



**PROGRAMMABLE RECONFIGURABLE  
OPTICAL TRANSPORT FOR EFFICIENTLY  
OFFERING UNCONSTRAINED SERVICES IN 6G**

# PROTEUS 6G

## **PROTEUS-6G: Advanced Optical Networking solutions in 6G front/mid-haul**

Prof. Ioannis Tomkos (*University of Patras*)  
*IEEE Fellow, OPTICA Fellow, IET Fellow*

*SNS Webinar – Introducing the Call-2 SNS projects*  
*March 7 @ 13:00 - 16:15pm*

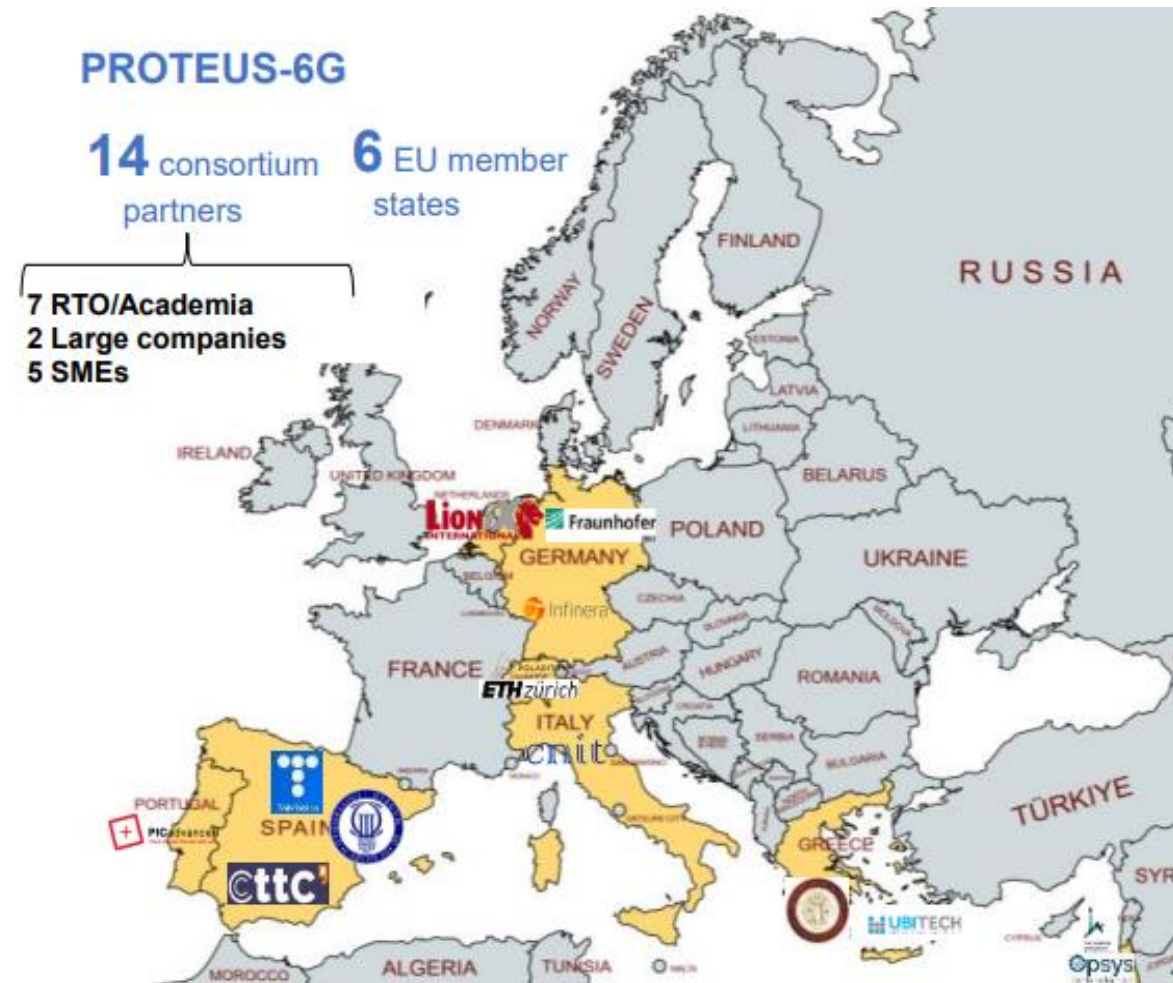


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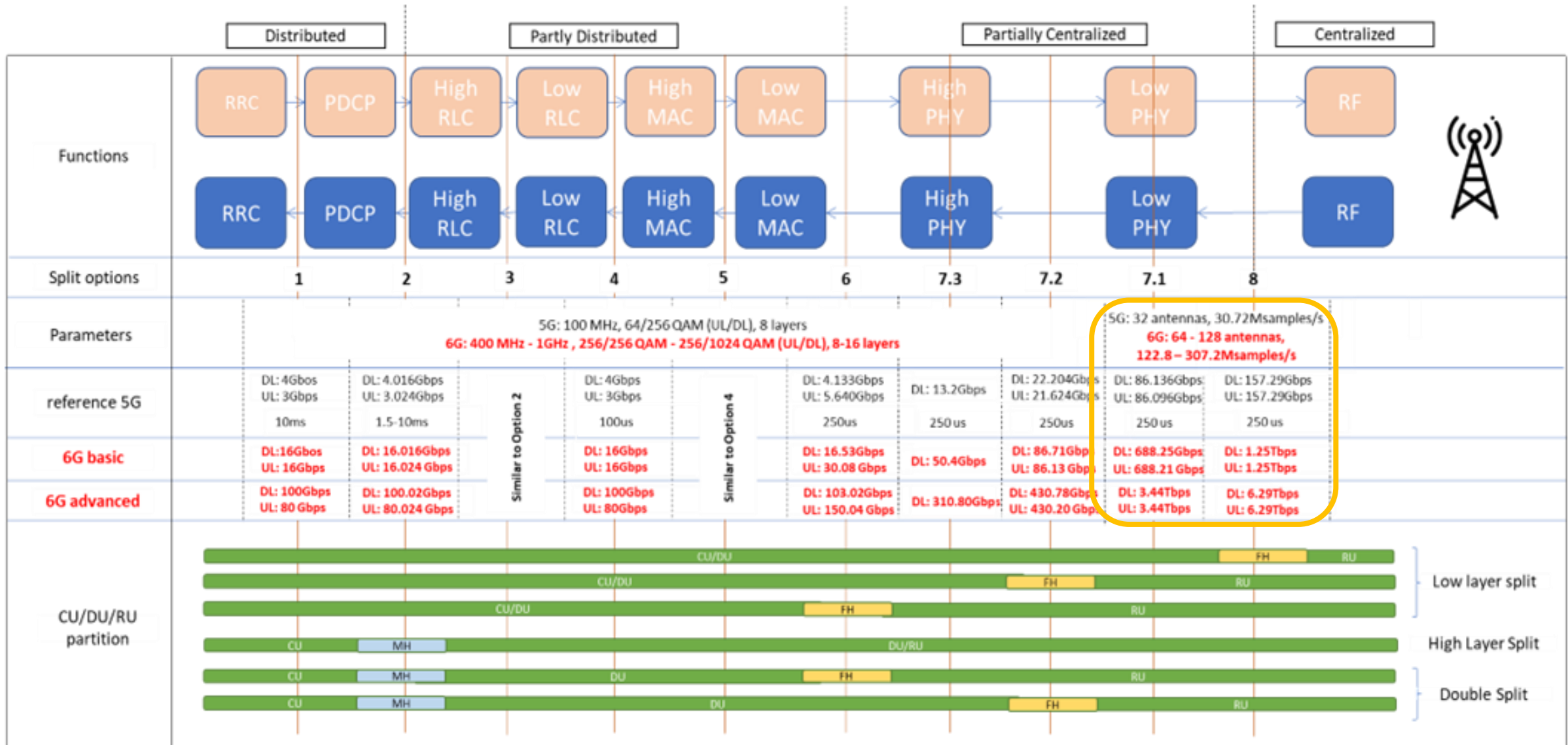
[www.proteus-6g.eu](http://www.proteus-6g.eu)

**Work Programme/Call** HORIZON-JU-SNS-2023 (HORIZON-JU-SNS-2023)  
**Topic ID** STREAM-B-01-03 (Communication Infrastructure Technologies and Devices)  
**Type of action** HORIZON-JU-RIA HORIZON JU Research and Innovation Actions  
**Project title** “Programmable Reconfigurable Optical Transport for Efficiently offering Unconstrained Services in 6G”  
**Project acronym** PROTEUS-6G  
**Contact person** Prof. Ioannis Tomkos  
**List of participants:**

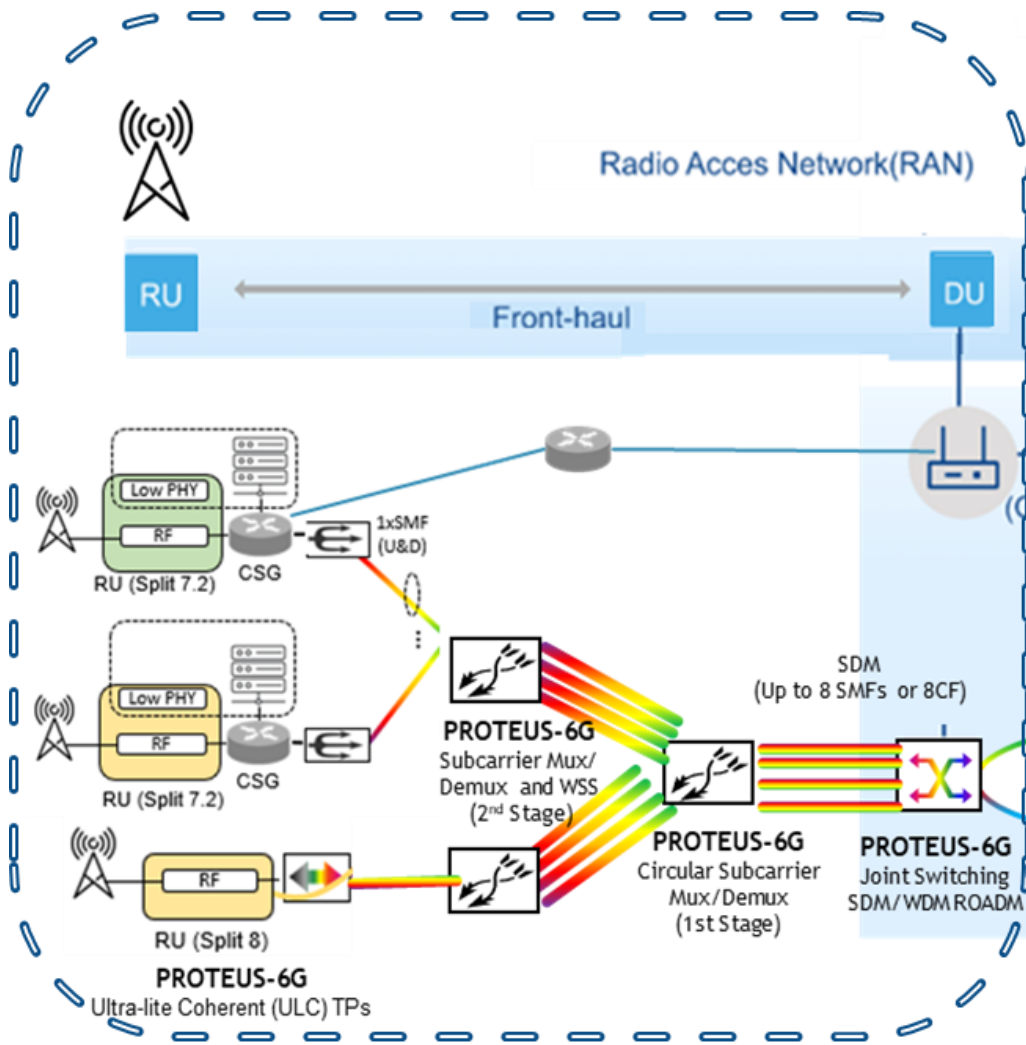
Participant Number	Participant Organisation Name	Short Name	Country
1	PANEPISTIMIO PATRON	UPAT	Greece
2	CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE TELECOMUNICAZIONI	CNIT	Italy
3	CENTRE TECNOLOGIC DE TELECOMUNICACIONS DE CATALUNYA	CTTC	Spain
4	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	HHI	Germany
5	THE HEBREW UNIVERSITY OF JERUSALEM	HUJI	Israel
6	LIONIX INTERNATIONAL BV	LIX	Netherland
7	OPSYS SENSING TECHNOLOGIES LTD	OPSYS	Israel
8	PICADVANCED, SA	PICA	Portugal
9	TELEFONICA INVESTIGACION Y DESARROLLO SA	TID	Spain
10	GIOUMPITEK MELETI SCHEDIASMOS YLOPOIISI KAI POLISI ERGON PLIROFORIKIS EE	UBI	Greece
11	CORIAN R&D GMBH	INF-G	Germany
12	UNIVERSIDAD CARLOS III DE MADRID	UC3M	Spain
13	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH	ETHZ	Switzerland
14	POLARITON TECHNOLOGIES AG	POL	Switzerland



# Our Focus: Fronthaul Requirements in 5G & 6G networks







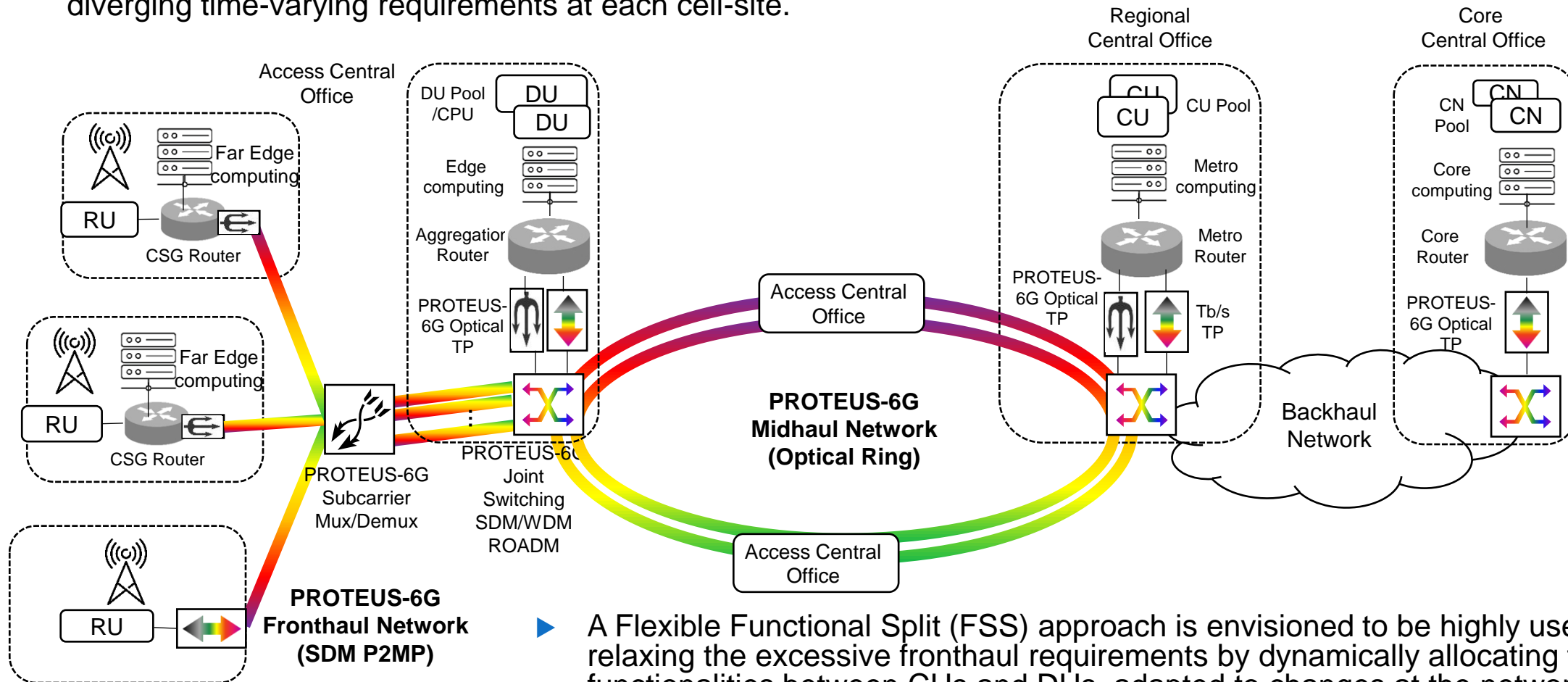
- ▶ PROTEUS-6G focuses on:
  - the development of advanced packet-optical front/mid-haul networking infrastructure,
  - relying on novel software-programmable photonic-integrated-circuit based subsystems
  - operated under an intelligent software management system, capable of simplifying and optimizing 6G fronthaul network operations
  - enabling dynamic configuration of functional splits.

- ▶ PROTEUS-6G Develops:
  - A novel spatially-diverse point-to-multi-point (SD-PtMP) optical fronthaul distribution network (ODN) that outperforms legacy deployments.
  - Next-generation Digital Subcarrier Multiplexing (DSCM) transceivers used for dynamic functional splits 1 up to 7-2.
  - Innovative ultra-high-speed, low-latency, low-cost and power-efficient Lite-Coherent (LITE-COH) transceivers (TXR), as key enablers for the realization of Option 8 for cell-free 6G.
  - Intelligent control plane for auto-configuration.



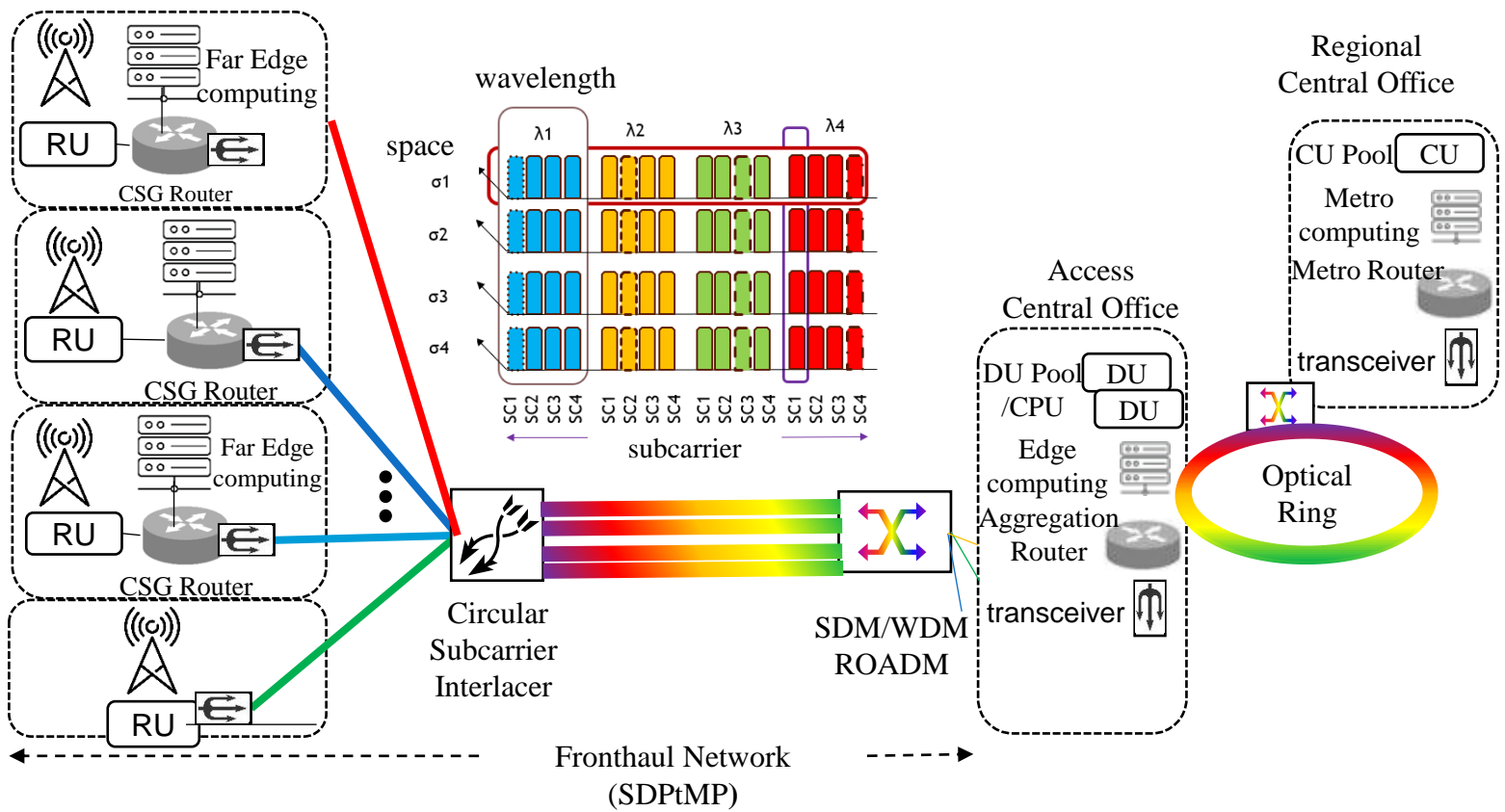
# Innovation Area A: Novel IP/Optical x-haul transport network for 6G

- ▶ The Functional Split option for each cell-site may be dynamically selected, to improve overall performance of future 6G networks by considering diverging time-varying requirements at each cell-site.



- ▶ A Flexible Functional Split (FSS) approach is envisioned to be highly useful to enable relaxing the excessive fronthaul requirements by dynamically allocating the processing functionalities between CUs and DUs, adapted to changes at the network.
- ▶ Advanced Optical Transport for mid-haul and front-haul.

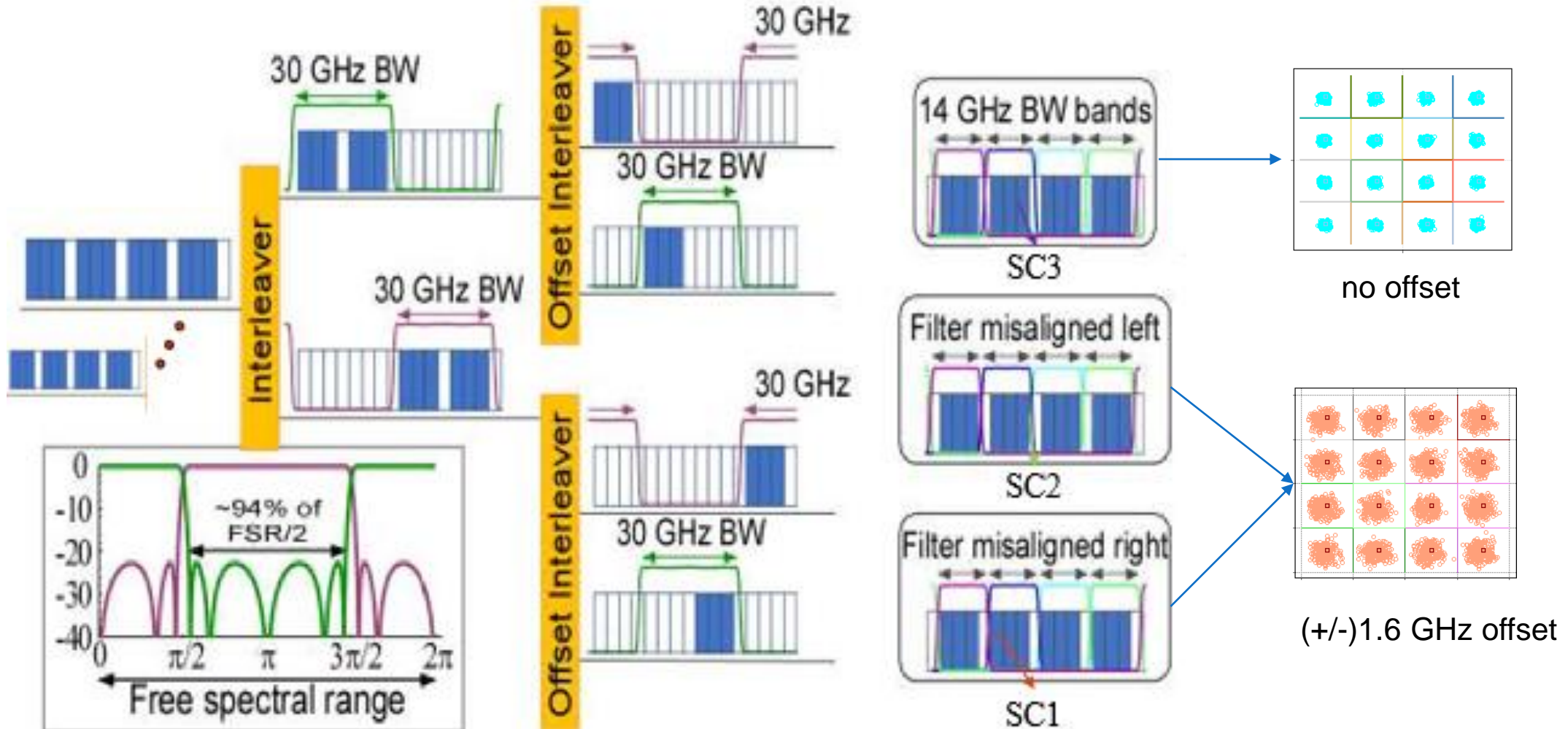




- ▶ PROTEUS-6G fronthaul architecture aggregates traffic from multiple RUs located at the cell sites to DU pools and eventually to CU pools, using a novel low-power, low-loss optical fronthaul network relying on digital sub-carriers that are distributed across the network.
- ▶ CU resources can be further located remotely and be interconnected via an SDM-WDM ROADM ring, enabling efficient traffic aggregation/distribution and allocation of resources across the network, as well as resiliency.
- ▶ Capacity benefits are offered from a WDM multiplier (via the use of tunable transceivers across the C/L-bands at high spectral utilization) and from an SDM multiplier, based on spatial channels (e.g. 4 as illustrated).

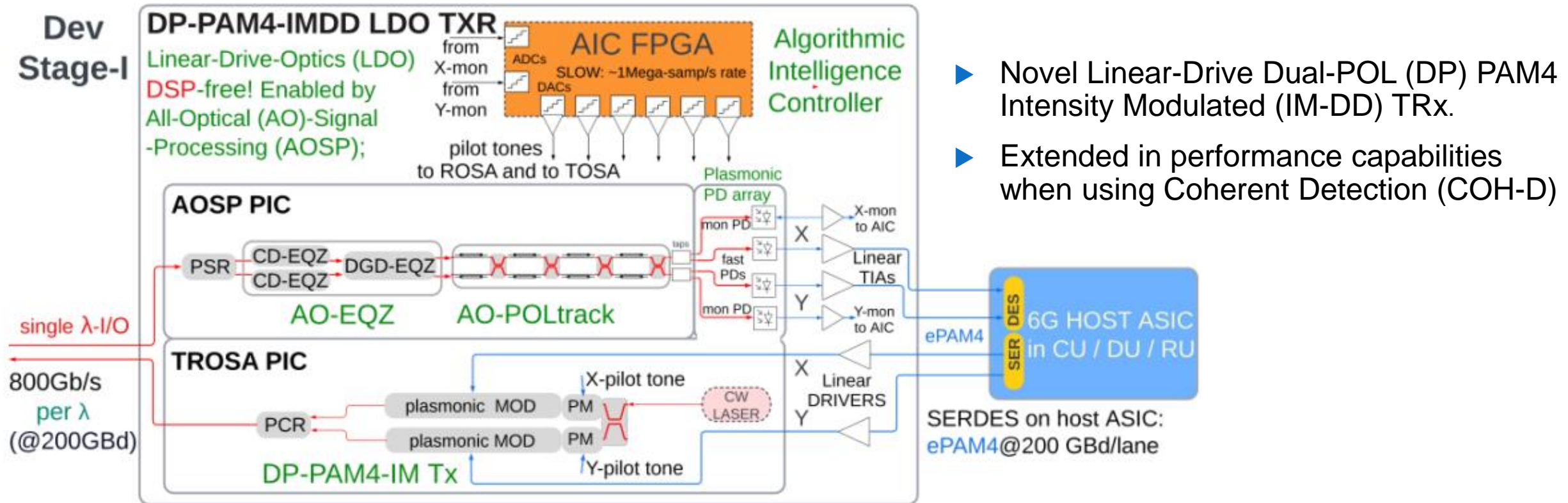


- ▶ We have shown the excellent performance of the received distributed sub-carriers over the PROTEUS-6G P2MP network, taking into account all possible transmission impairments.





# Innovation Area C: Simplified Coherent energy-efficient Transceivers

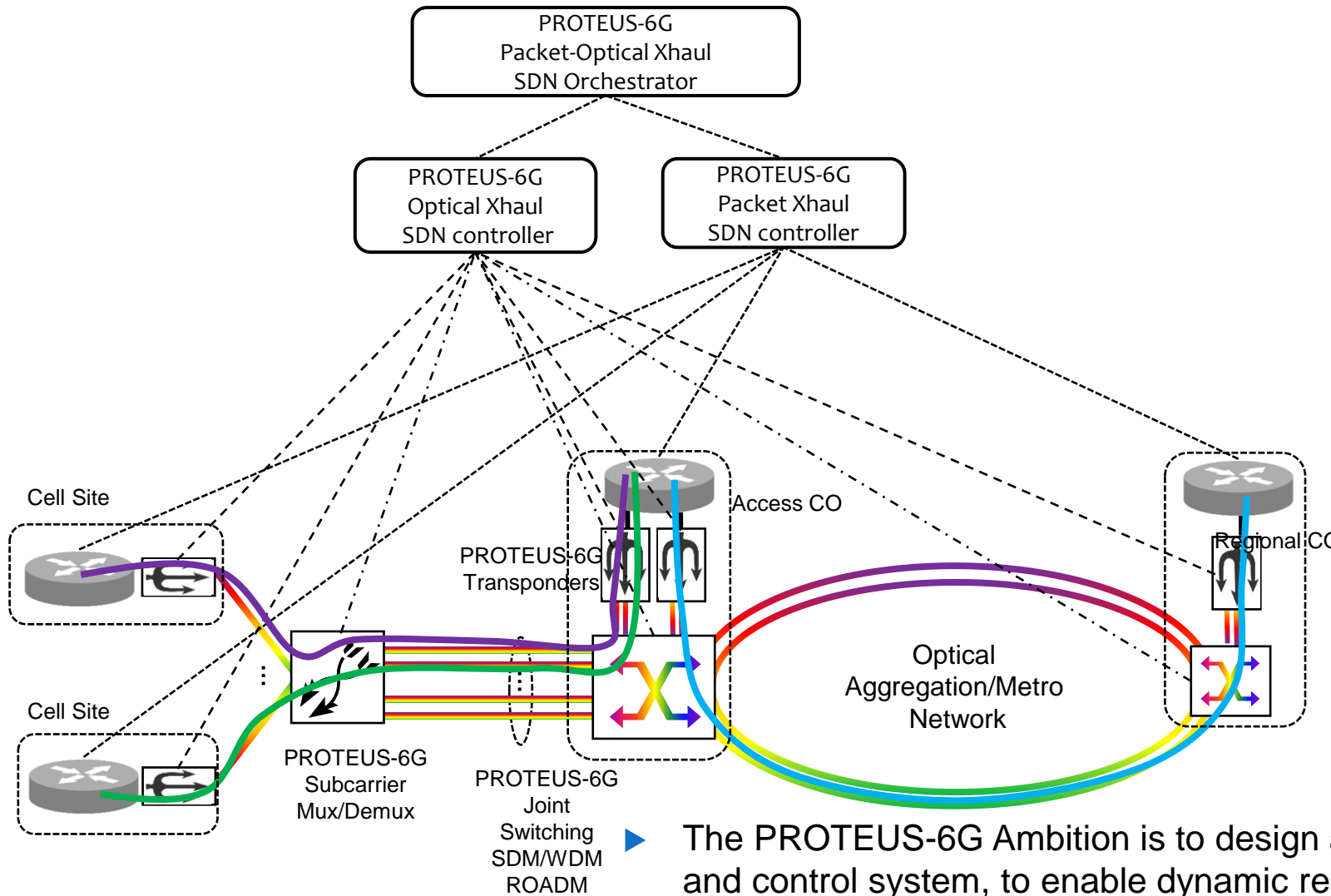


- ▶ Novel Linear-Drive Dual-POL (DP) PAM4 Intensity Modulated (IM-DD) TRx.
- ▶ Extended in performance capabilities when using Coherent Detection (COH-D)

- ▶ The innovative TRx PIC, all-optically mitigates transmission impairments (e.g. CD, PMD) and is capable to all-optically POL-demux (decouple) the two X- and Y- polarizations signals that get cross-coupled upon propagating along the optical fibre links, without using power-hungry DSP chips.
- ▶ This PIC comprises two modules in series, following spatial separation of the X,Y incoming POLs: the All-Optical Equalizer (AO EQZ) and the All-Optical Polarization demultiplexer/tracker (AO-POL).







- ▶ We investigate, design, and implement SDN control and telemetry architectures for the x-haul, providing dynamic management of services in the fronthaul/midhaul segments.
- ▶ The underlying infrastructure comprise at the packet layer IP routers located in cell-sites, access/regional COs and advanced optical nodes at the mid-haul with programmable ODN and Transceivers at the fronthaul.
- ▶ The all-optical x-haul network developed in PROTEUS-6G will provide connectivity between these routers. Each layer (packet/optical) will be assigned a dedicated SDN controller.

- ▶ The PROTEUS-6G Ambition is to design an intelligent service management, orchestration and control system, to enable dynamic reconfiguration of the selected functional split, adaptive to changing environments, such as new services & traffic changes.











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# PROTEUS

THANK YOU FOR YOUR ATTENTION

**Prof. Dr. Ioannis Tomkos**

*email:*

[itom@ece.upatras.gr](mailto:itom@ece.upatras.gr)

*Linkedin:*

<https://www.linkedin.com/in/dr-ioannis-tomkos-086b102/>



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