

OPEN XR

OPTICS FORUM

Title Open XR Optics Forum – OFC 2024

Date March 27th, 2024

Andrew Lord, BT Fellow

Venk Mutalik, Comcast Fellow

Oscar González de Dios, Expert Telefonica CTIO

Dave Welch, Founder Infinera

Agenda

Topic	Speaker
Introduction Open XR & Update on XR Standardization Progress	Andrew Lord, Senior Manager of Optical Research, FIEEE and BT Fellow, BT
Benefits and Deployment scenarios for XR Optics Technology	Venk Mutalik, Comcast Fellow, Comcast
Flexible Bandwidth Allocation through Point to Multipoint Technology	Oscar Gonzales de Dios, Expert, Global CTIO, Telefonica
Architecture Transformation through Open XR	Dave Welch, Founder, Chief Innovation Officer, and Director, Infinera
Q&A	All



Open XR Optics Forum Update at OFC 2024

Andrew Lord

BT Fellow

Venk Mutalik

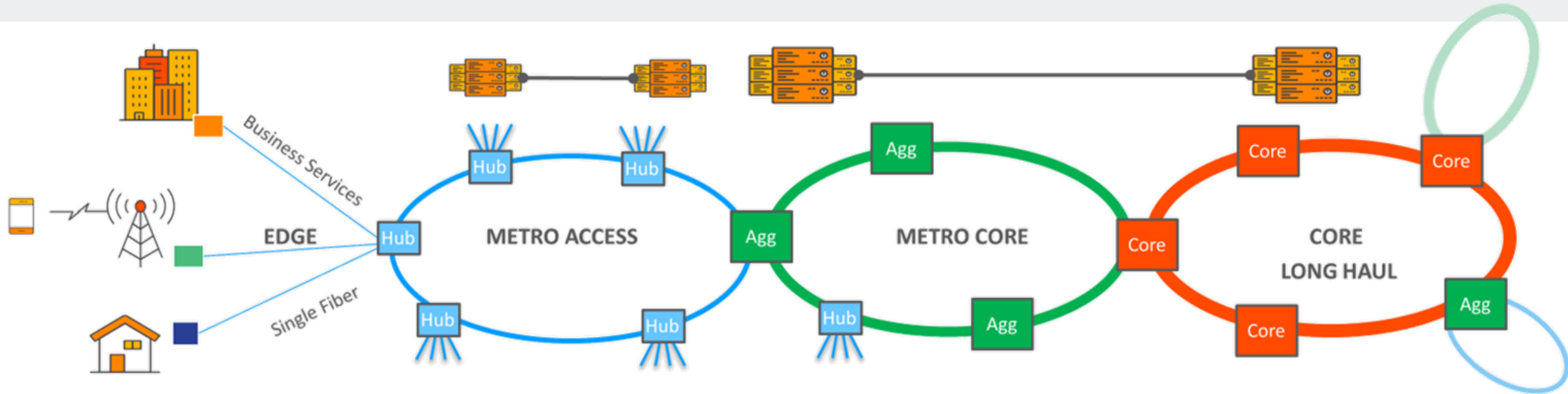
Comcast Fellow

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APPLICATIONS

- High-Capacity Overlay
- Any to any Host (CFP2, QSFP-DD)
- Dynamic Bandwidth Upgrade

KEY TECHNICAL BENEFITS

- Single Laser BiDi
- Coherent Breakout
- Nyquist Subcarriers
- Dispersion Tolerance

FLEXIBLE MANAGEMENT

- Managed by Host & independent monitoring
- Host independent & remote management

Open XR Optics – Open and Operator Driven

Applications and Requirements

- Applications, Use Cases, and requirements ✓
- Reference Implementations → SOON
- Management Interfaces Requirements → SOON

Transceiver Specifications

- Performance Specifications ✓
- Open XR Signal Specification → SOON
- Pluggable Form Factor Specifications ✓

Management Interfaces

- CMIS contributions ✓
- Open XR CMIS registers → SOON
- Open XR Module API(s) → SOON
- Controller API extensions → SOON

Open XR Specifications and Whitepapers

SPECIFICATIONS

- Open XR Management Architecture Specification – **Published** ✓
- Open XR Optics 400G Optical Module Form Factor Hardware Specifications – **Published** ✓
- Open XR Optics Transceiver Optical and Client Interface Specifications – **Published** ✓
- Open XR Signal Format Specifications: Mid Span Meet – In Progress → SOON
- Open XR Transceiver Management Specification (CMIS registers) – In Progress → SOON

WHITEPAPERS

- Open XR Concept Introductory White Paper – **Published** ✓
- Introduction to Applications of XR Optics to Coherent Optical Communication Networks – **Published** ✓
- Open XR Signal Format White Paper – In Progress → SOON
- Open XR Management Interfaces Requirements White Paper – In Progress → SOON

Published Open XR Documents available at:
<https://www.openxropticsforum.org/documents>



Relevant Activities in Other Forums

OIF

Management White Paper & Contributions to CMIS 5.3



IOWN APN Functional Architecture 2.0 includes subcarrier multiplexing

CableLabs®

Subcarrier track in CPON



Subcarrier technology has been introduced in FSAN and several study groups



Discussions on Management of next generation pluggable transceivers

Open XR Optics Forum POCs

Legend



Completed



Running



P2P Performance and Host Independent Management

- P2P performance trials
- Dual Management

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P2MP network configurations and Dual Management PoC

- Disaggregation of Hosts & Line Systems
- Dual Management



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Metro and Access Network Convergence

- P2MP aggregation
- Central Office consolidation

 TIM  DTS  Infinera®



Flexible and Energy Efficient IP/MPLS Networks

- Disaggregated transport networks
- Convergent IPoWDM infrastructure

 Telefónica  ttc[®]  Infinera®
Centre Tecnològic de Telecomunicacions de Catalunya

Reports available at: <https://www.openxropticsforum.org/documents>

Open XR Optics Forum Members (41) March 2024

<p>Network Operators</p> <p>21</p>	
<p>Equipment Providers</p> <p>15</p>	
<p>Component Manufacturers</p> <p>5</p>	

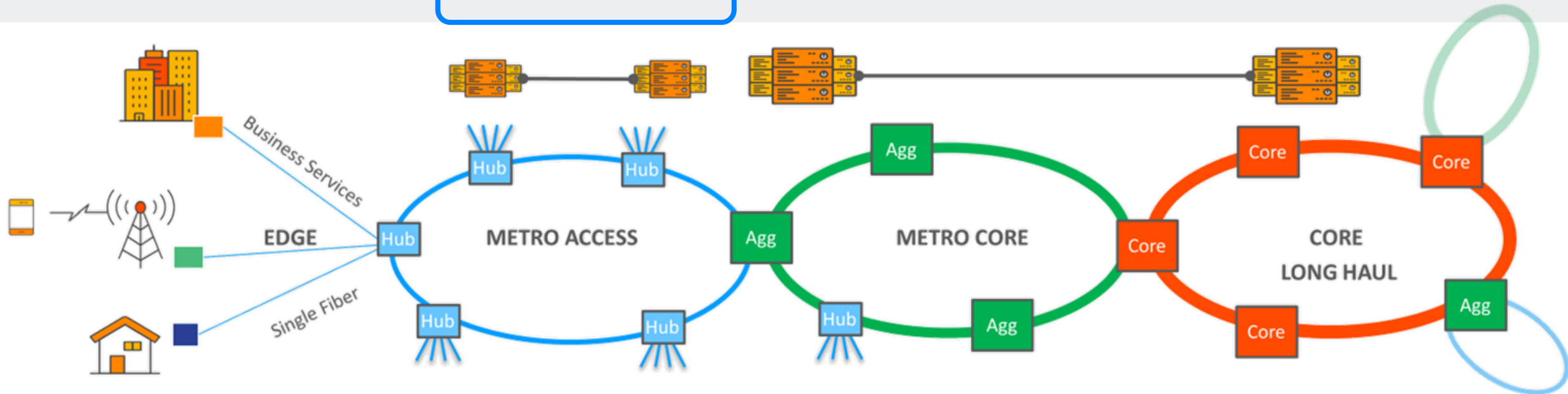
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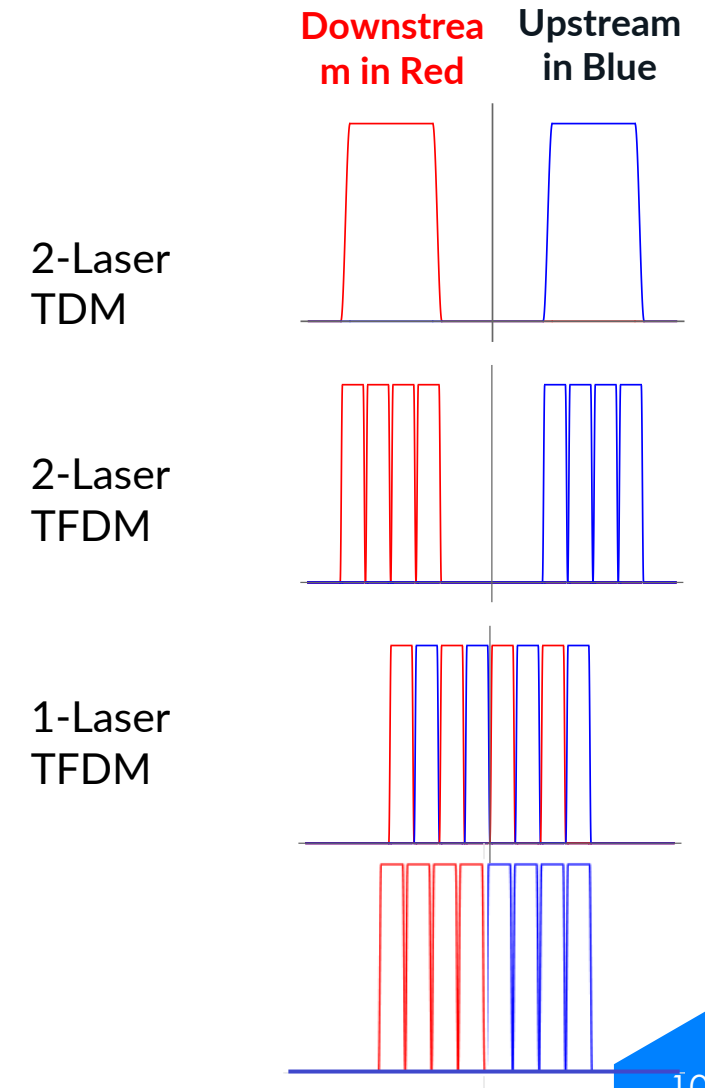
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- **Nyquist Subcarriers**
- **Dispersion Tolerance**

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Single Wavelength BiDi Operation with Subcarriers

- Single Carrier TDM:
 - TDM requires 2 separate wavelengths for upstream and downstream
 - Requires the use of 2 lasers in each module
- Subcarrier
 - 2-Laser TFDM: TFDM with 2 separate wavelengths for upstream and downstream, 4 subcarriers in each direction
 - 1-Laser TFDM: Interleaved TFDM with single wavelength for upstream and downstream, total of 8 interleaved subcarriers, 4 in each direction (interleaved)



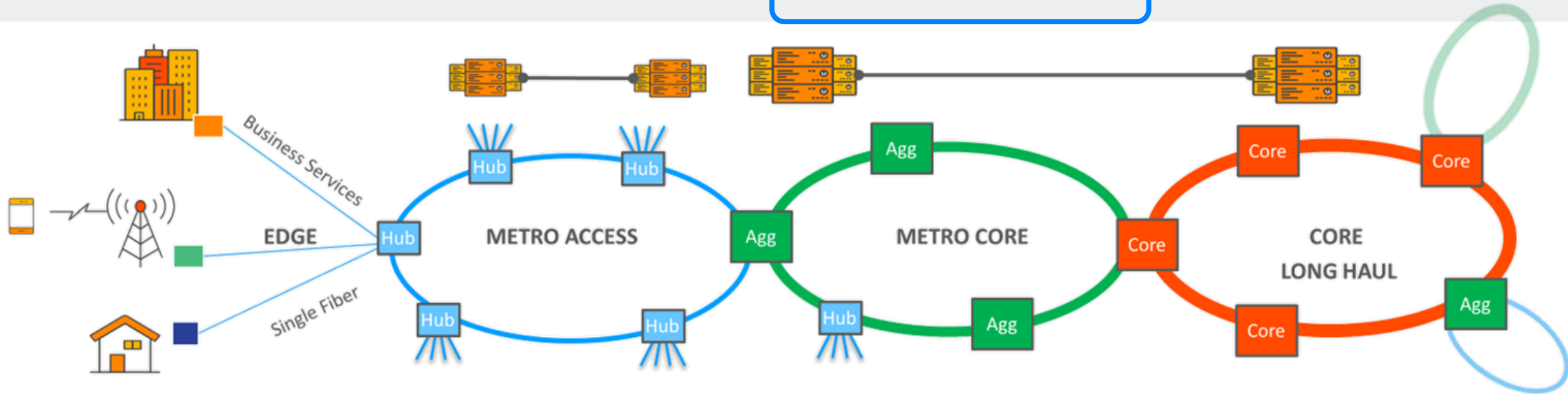
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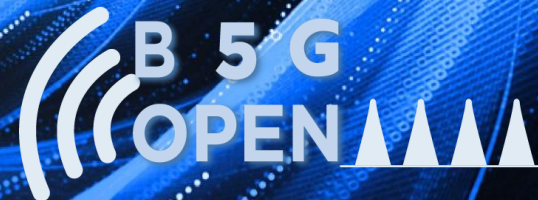
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Benefits of Flexible Bandwidth Allocation through Point to Multipoint Technology

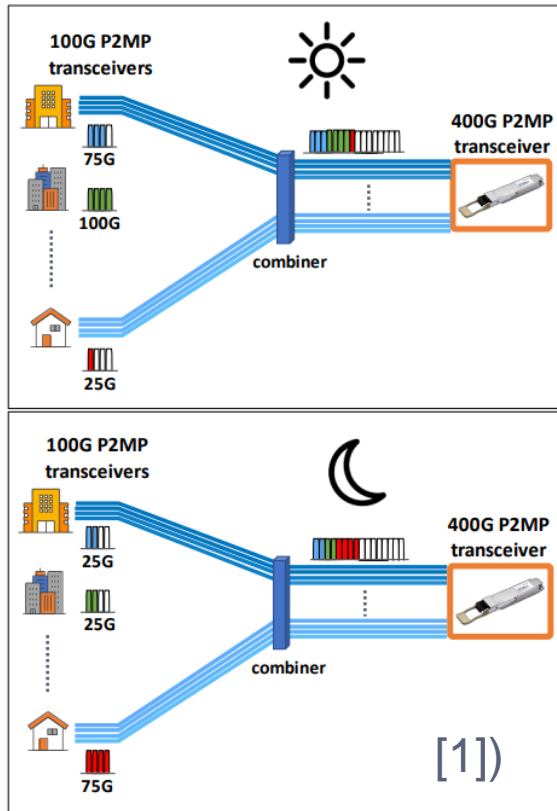
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Óscar González de Dios, Edward James Echeverry, Juan Pedro Fernández-Palacios, José Manuel Rivas Moscoso, Ramon Casellas, Antonio Napoli

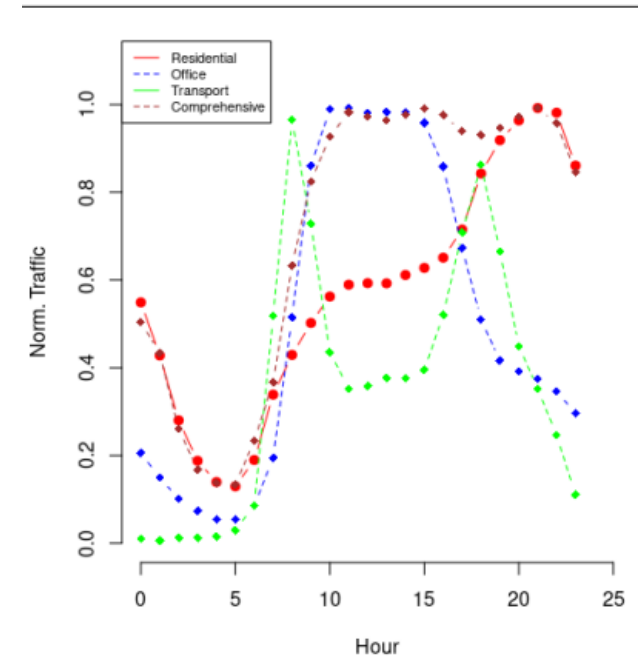
Wednesday March 27th



Dynamic Bandwidth allocation



1. IP Traffic data is collected, analyzed and predictions made.
2. Different traffic profiles per type of traffic
3. Through XR management interface the number of subcarriers is adjusted based on the predictions.
4. Through CMIS the host data rate is adjusted.
5. Bandwidth is adjusted to the real needs, minimizing transceivers and energy



Traffic per hour (examples of different profiles [2])

- [1] J. A. Hernandez, F. Arpanaei, A. Napoli, C. Castro, O. Gonzalez de Dios and J. P. Fernandez-Palacios, "On clustering coherent optics point-to-multipoint trees for cost-effective bandwidth assignment in MANs," in *Journal of Optical Communications and Networking*, vol. 15, no. 12, pp. 999-1007, December 2023,
- [2] F. Xu et al., "Understanding mobile traffic patterns of large scale cellular towers in urban environment," *IEEE/ACM Transactions on networking* 25, 1147–1161 (2016).

PoC @ Telefonica Future Network Lab

Telefonica is carrying out a PoC in Madrid Headquarters Future Network Lab

Goal 1:

- Demonstrate the use of XR with dual management in commercial routers (Juniper, Nokia) and in whiteboxes (edgecore/ufispace with commercial/open source operating system).

Goal 2:

- Demonstrate XR Dynamic reconfiguration capabilities (turning on/off subcarriers) orchestrated by an SDN controller

Goal 3:

- Prove the Feasibility of Dynamic bandwidth allocation following traffic patterns in P2P and P2MP scenarios (in topologies emulating rings, meshes and/or PON scenarios).

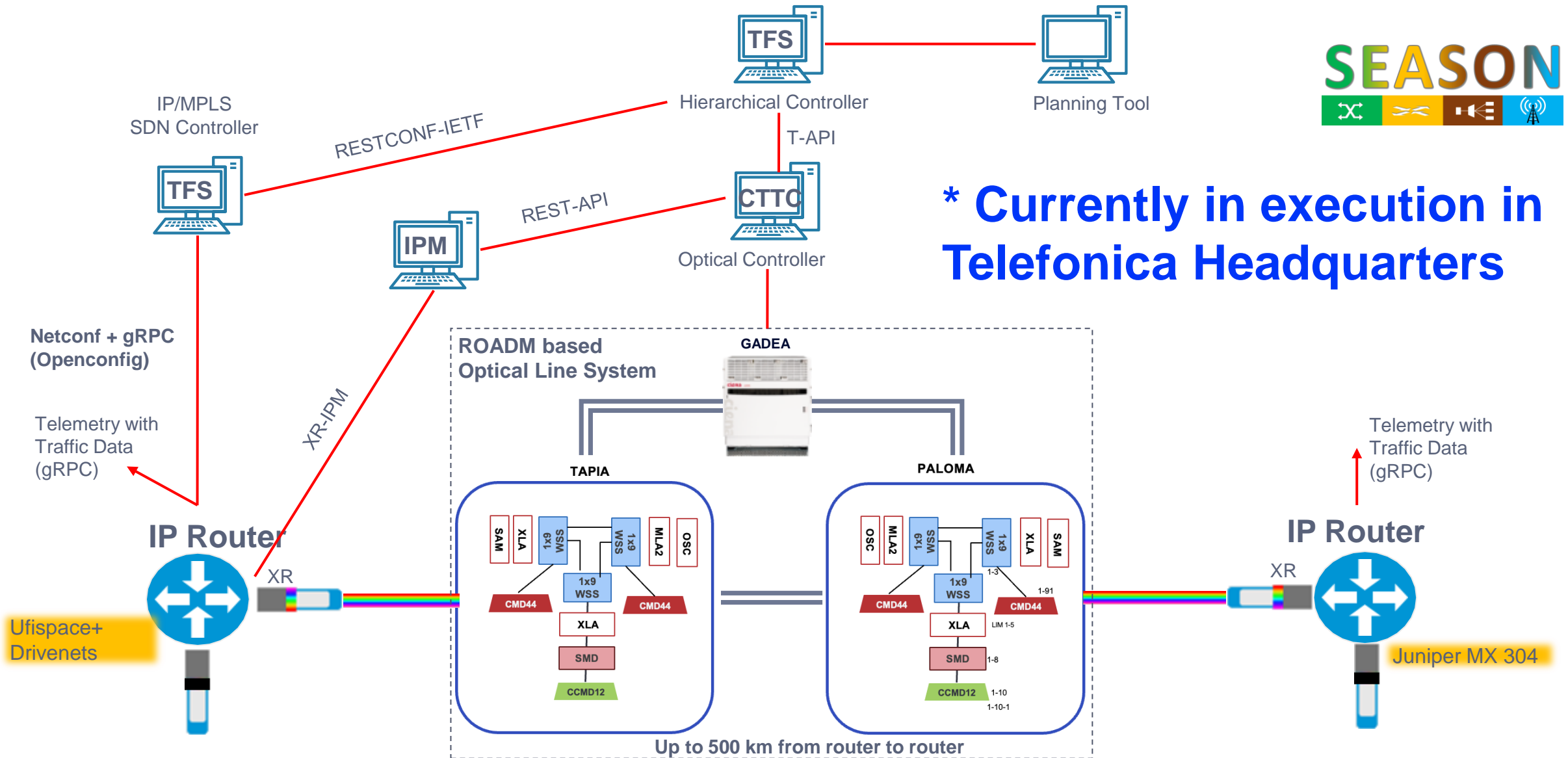
Goal 4:

- Quantify the energy savings by adjusting the capacity to the traffic pattern.

Goal 5:

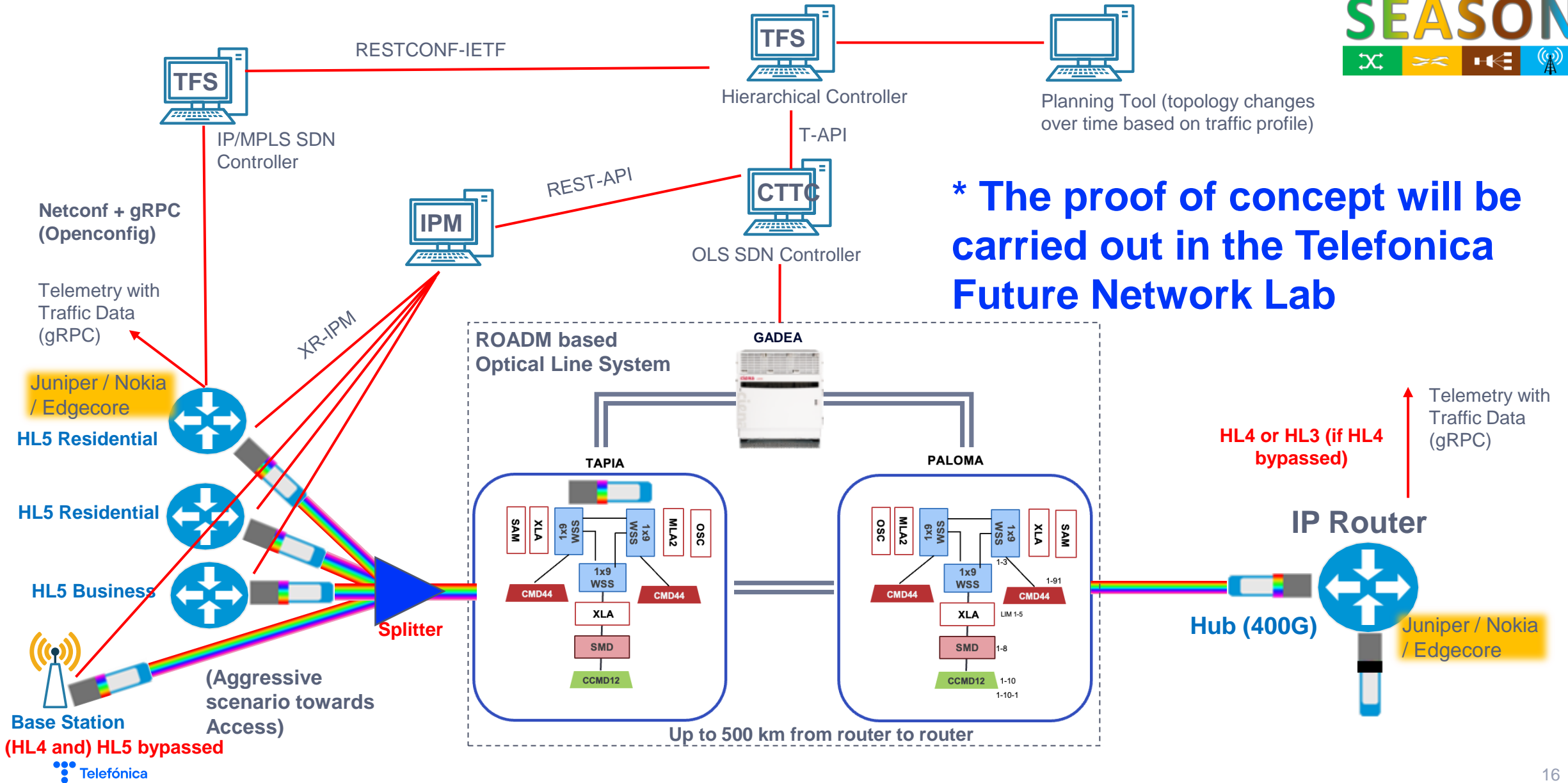
- Demonstrate the potential of XR to build flexible topologies.

Telefónica proof of concept – P2P, Phase 1



*** Currently in execution in Telefónica Headquarters**

Telefónica proof of concept – P2P, Phase 2



Status of PoC

- Currently, P2P setup up & running
 - XR pluggables properly working in the commercial routers
 - Connection to IPM established
- First work with SDN integration in progress
- Energy measurements in progress
- Q2' 2024 integration with SDN controller
- Q3' 2024 start with point to multipoint scenario

Acknowledgements

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- **SEASON** (grant No. 101096120)



- **B5GOPEN**





Telefónica

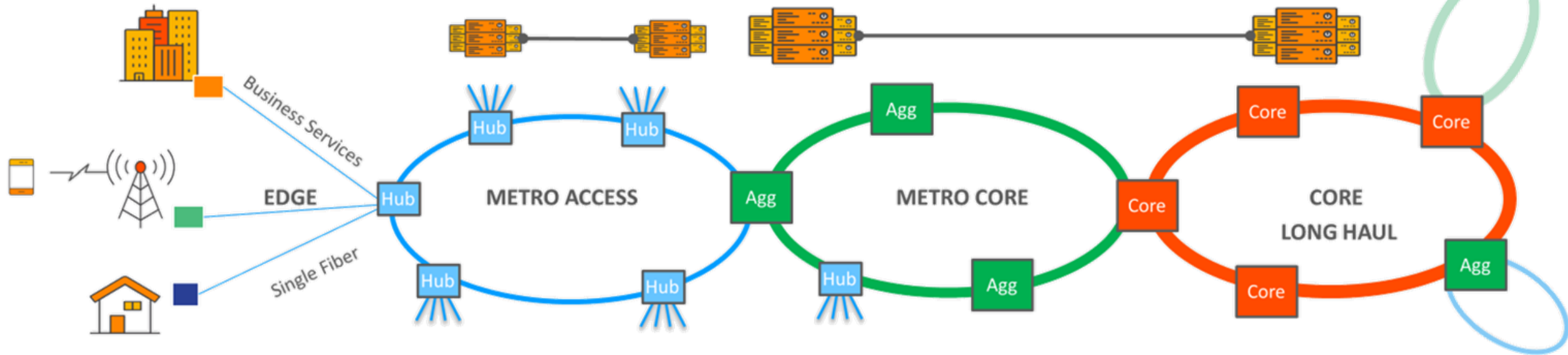
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XR - The most effective tool in aggregation

- 40-70% cost savings in CAPEX/OPEX
- Future proof compatibility
- Bidirectional traffic
- PON Overlay
- Mixed traffic aggregation
- Independent or Host Management
- ZR+ or XR modes
- Power efficient networking

Open XR Forum

- MSA standard
- Service Provider Driven
- Expansive PoC initiatives
- OIF collaboration

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