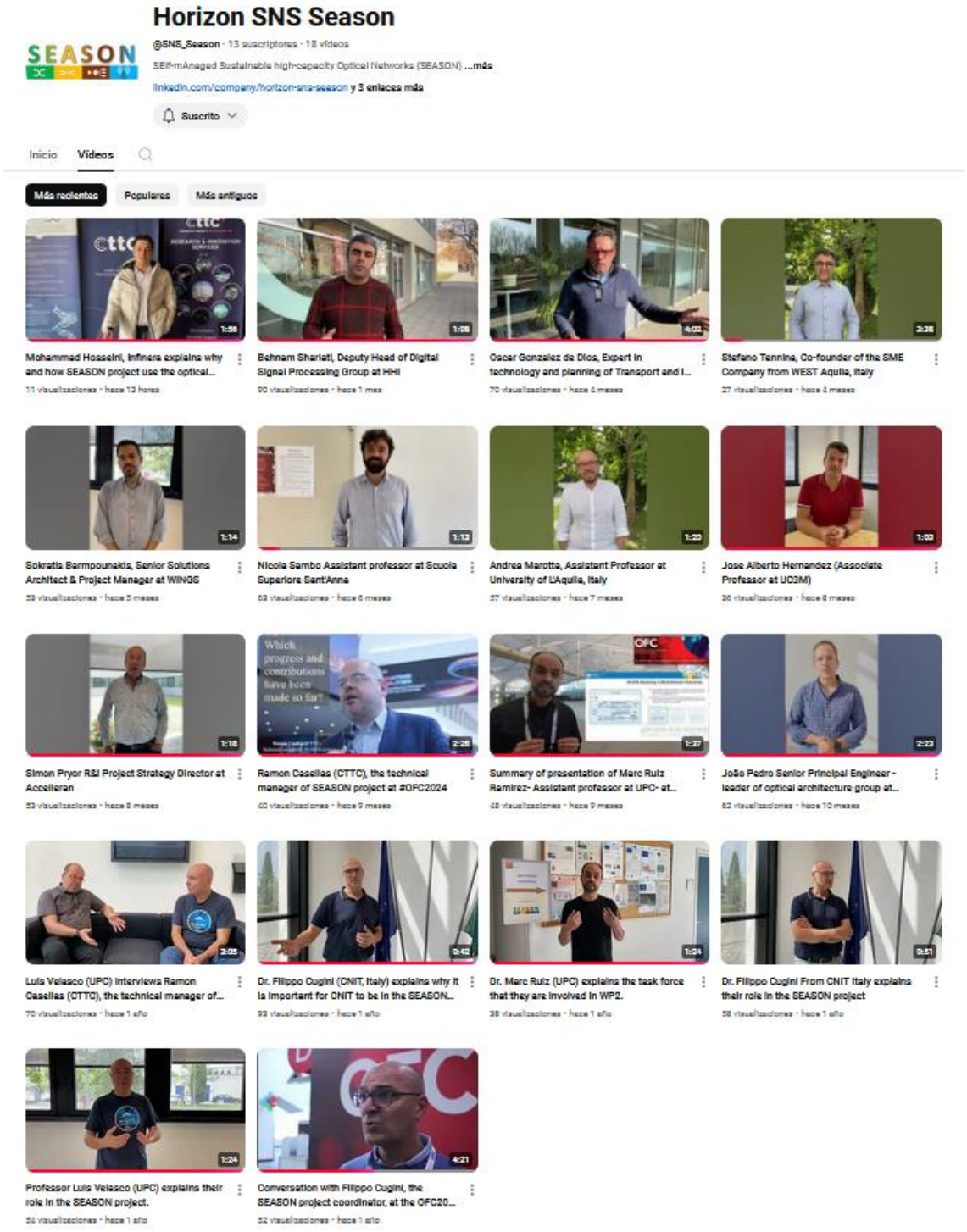


Figure 10: SEASON YouTube channel.

2.2.3. Podcasts generated with AI

NotebookLM from Google (http://notebooklm.google.com) can now read PDF files and generate Podcast interviews about their contents. We plan to use this technology to generate summaries of published works to complement project communication.

Dissemination Level	SEN (Sensitive - limited under the conditions of the Grant Agreement)

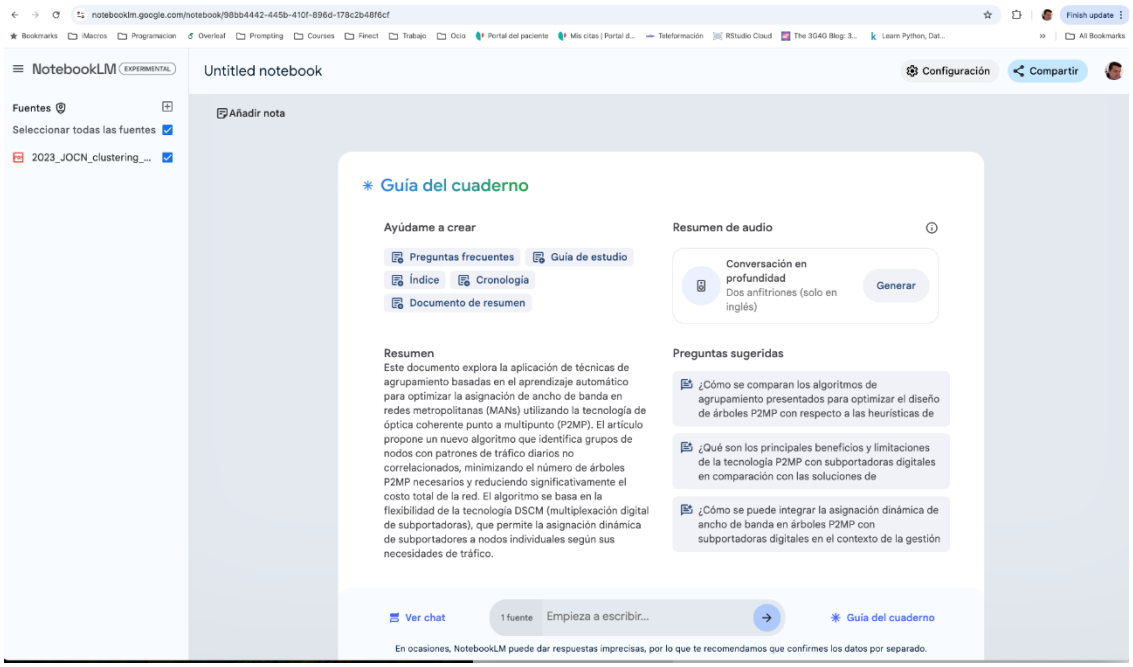


Figure 11: Example of Podcast generated using NotebookLM

2.2.4. Other communication activities

2.2.4.1. Year 1

- Given its role of Technical Manager, during the first year of the project, CTTC communication and dissemination activities focused primarily on raising project awareness in events and workshops. This included, for example, presenting SEASON in the ETSI standards conference, (February 2023), ONDM (Coimbra, 2023) as well as participating in the Technical Board meetings of the SNS program. CTTC contributed to social media commenting in SEASON related posts, sharing posts and insight and contributing to the overall optical networking ecosystem.
  CTTC contributed to the Special Session proposal that was submitted to EuCNC. From the point of view of scientific and technical publications, CTTC submitted conference and journal papers covering the topics of multiband S-BVT, multi-granular optical node, SDN control plane and AI/ML in support of network operation. Accepted and submitted conference and journal papers are listed in this document.
- During this first year of the project, the communication plan was mainly devoted to internal dissemination and discussing solutions that were under development, with colleagues from the engineering departments in order to understand their applicability in the evolution TIM network. Several collaborations are ongoing with other partners that will end in future contributions to scientific papers and conferences.
- In the 1st year, the objective and scope of the project for ADVA was communicated in Advanced Photonic Congress 2023 in the “Special Programs” Event at the “AI and Digital Twin” workshop session, presented on the topic “Digital Twins in Optical Transport Network”. The scope and ongoing contributions in the project were also

disseminated to internal research teams, during the regular meetings, to discuss on the optimal solutions to improve the work further. The publications associated with the project are updated in Zenodo, and also social media posts are shared/re-posted to increase the project visibility.

- During year 1, Infinera (INF-P and INF-G) focused on the internal communication of the project guiding principles and on potential architectures, aiming to (i) collect useful feedback on the scope of applications of SEASON solutions; and (ii) further refining some of the concepts being investigated in the project. INF-P and INF-G engaged in cooperation with multiple project partners that led to publications in major conferences and journals in the field. Moreover, INF-P and INF-G continued to make more extensive use of social media (e.g., LinkedIn) to disseminate the project findings to a larger audience.
- In Genoa, professionals, experts and industry leaders gathered the 14th and 15th of November 2023 to discuss the future of mobile networks during the 12th edition of the Ericsson R&D Italy Innovation Days.

Figure 12: Ericsson R&D Italy Innovation Days

The program of the two-days event included panels and presentations with the participation of Ericsson customers, technology experts and companies driving the evolutions of 5G mobile networks.

The plenary sessions were interleaved with live demonstrations of innovative prototypes developed by Ericsson researchers, within the three major R&D centres of excellence in Italy: Genoa, Pisa and Pagani. (See: Post | LinkedIn)

Figure 13: Live demonstrations of innovative prototypes during Ericsson R&D Italy Innovation Days

A dedicated space, in the main live demos area, was set-up to highlight the commitment of Ericsson in EU funded projects as part of the innovation program. A set of selected dissemination slides, continuously running on a monitor, highlighted the vision, goals and challenges of the SEASON Project. Dedicated presentations were given to visitors during the demo sessions.

- In this period, the main dissemination activity of WEST related to the preparation and submission of papers in scientific venues, such as conferences and journals.
  During the phases of demo preparation, as per the project proposal, WEST (*i*) participated in EU Researcher's Night in L'Aquila, with a target 300-400 audience of school students, engaging students in a research environment and familiarizing them with EU-funded actions and SEASON activities as well as (*ii*) presenting preliminary demo results from working testbeds in industry attended events or events organized by the EC. The main project's social media channels informed the general public regarding the project's events, activities, and advances.
- Accelleran promoted and credited SEASON at available speaking slots, specifically at the 'IMEC Wireless Community' event on 5/10/2023 (https://www.wirelesscommunity.be/work-meetings/softwarization-and-virtualisation-for-intelligent-wireless-networks/), a Belgian technical forum facilitated by IMEC, where Simon Pryor presented a talk on 'Going green and saving OPEX with 5G Open RAN', where the SEASON next-gen transport networks, with WP4 multi-domain Open RAN RIC intelligence, was discussed and elaborated, within an energy saving context.
  The goal of Accelleran is to further promote and disseminate SEASON at future events and conferences (like EuCNC but also industry events and fora relevant to Open RAN, mindful, at the same time, of Accelleran being an industrial rather than an academic partner). There is growing industry-wide interest in this specific topic of cross-domain integration (of RAN, transport network & core) in the control-plane

towards 6G, especially within an Open RAN context, leveraging the RIC, and ACC considers this an ideal vehicle to promote and position the ACC brand and thought leadership, resulting from the excellent SEASON research to date.

2.2.4.2. Year 2

- In year 2, CNIT presented the SEASON project at the “Internet festival”, an annual event held in Pisa, Italy, focusing on the digital world and its impact on society. The event brings together experts, enthusiasts, and the general public to explore topics such as technology, innovation, and digital culture. CNIT also contributed to social media, sharing posts and insight.
- In order to better communicate the SEASON project activities to future Engineers, at UPC PhD students presented key research topics and provided details on how to become a researcher during master courses. In particular, Sadegh Ghasrizadeh presented the hot topic of network digital twins applied to optical communications in a course on Mathematical Models. To illustrate digital twin applications, Sadegh presented some ideas that SEASON has implemented and requested the students to envision new ones. In addition, Pol González focused his presentation on a different hot topic related to pervasive telemetry data collection and processing in a course on Network Security. Advanced methods for providing robust and secure data and models exchange in distributed environments were discussed with the students. Finally, for undergraduate students, Prof. Marc Ruiz gave a talk in a course on Cybersecurity Management. He highlighted SEASON research as an example enhancing protection of AI-based systems in 6G network environments.

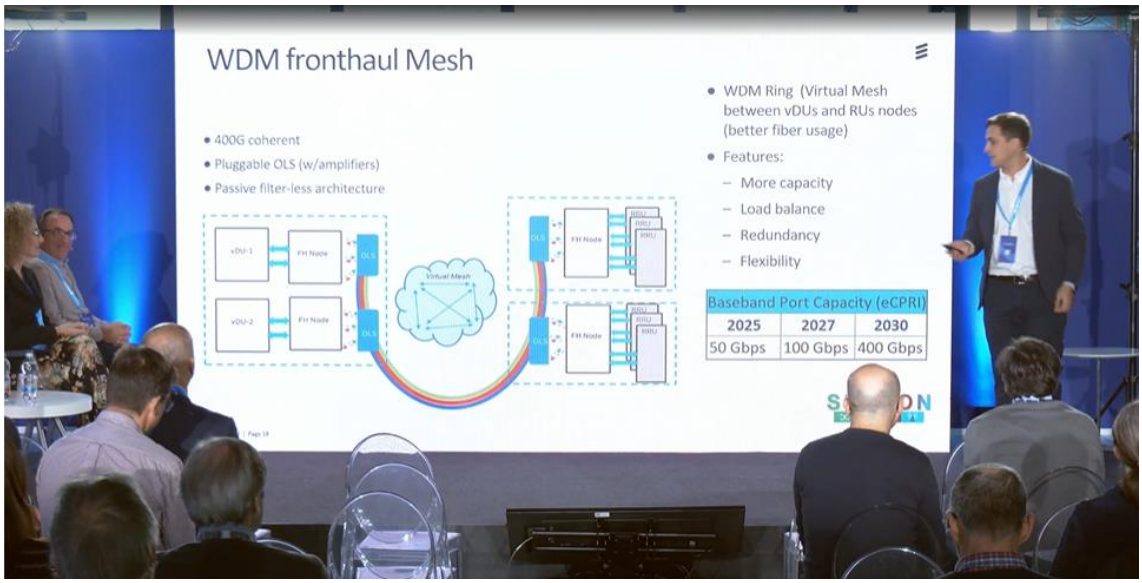
Figure 14: UPC Outreach Activities

Dissemination Level	SEN (Sensitive - limited under the conditions of the Grant Agreement)

- In order to both complement the work on scientific and research papers, and serve as technical manager of SEASON, CTTC has presented the SEASON project in the SNS JU Technical Board, including participating in questionnaires, the SNS journal and contributing with SEASON concepts to the SNS software Networks working group white paper. SEASON has also been presented in invited talks and workshops as well as internal CTTC seminars.
- At Mobihoc 2024's AIoT workshop, WINGS presented the SEASON project during the keynote presentation. WINGS also presented SEASON WP4/WP5 related activities in the SNS JU TMV WG activities, as well as at internal WINGS seminars.
- In 2024, TIM's main dissemination activities were focused on participating jointly with other partners (in particular INF-G, INF-P, CNIT, CTTC, UC3M and TID) in the drafting and submission of papers to conferences and journals. A list of accepted and published papers is presented in subsection 2.2.1. In June 2024 TIM delivered a seminar at the University of Pavia entitled " Wavelength Switching Technologies and Coherent Systems Design in Photonic Networks". This was partially supported by the SEASON project and with contents related in part to activities ongoing in the SEASON project. Internally, TIM has disseminated the project results at internal meetings attended by colleagues from the Network Engineering Department, that were looking for solutions to address capacity expansion and networking efficiency in deployed networks.
- In Year 2, TID engaged in comprehensive dissemination activities, collaborating with partners such as UC3M, CTTC, and CNIT to draft and submit papers to prestigious conferences and journals. Works that were accepted and published are detailed in subsection 2.2.1. Furthermore, TID actively participated in standardization efforts, contributing to TIP MANTRA, OpenConfig, and TeraflowSDN initiatives alongside partners like CTTC and CNIT. These collaborative endeavours aimed to advance industry standards and promote innovation in telecommunications and network technologies.
- In 2024, ADVA/ADTRAN gave a presentation about SEASON at the ECOC Conference and at the FONDAC 2024 workshop organized by the Universität der Bundeswehr in Munich. Additionally, papers on demonstrations were presented and submitted to the ECOC 2024, CNSM 2024 and OFC 2025 conferences. ADTRAN also contributed by communicating about the project by sharing posts in social media.
- As in 2023, the primary dissemination activities of WEST in 2024 were focused on the preparation and submission of papers in scientific venues, such as conferences and journals. The preliminary activities for setting up the project's demo are under evaluation for the possibility of showing the potential of the project outcomes with using portable devices in local events, including, but not limited to, the afore mentioned EU Researcher's Night, in L'Aquila.
- In 2024, HHI co-organized a well-attended workshop at ECOC 2024 entitled "WORKSHOP 5: WHAT CAN DIGITAL TWINS FUELED WITH GENERATIVE AI OFFER TO OPTICAL NETWORKS?". Several other SEASON partners, including

CTTC and ADTRAN also presented their work at the workshop. HHI also presented the activities of the project within ETSI ISG F5G group.

- On November 14th and 15th, 2024, during the 13th edition of the Ericsson R&D Italy Innovation Days, Genoa hosted a gathering of professionals, experts, and industry leaders to delve into the future of mobile networks. The event spanned two days and featured an array of panels and presentations, including contributions from Ericsson's customers, technology innovators, and companies at the forefront of 5G mobile network development. Plenary sessions were enriched with live demonstrations of state-of-the-art prototypes created by Ericsson from the company's three principal R&D centres of excellence in Italy: Genoa, Pisa, and Pagani. In the main area dedicated to live demos, a special space was established to highlight Ericsson's dedication to EU-funded projects as a facet of its innovation program. A continuous loop of selected slides showcased the vision, objectives, and challenges of the SEASON Project, and visitors were provided with tailored presentations during the demonstration sessions.



3. STANDARDIZATION - INITIAL PLAN AND ACTIVITIES

3.1. TARGETS FOR STANDARDIZATION

Standardization is a key target for the SEASON project, and many aspects of SEASON developments are subject to active standardization. The list of targeted standardization activities is compiled below.

Table 5: List of target standardization activities

SDO / Open-Source Project	Target direction for standardization	Partners
ETSI OSM	Integration of ETSI OSM with transport SDN with the development of OSM plugins to interwork with the TAPI North Bound Interface of Transport SDN controllers, to dynamically provision end to end connectivity services.	CTTC, TID
ETSI ISG F5G	Align with the ETSI Industry Specification Group on 5th generation fixed network, to support three main features: full-fibre connection (FFC), enhanced fixed broadband (eFBB) and guaranteed reliable experience (GRE). CTTC, HHI and TID are members of the ETSI ISG	CTTC, HHI, TID
ETSI ZSM / ENI	Provision of information regarding the orientation of the project, architecture elements, results from PoC	WINGS
IETF/IRTF	Interaction with research groups working on network management and related algorithms and operations WG (e.g., OPSAWG).	WINGS, TID
ITU-T	Contribute to ITU-T Focus Group on “Environmental Efficiency for Artificial Intelligence and other Emerging Technologies” (FG-AI4EE) with SEASON innovation on energy efficiency SDM Optical Access. Contribute to ITU-T SG15 Q2 “Optical systems for fibre access networks”	WEST, TIM
5G-PPP TMV WG	Contributions related to Test, Measurement, and KPIs Validation for validating technology performance.	WINGS
OIF	Contribution to PLL WG MANAGEMENT TRACK for pluggable interface management using CMIS interface and Network Operator (NetOp) WG	TID
ONF ODTN/ ONOS	ONOS SDN Controller and open data models to control (1) disaggregated Multi-band over SDM infrastructure, (2) innovative computing nodes and DPU/smartNICs equipped with coherent pluggables for edge-to-cloud power-efficient interconnections.	CNIT. CTTC, ADVA
ONF OTCC	Development of TAPI NBI. Improvement of the photonic media layer, with focus on the modelling of physical	CTTC, TID,

	layer impairments, provisioning of services B100G, new cases related to Path Computation, Alarm Management and OAM, based on successive refinements over the TAPI 2.3 version. Develop transport SDN use cases to be fed to for a, such as TIP.	ADVA
Open Config	Development of data modes and Manifest files in support of Optical Transport devices such as transponders.	TID
OpenROADM	Optical and YANG data models interoperability specifications of ROADM switch as well as transponders and pluggable optics.	TIM, INF-G/P
ORAN	Submission of results of integration of optical transport SDN controllers with SMO and Near-RT RIC for potential O-RAN standard evolution (WG1, WG3, WG4, WG9	ACC
TIP MANTRA	Development of PoC and demonstrations in the TIP Metaverse ready Architectures for Open Transport (MANTRA) subgroup, to demonstrate unified SDN control and management of the disaggregated, multi-vendor components within an open optical network: Open Line System (OLS), Open Terminals (OTs) and Optical Planning tools, in view of the Multi-vendor integration and service operations were achieved through open standard models and APIs supported by the Optical SDN Controller, including OpenConfig, Transport-API (TAPI) and Open REST	TID
TIP MUST	Development of Transport SDN Use Cases in sub-group within the Open Optical & Packet Transport project group, called MUST (Mandatory Use Case Requirements for SDN for Transport). The main objective is to accelerate and drive the adoption of SDN standards for IP/MPLS, Optical and Microwave transport technologies	TID, CTTC, TIM
OpenXR Optics Forum	Contribute with scientific works and standard proposals towards enabling the deployment of P2P & P2MP smart transceivers.	TID, TIM, INF-G/P

3.2. ACTIVITIES

TeraflowSDN

- CTTC is leading the effort on ETSI TFS and managing the overall community. TFS is being used by several projects in the SNS umbrella, such as SEASON, FLEXSCALE, PROTEUS-6G and ACROSS. SEASON is contributing to the TeraflowSDN ecosystem in aspects such as network orchestration and IP control.

- TID and ADTRAN are members of the Technical Committee.
- TID and CNIT are contributing to the TeraflowSDN ecosystem in aspects such as network orchestration, IP control and Coherent Pluggable Control.

Table 6: Contributions to TFS

Contribution	**Link to contribution**
Create IP link with supporting coherent pluggable	https://labs.etsi.org/rep/tfs/controller/-/merge_requests/239
Multi-vendor Openconfig driver	https://labs.etsi.org/rep/tfs/controller/-/merge_requests/104
Enhancement of Openconfig driver	https://labs.etsi.org/rep/tfs/controller/-/merge_requests/162
Expose Device inventory via NBI	https://labs.etsi.org/rep/tfs/controller/-/merge_requests/237
ZR + Pluggable control	https://labs.etsi.org/rep/tfs/controller/-/tree/cnit_related_activity?ref_type=heads

ETSI F5G.

- CTTC has been contributing to the F5G ETSI ISG in several ways. CTTC has been participating in the technical meetings and standardization meetings, characterizing the evolution of F5G advanced. CTTC has organized and contributed to F5G workshops and talks, such as NGON / NetworkX talk on “ETSI: Evolving Towards F5G-Advanced for Green 10Gbps Everywhere”, by Dr. Raul Muñoz.

ETSI OSM

- Given the relative maturity of ETSI Open-Source Mano (OSM), the contributions to OSM are targeted, and these include making sure that the OSM releases can be integrated with the TFS SDN controller and minor changes to the underlying framework. CTTC contributes to hackfests and coordinated events in support of Open Source.

SDN Controller

- CNIT was initially planning to use and improve the ONOS SDN Controller to control disaggregated Multi-band over SDM infrastructure as well as innovative computing nodes and DPU/smartNICs equipped with coherent pluggables for edge-to-cloud power-efficient interconnections. However, during the early phase of the project, the SEASON Consortium agreed that ONOS is not the ideal open-source SDN platform to perform the required technical activities. Instead, the ETSI TeraFlow (TFS) SDN Controller has been identified as the preferred SEASON Platform to be used as SDN Controller. During Year 1 multiple

enhancements to TFS have started and are progressing well. Such enhancements will be released as open-source when adequately tested (e.g., during Year 3 of the Project).

- Similarly, CTTC is not contributing to the ONOS SDN Controller after recent changes in organization. Priorities have been shifted to either contribute to TeraflowSDN or, in the specific case of optical control, rely in its own proprietary software.

TIP MANTRA (Metaverse ready Architectures for Open Transport).

- Development of PoC and demonstrations in the TIP MANTRA subgroup. SEASON IPoWDM control candidate to be used in MATRA PoC for 2025

TIP MUST (Mandatory Use Case Requirements for SDN for Transport).

- Telefonica (with contributions and collaboration from CTTC) has been contributing to TIP MUST, mostly in topics related to the adoption of Transport SDN from the perspective of network operators, consolidating use cases and raising awareness of TeraflowSDN as a reference platform.
- The main objective is to accelerate and drive the adoption of SDN standards for IP/MPLS, Optical and Microwave transport technologies

OpenROADM.

- TIM held the role of chairperson of the consortium from October 2022 until September 2023; during this period, YANG models releases 12.1, 13.0 and 13.1 14.0 have been published.

  Within the SEASON Project an OpenROADM agent developed by TIM complied to R12.1, has been updated for the management of external pluggable transceivers.

OpenROADM.

- Development of data modes and Manifest files in support of Optical Transport devices such as transponders. TID attends to weekly calls reviewing and contributing.

Table 7: Contributions to OpenROADM

Contribution	Link to contribution
Update openconfig transport types	https://github.com/openconfig/public/pull/1011

Linux Foundations ONMI (former ONF)

- CTTC, as a member of the Technical Steering Team (TST), contributes to the TAPI releases 2.4 and 2.5 having served as editor of the TR-547 on Reference Implementation Agreement. Refinement of TAPI RIA use cases. Initial considerations for the migration towards TAPI 2.5 or 2.6

- Improvement of the photonic media layer, with focus on the modelling of physical layer impairments, provisioning of services B100G, new cases related to Path Computation, Alarm Management and OAM, based on successive refinements over the TAPI 2.3 version.
- Attending meetings, reviewing implementation agreements and refinements. Ongoing work to be published in next version.
- Contributions by CTTC, ADVA, TID

O-RAN.

- Submission of results of integration of optical transport SDN controllers with SMO and Near-RT RIC for potential O-RAN standard evolution (WG1, WG3, WG4, WG9. ACCELERAN is closely following the standard to ensure SEASON is aligned in terms of RAN-Optical transport integration.

IETF.

- Standardization of use case and architecture for the control of IP – optical network with coherent plugglables.
- Presentation of multiple drafts in IETF meeting
- Currently, the SEASON ACKed draft is candidate for working group adoption

Table 8: Contributions to IETF

Contribution	Link to contribution
Applicability of Abstraction and Control	https://datatracker.ietf.org/doc/html/draft-poidt-ccamp-actn-poi-pluggable
Use cases, Network Scenarios and gap analysis for Packet Optical Integration (POI) with coherent pluggables under ACTN Framework	https://datatracker.ietf.org/doc/draft-poidt-ccamp-actn-poi-pluggable-usecases-gaps/

OpenXR.

Telefónica and CTTC have done several presentations

4. EXPLOITATION

4.1. STRENGTHS, WEAKNESSES, OPPORTUNITIES, THREATS

The project has carried out strategic analysis of the strengths, weaknesses, opportunities, and threats related to:

- Innovation and Technological Advancement
- Sustainable and Efficient Network Solutions
- Market Impact and Capacity Building

Figure 14, Figure 15, and Figure 16 show the summary of the SWOT analysis.

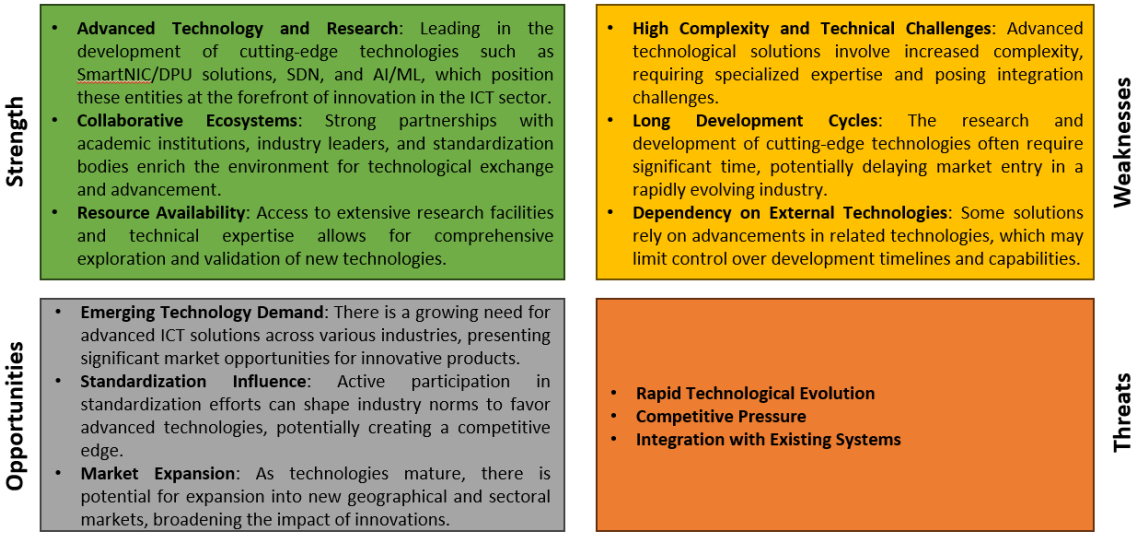


Figure 14 Innovation and Technological Advancement

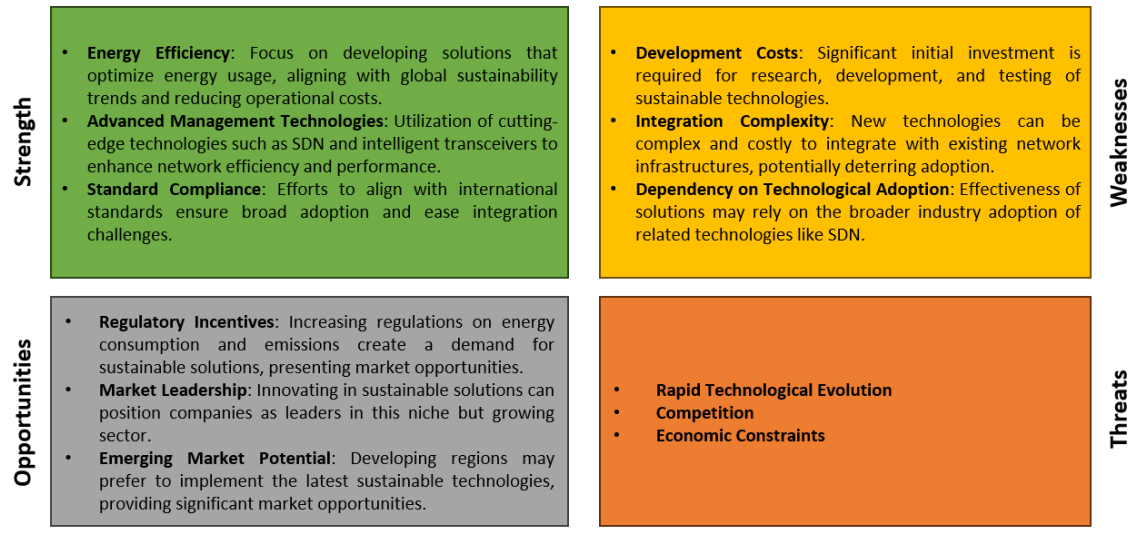


Figure 15 Sustainable and Efficient Network Solutions

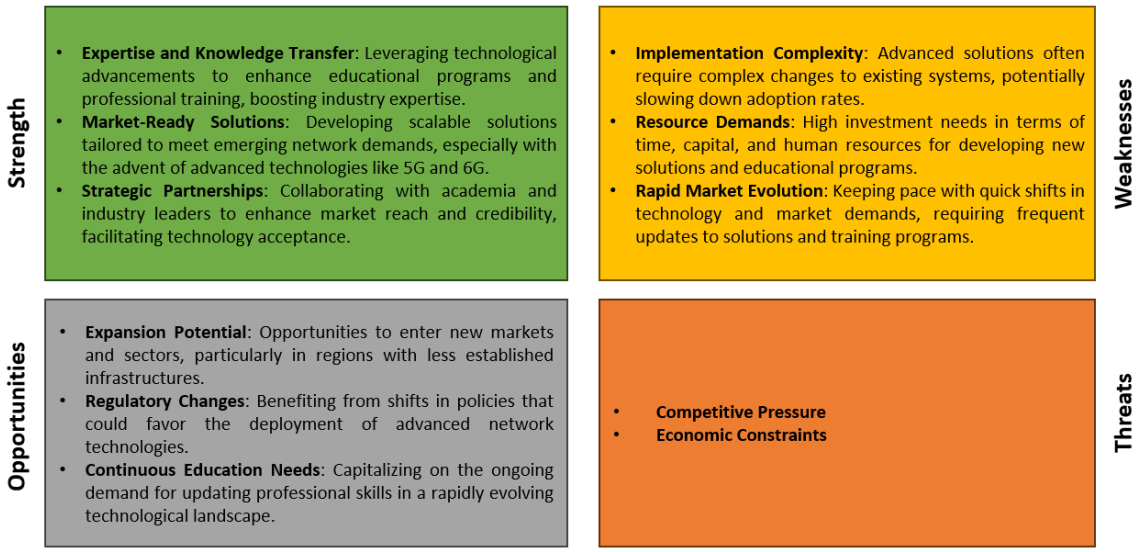


Figure 16 Market Impact and Capacity Building

4.2. INNOVATION QUESTIONNAIRE

The questionnaire was prepared to show how the innovation is connected with the SEASON project. The questionnaire identified each innovation as follows:

Intellectual property of the innovation:

- Technical Readiness Level (TRL) before
- Asset type
- TRL expected
- Business mode
- Description

Main features

- Intellectual property / License scheme?
- Market segment which your asset is targeting
- Roadmap
- Expected Achievements
- Capability / technology gap addressed
- How does this move beyond state of the art

In this deliverable, we report the identified innovations and the evolution of the TRL level before and after the conclusion of SEASON (see Table 9).

Table 9: Identified innovations

Innovation aspect	**TR level (Current –> Expected)**

DPUs loaded with pluggable optical transceivers to offer joint network and computational functionalities.	*2->5*
Teraflow SDN Controller for openconfig-based control of IP and optical resources (i.e., coherent transceivers).	*3->5*
ROADM-based control of coherent transceivers	*2->5*
MB(oSDM) sliceable bandwidth/bitrate variable transceiver (S-BVT)	*2->4*
MBoSDM node	*2->4*
Multi-band Optical Power Consumption Models and Energy-Efficient ML-enabled Algorithms to assist SDN control operations	*2->4*
SDN Controller for multi-band flexi-grid over SDM networks	*2->4*
Advanced Sustainable AI/ML solutions for SDN-controller multi-band/SDM transport networks	*2->4*
Telemetry Agent	*3->4*
Optical Network Digital Twin	*2->3*
NetDevOps based telemetry streaming and network management	*1->3*
OCATA Digital Twin	*2->4*
Dynamic bandwidth allocation optimization software based on a point-to-multipoint transmission scheme	*2->3*
Power Optimization on Multi-band Systems Using Multi-Objective Genetic Algorithm	*2->3*
SDM-PON	*2->4*
REST Controller for Optical Access Networks	*4->5*
XR system with computation at the Edge	*4->5*
The integration of Near-RT RIC with optical transport SDN controllers.	*3->4*
AI/ML-powered Service/Application-component orchestration	*2->3/4*
E2E 5G lab continuously updated with latest Ericsson Radio, Baseband and RAN Transport Solutions	*2->4*

Industrial collaboration and technology transfer to P2MP technology	*3->5*

5. GLOSSARY

Acronym	Description
B5GNeO	Workshop on 6G Network Operation
DPU	Data Processing Units
ECOC	European Conference on Optical Communication
eFBB	enhanced fixed broadband
EuCNC	European Conference on Networks and Communications
FFC	Full-fibre connection
FG-AI4EE	Focus Group on Environmental Efficiency for Artificial Intelligence and other Emerging Technologies
GLOBECOM	Global Communications Conference
GRE	Guaranteed reliable experience
ICC	IEEE International Conference on Communications
ICT-DM	Information and Communication Technologies for Disaster Management
ICTON	IEEE International Conference on Transparent Optical Networks
IMOC	International Microwave and Optoelectronics Conference
JOCN	Journal of Optical Communications and Networking
MANTRA	Metaverse ready Architectures for Open Transport (
MUST	Mandatory Use Case Requirements for SDN for Transport
NetSoft	International Conference on Network Softwarization
OFC	Conference on Optical Fiber Communication
OLS	Open Line System
ONDM	IEEE International Conference on Optical Network Design and Modelling
OSM	Open-Source MANO
OT	Open Terminal
PSC	Photonics in Switching and Computing
SB	Steering Board
S-BVT	Sliceable bandwidth/bitrate variable transceiver
SDO	Specification Developing Organizations
TAPI	Transport-API
TB	Technical Board
TST	Technical Steering Team
WeInTel	Women in Telecommunications
WiTaR	Women in Telecommunications and Research