D 1.6 PUBLIC PROGRESS REPORT 1

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History of changes

Version	Date	Comments	Main Authors
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0.2	21/11/2018	Revised version	All the WP leaders
0.3	28/11/2018	Comments	Boffi, Parolari, Martelli (POLIMI)
0.4	29/11/2018	Quality review	Vallan (POLIMI)
1.0	30/11/2018	Final version	Boffi, Parolari (POLIMI)

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EXECUTIVE SUMMARY

The deliverable D1.6 is PASSION first Public progress report.

It includes the publishable summary evidencing the overall objectives of the project, with attention to the work performed and to main results achieved so far. The progress beyond the state of the art, and the expected results and potential impacts, including the socio-economic impact and the wider societal implications, are also described.

The document concludes with the list of achieved deliverables and milestones.

1 SUMMARY FOR PUBLICATION

1.1 SUMMARY OF THE CONTEXT AND OVERALL OBJECTIVES OF THE PROJECT

In the last decade we assisted to a continuous growth of the metro network, but we are now facing a bottleneck in the transmission and routing of the huge amount of data due to the dramatic increase of the number of users, the content size, and to the convergence with mobile and datacom networks. Photonics is a key enabling technology for the evolution of the entire telecommunications infrastructure, supporting increasing bandwidth requirements and quality of service (QoS), but the traditional optical technologies exploited today mainly for long haul transmission are too expensive and power hungry for the future metro network.

The aim of PASSION project is to develop new photonic technologies and devices for supporting sustainable metro networks, capable of enabling target capacities of Tb/s per spatial channel, 100 Tb/s per link and Pb/s per node over a few hundred-kms distances. A new metro network infrastructure is envisioned within the project, fitting the network operator requirements and roadmaps and offering multiple relevant characteristics that include: (i) reduced network cost, energy/power consumption and equipment footprint, that are achieved by the development of compact/cost-effective switching technologies and transmitter (using direct modulated vertical-cavity surface-emitting lasers, VCSELs) and multi-channel coherent receiver modules with dense photonic integration; (ii) increased system flexibility and modularity by the adoption of sliceable bandwidth/bitrate variable transceivers (S-BVTs) with reconfigurable parameters; (iii) increased network and system scalability, programmability and reconfigurability, that are enabled by agile aggregation in the spectrum, polarization and space dimensions and the implementation of a software defined networking (SDN) control platform.

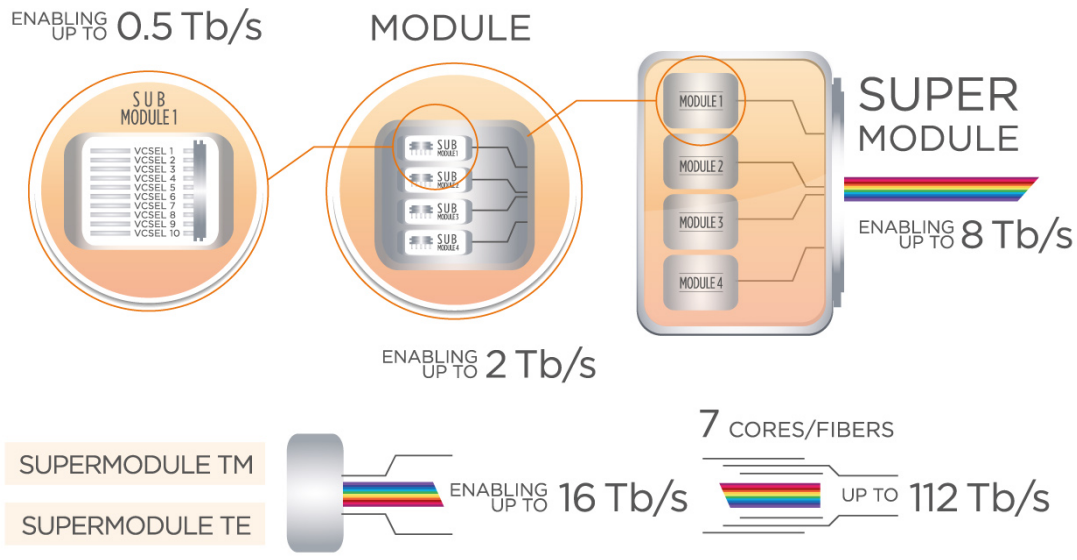

Figure 1. PASSION S-BVT Tx based on the modular approach.

In particular, Figure 1 shows the S-BVT Tx based on the modular approach: the module integrating 40 VCSELs in Silicon photonics capable of enabling up to 2 Tb/s aggregated capacity constitutes the building block of the S-BVT. By combining four of such a module, a full 160-channel Tx supermodule is obtained with 25-GHz granularity over the whole C band and with up to 8 Tb/s capacity. By exploiting also polarization-division multiplexing and spatial multiplexing, coupling two supermodules outputs orthogonal in polarization and exploiting bundles of fibers or multi-core fibers, PASSION Tx is able to reach a capacity per link higher than 100 Tb/s.

PASSION network platform is also realized by means an innovative energy-efficient and small-footprint node approach, adopting different technologies: flex-grid aggregation/disaggregation/add switches; high-connectivity multicast switches, and large-port photonic polymer PLC-based space switch matrixes. Such a S-BVT based network architecture (Fig. 2) with 25-GHz fine granularity guarantees reconfigurability and flexibility at different levels (in spectrum, polarization and space), and scalability to support a "pay-as-you-grow" scheme. SDN ensures network programmability, fitting network operator requirements and roadmaps.

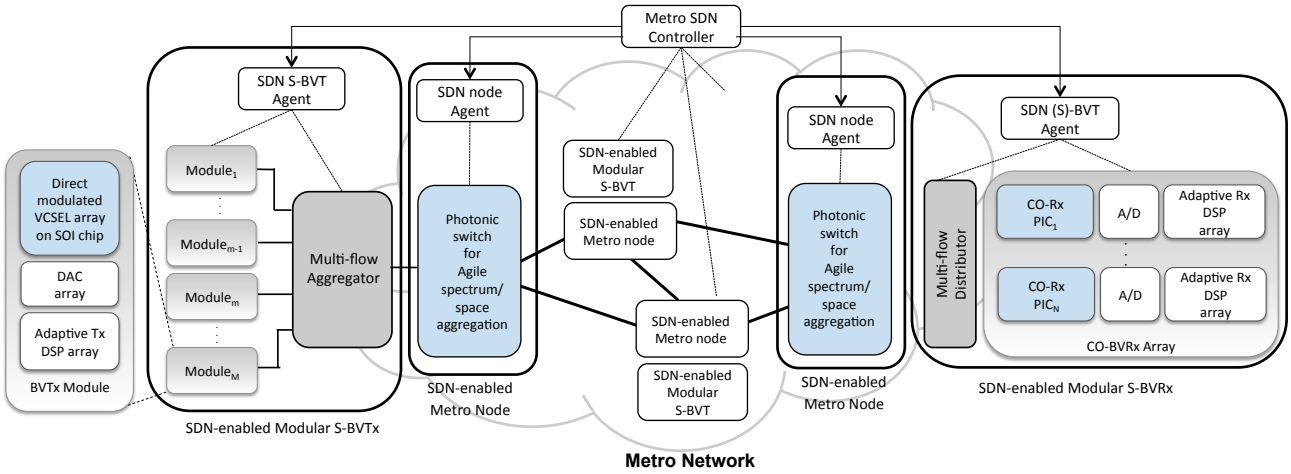

Figure 2. PASSION metro network envisioned infrastructure.

1.2 WORK PERFORMED FROM THE BEGINNING OF THE PROJECT TO THE END OF THE PERIOD COVERED BY THE REPORT AND MAIN RESULTS ACHIEVED SO FAR

After 12 months from the start of the project (December 1st, 2017) 12 PASSION deliverables have been completed and 4 milestones have been achieved. In particular, in addiction to outcomes related to the project management and dissemination (such as the PASSION website, the dissemination and data management plans), we achieved important scientific results reported in the following.

- Definition of use cases and requirements for the PASSION network, systems and sub-systems. Considering the targeted uses cases, a detailed definition of the metro network architecture divided into a number of hierarchical levels supporting different aggregated data traffic volumes and operating at heterogonous granularities has been provided.
- Definition of the technological circuitry matching the functionalities required by the PASSION optical node. Photonic integrated circuits able to handle the add/drop traffic and traffic aggregation/disaggregation functionalities with a modular approach have been identified with the aim to deliver on-chip switch node functionalities for flexible Pb/s capacity.

- Detailed design of the 40-VCSELs Tx module architecture targeting up to 2 Tb/s aggregated capacity. The Si-Ph architecture with multiple VCSELs bonded and coupled on a SOI-based Si-PIC embedding wavelength multiplexing capabilities has been proposed, including assembly strategy and optical and electrical interfaces. First test of the VCSEL sources supported by the selected electrical drivers has been performed.
- Development of the process and the building blocks to enable the monolithically integrated coherent receiver submodule per each channel.
- Design of the scalable S-BVT architecture, considering the different components and identifying the S-BVT requirements, parameters and features, including the modularity, granularity and slice-ability.

1.3 PROGRESS BEYOND THE STATE OF THE ART, EXPECTED RESULTS UNTIL THE END OF THE PROJECT AND POTENTIAL IMPACTS (INCLUDING THE SOCIO-ECONOMIC IMPACT AND THE WIDER SOCIETAL IMPLICATIONS OF THE PROJECT SO FAR)

The fulfilment of PASSION main goal is the availability of an application driven photonic technological platform for the development of a new generation of low-cost, energy-efficient and reduced-footprint devices, modules and sub-systems exploiting the synergy between directly-modulated VCSEL capabilities with massive integration in Silicon Photonics, multichannel coherent detection, innovative switching technologies and spectrum/space aggregation. They will support a radically new sustainable modular and scalable network architecture for the metro segment. In this perspective, PASSION is expected to significantly impact on the metro network architecture, based on the superimposition of the spectrum and space aggregation. Scalability arises as a key functionality to be considered in the design of the envisioned metro network architecture in order to easily expand/upgrade the network according to the existing and future traffic demand. Hence, a programmable and modular approach becomes crucial to enhance network scalability without requiring significant re-engineering of the existing infrastructure.

The innovation potential of the European photonic companies and notably of the SMEs involved in the project will be improved by the cooperation along the value chain in PASSION. PASSION is a multi-disciplinary project requiring optical design, integration design, packaging design, system design as well as network design skills. Each Partner will focus on his core competences in terms of his resources and infrastructures, while relying on other Partners, thanks to already-established long-lasting relationships, with a new open access infrastructures and services to design, prototyping manufacturing and testing.

2 DELIVERABLES

Del. No.	Deliverable name	WP No.	Lead benef	Type	Diss level	Deliv date	Submis date	Comments
D1.1	Project presentation	WP1	POLIMI	R	PU	M1	22/12/17	Document produced within WP1 “Project management and coordination” with an overview of the project. D1.1 includes the project fact sheet and the project

								presentation slides (Annexes).
D1.2	PASSION web site	WP1	POLIMI	R	PU	M2	30/1/18	Document produced within WP1 “Project management and coordination” with an overview of the project website realization and actual features. The project web site was launched in the second month of the project at the address http://www.passion-project.eu, and then it will be continuously updated. While the availability of the site and its organization can be tested online, its main features are shortly described in this accompanying document.
D4.1	Circuitry and technology matching to the path functionality in the optical node	WP4	TUE	R	PU	M4	30/3/18	Document produced within WP4 “Switching, aggregation and Rx photonic technologies” defining the photonic circuitry within each building block to serve the specific path functionality (add/drop/space switching/disaggregation/aggregation).
D3.1	Detailed design of the Tx module architecture and interfaces	WP3	VTT	R	CO	M5	30/4/18	Document produced within the WP3 “Photonic technologies for Tx” defining the design of the Tx module architecture. D3.1 is confidential. D3.1 includes in Annex I a summary available for public.
D6.1	Definition of PASSION dissemination plan	WP6	EPIC	R	PU	M5	27/4/18	Document produced within WP6 “Exploitation plan, dissemination and standardization” defining the PASSION dissemination plan in terms of scientific and industrial oriented dissemination, use and transfer of results, standardization.
D1.3	Data Management Plan	WP1	POLIMI	R	PU	M6	31/5/18	Document produced within WP1 “Project management and coordination” providing the plan for managing the data generated and collected during the project.

D1.4	Video and dissemination materials	WP1	POLIMI	R	PU	M6	31/5/18	Document produced within WP1 “Project management and coordination” giving an overview on the main PASSION dissemination materials, namely PASSION videos, flyer and roll-up.
D3.2	First testing of directly modulated VCSELs with selected drivers	WP3	VERT	R	PU	M6	24/7/18	Document produced within the WP3 “Photonic technologies for Tx” describing the choice of the VCSEL drivers and showing the first test results of VCSEL direct modulation with the selected drivers. The deliverable has been submitted with a delay due to the late delivery of the selected drivers and evaluation boards from the supplier.
D2.1	Definition of use cases and requirements for network, systems and subsystems	WP2	TID	R	PU	M10	29/9/18	Document produced within WP2 “Network and system architecture, requirements and features” based on MS1 inputs including the selected use cases taken as the project reference and network and systems/sub-systems requirements.
D6.2	Report on industrial-oriented and scientific-oriented dissemination activities 1	WP6	VLC	R	PU	M12	30/11/18	Document produced within WP6 “Exploitation plan, dissemination and standardization” related to the first report about the scientific oriented dissemination activities.
D1.5	First periodic report	WP1	POLIMI	R	CO	M12	30/11/18	Document produced within WP1 “Project management and coordination” related to the first report about the full financial, technical and risk management progress.
D1.6	Public progress report 1	WP1	POLIMI	R	PU	M12	30/11/18	Document produced within WP1 “Project management and coordination” related to the first public progress report.

3 MILESTONES

Milestone	Milestone name	WP no	Lead benef	Delivery date	Subm date	Mean of verification	Achieved
MS1	Preliminary set of requirements for systems, subsystems and technology developments and definition of initial use cases	WP2	TID	1/4/2018	29/03/18	Document PASSION_MS1_v2.0.pdf uploaded in the PASSION repository on March 29th, 2018.	YES
MS2	Consolidated design of the transmitter architecture	WP3	VTT	1/5/2018	30/04/18	Deliverable D3.1 "Detailed design of the Tx module architecture and interfaces" uploaded on April 30th, 2018.	YES
MS3	Direct modulation of VCSELs demonstrated with selected drivers	WP3	VTT	1/6/2018	24/07/18	Deliverable D3.2 "First testing of directly modulated VCSELs with selected drivers".	YES
MS4	Preliminary definition of the network architecture	WP2	CTTC	1/12/2018	29/11/18	Document PASSION_WP2_MS4_v2.pdf uploaded in the PASSION repository on November 29th, 2018.	YES