



The Standards People



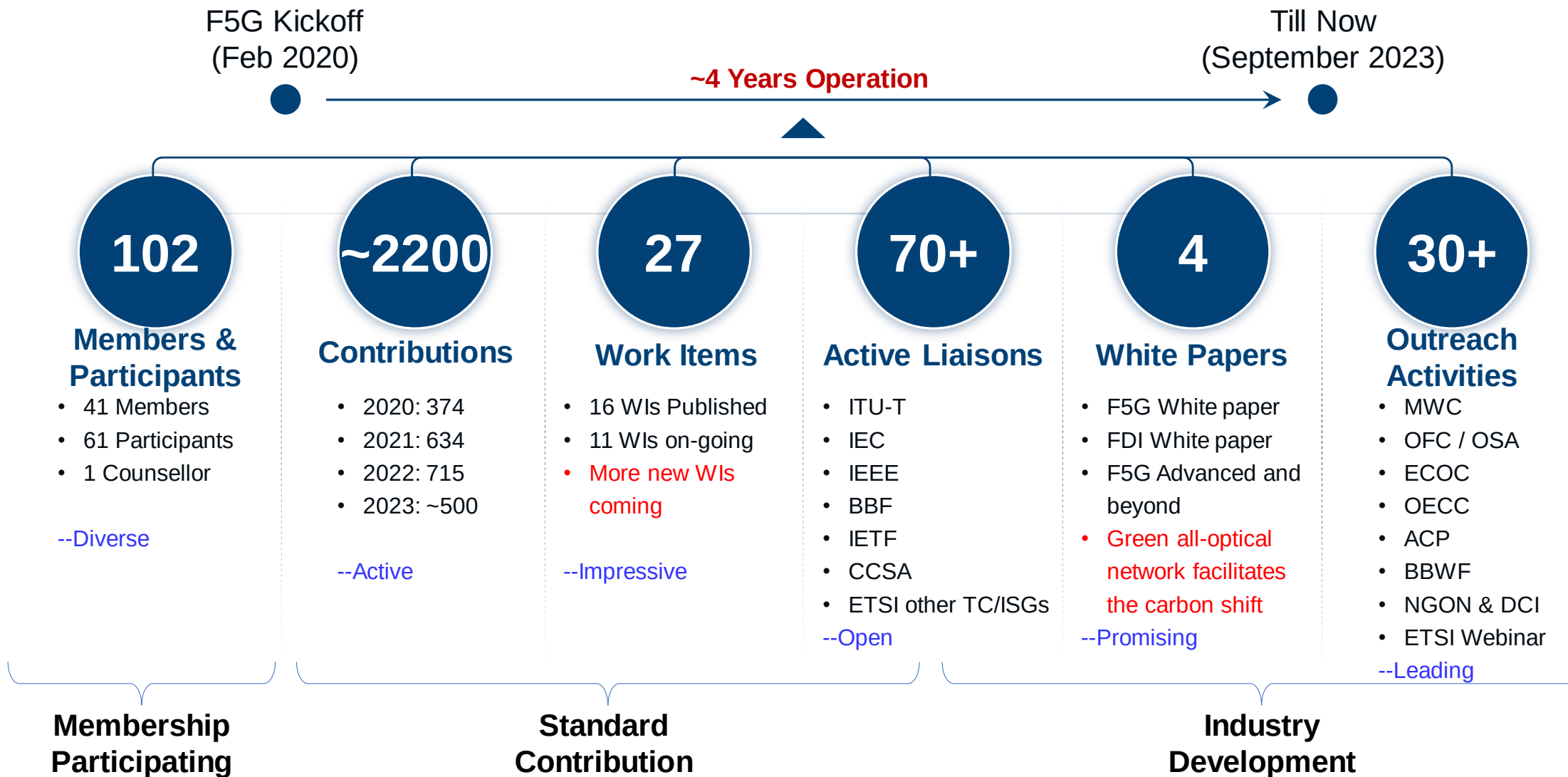
F5G Green and Digital Transformation

ETSI ISG F5G Update at ECOC2023

Presented by: **Marcus Brunner, ETSI ISG F5G Liaison Officer**

ECOC 2023, Glasgow, UK, 1 October 2023

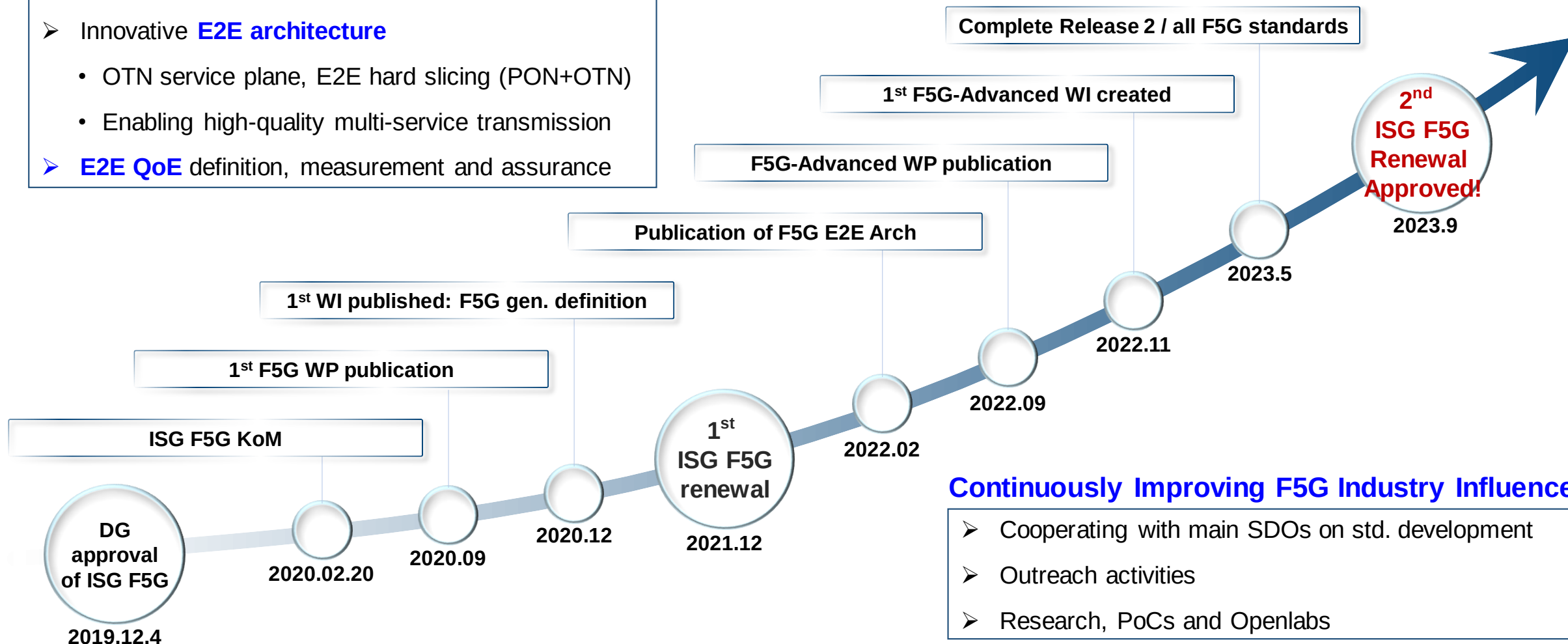
Key Figures of ISG F5G



Milestones Progress for ISG F5G

ISG F5G Key Standard Innovations

- Origination and promotion of **FTTR**
- Innovative **E2E architecture**
 - OTN service plane, E2E hard slicing (PON+OTN)
 - Enabling high-quality multi-service transmission
- **E2E QoE** definition, measurement and assurance



Continuously Improving F5G Industry Influence

- Cooperating with main SDOs on std. development
- Outreach activities
- Research, PoCs and Openlabs

Standards Contribution: 27 WIs Created (16 of them Published)

	Release 1 – F5G	Release 2 – F5G	Release 3 – F5G-Advanced
General	001 F5G definition		021 F5G-A definition
	002 F5G UC v1	008 F5G UC v2	020 F5G-A UC
	003 F5G TL v1	013 F5G TL v2	023 F5G-A TL
	004 F5G arch. v1	014 F5G arch. v2	024 F5G-A arch.
	006 F5G E2E mgmt v1		019 F5G AN Levels 027 F5G-A MCA
QoE	005 QoE definition	015 Home QoE evaluation	017 Home QoE measurement 026 Home QoE monitoring
Industry		007 Industry PON - GR	022 Industry PON - GS
Access		011 AN Telemetry frame. 016 AN Telemetry model	025 Computing in PON
Transport			018 OCN arch
Security		010 Security analysis 012 Security arch	
PoC	009 PoC #1 Industrial PON #2 Telemetry #3 Optical Service		#4 Visual Inspection #5 AGV
Whitepaper	2020: F5G: Bringing Fibre to Everywhere and Everything	2021: F5G Impact & Benefits: Fibre Development Index	2022: F5G Advanced and Beyond 2023: All-fibre network facilitates the Carbon Shift

Legend: Published Early draft Whitepaper

➤ Till now:

- **Weekly** conference call
- **16** WIs published
- **11** WIs under development
- **3** Whitepapers published *(2023 WP will be published soon)*
- **5** PoCs created, **3** of whom finished

➤ Release 1 & 2 were done and all set published

➤ Now working on F5G-Advanced (Release 3)

Industry synergy (1) – Cooperation with Other SDOs

SDO Cooperation

Industry Outreach Activities

Academia Activities

➤ Multi-SDO (ETSI, ITU, CCSA, BBF) Joint FTTR workshops, promoting FTTR



1st WS (2021.6)

- Share UCs
- Identify tech. gaps

2nd WS (2022.6)

- Align tech. direction
- Common sense in data rate

3rd WS (2023.6)

- Sync up arch. & tech. spec.
- Discuss future evolution

ISG F5G put forward FTTR, initiated the WS and takes the lead in multi-SDO cooperation, greatly promoting ISG F5G

➤ Cooperation between ETSI and BBF

Extra efforts based on previous year (cooperation in the name of ETSI, not just in ISG F5G)



➤ Cooperation between ETSI and CCSA



- ETSI-CCSA CA signed
- Joint F5G workshop on 2022.11.09
- Luis (ETSI DG) & Wen Ku (CCSA DG) attended the WS

Industry synergy (2) – Cooperation with Ecosystem Players

SDO Cooperation

Industry Outreach Activities

Academia Activities

- **10+** outreach activities per year
- Participants: **Top experts** from Tier-1 operators, mainstream vendors (including Nokia, Infinera, Ciena) etc.

Domains	Event	Theme & Way of Work	Date & Venue
Industry	MWC 2023	F5G workshop	Feb 27 ~ March 02, Barcelona
Academia	OFC 2023	F5G workshop (online + onsite)	March 05~09, San Diego, USA
Industry	FTTH Council 2023	F5G presentation	April 18~20, Madrid
Industry	NGON & 5G Transport	F5G Workshop	May 30, Mandelieu-La Napoule
Standard	3rd FTTR 4-party joint FTTR Workshop	ITU, together with ETSI and CCSA & BBF	June 23
Standard	ETSI Webinar	F5G Architecture introduction	July, 2023
Technical	BAsE	Broadband Technical Summit (UFBB)	September 27~28, Den Haag –deferred 1Q24
Academia	ECOC 2023	F5G and Evolution towards F6G	Oct 01~05, Glasgow
Application	BBWF 2023	F5G Workshop	Oct. 24~26, Paris
Standard	2nd ETSI & CCSA joint F5G Workshop	2nd ETSI & CCSA joint F5G Workshop	November 2023 (planned)
Academia	ACP 2023	F5G Workshop	Nov 05~08, Wuhan



HHI F5G Openlab @ MWC



HHI F5G Openlab @ Hannover



F5G Green All-Optical Forum @ MWC



F5G workshop @ NGON



WBBAworkshop @ Network X

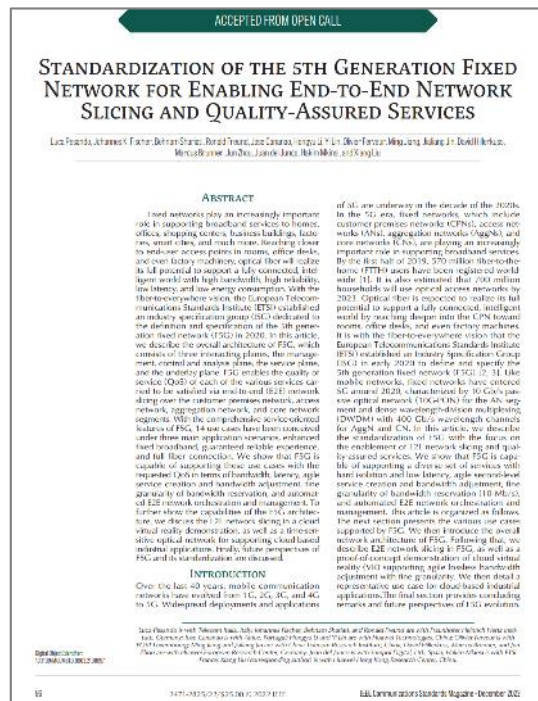
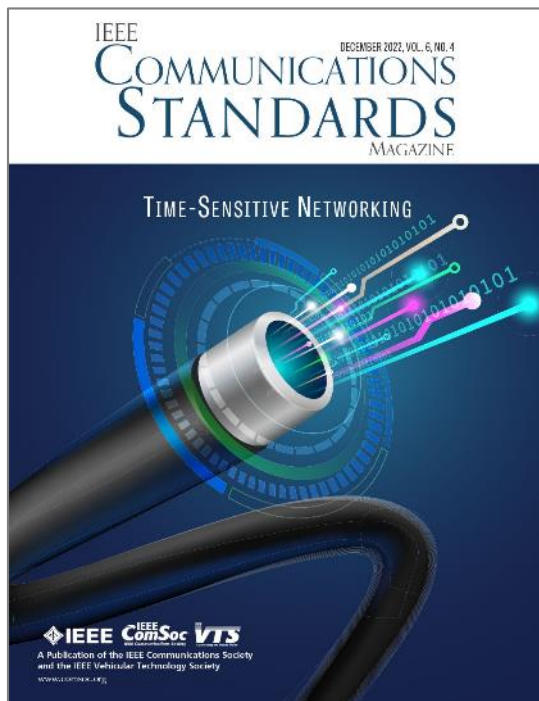
Industry synergy (3) – Cooperation with Academia

SDO Cooperation

Industry Outreach Activities

Academia Activities

IEEE Paper



FRONT-EDGE (Academic Salon)



Workshop on Broadband Access and Edge Networking

Co-organized with the FRONT-EDGE Salon:
FutuRe Optical Networking Salon (FRONT): The EDGE



2021: Barcelona (at UPC)
2022: Porto (with CSNDSP)
2022: Bucharest (in ICTON)

ACCESS I Chair: Josep Prat / Josep Segarra	ACCESS II Chair: Ivan Cano	ACCESS & PhotoMAN Chair: Michela Svaluto
Tu.C1.1 The 6th generation fixed network (F6G): Vision and directions M. Brunner Tu.C1.2 Multi-RAT fiber-wireless technologies towards 6G networks C. Vagionas, R. Maximidis, K. Kanta, P. Toumasis, G. Giannoulis, D. Apostolopoulos, G. Kalfas, M. Gatzianis, A. Mesodiakaki, H. Avramopoulos, A. Miliou, and N. Pleros Tu.C1.3 F5G OpenLab: Enabling twin transition through ubiquitous fiber connectivity M. Balanici, B. Shariati, P. Safari, P. Chojekci, M. Chemnitz, D. Przewozny, J. K. Fische, and R. Freund Tu.C1.4 FDMA in point-to-multipoint fibre access systems for non-residential applications I. N. Cano, G. Caruso, Jinlong Wei, G. Talli, C. Bluemm, S. Calabro, H. von Kirchbauer, U. Wuensche, P. Leyva, H. Rongfang, Kuo Zhang, and Zhicheng Ye Tu.C1.5 Digital subcarrier based point-to-multipoint coherent transceivers for bidirectional transmission A. Napoli	Tu.D1.1 SOA-based optical networks with sub-microsecond control plane for low-latency applications H. Santana, A. Mejleh, and N. Calabretta Tu.D1.2 Band evaluation of coherent udWDM-PON with paired lasers J. Segarra, V. Sales, and J. Prat Tu.D1.3 PIC-based transceiver for access networks: Package and functionalities verification towards a commercial solution F. Rodrigues, J. Santos, C. Rodrigues, H. Neto, and A. Teixeira Tu.D1.4 Optical DACs for ultra-high-speed green photonic interconnects M. Nazary and I. Tomkos	We.A1.1 ML-based optimization of geometric constellation shaping for unamplified coherent optical systems B. M. Oliveira, M. S. Neves, F. P. Guimaraes, M. C. R. Medeiros, and P. P. Monteiro We.A1.2 Performance evaluation of high data rate transmission and optically powered IoT ecosystem over SI-POF for smart home applications F. M. A. Al-Zubaidi, D. S. Montero, P. J. Pinzon, and C. Vazquez We.A1.3 Experimental demonstration of a 400 Gb/s full coherent transmission in an in-field metro-access scenario M. Casasco, G. Rizzelli, A. Pagano, R. Mercinelli, M. Valvo, V. Ferrero, and R. Gaudio We.A1.4 Investigation of mid-term migration scenarios to multi-band solutions in metropolitan networks J. P. Fernandez-Palacios, F. Arpanaci, J. M. Rivas-Moscoso, J. A. Hernandez, and D. Larrabeiti

- Author: 16 main contributors of ISG F5G
- “Standardization of the 5th Generation Fixed Network for Enabling End-to-End Network Slicing and Quality-Assured Services”
- IEEE Communications Standards Magazine, Volume 6, Issue 4, 2022.12

3-year program for F5G academic salon (2021, 2022 & 2023)

- Cutting edge application use cases
- DSP & transmission in edge/access
- Enabling technologies

Evolving F5G to F5G Advanced for 10Gbps Everywhere

Gigabit Society

10Gbps Everywhere

F5G

2020

F5G Advanced

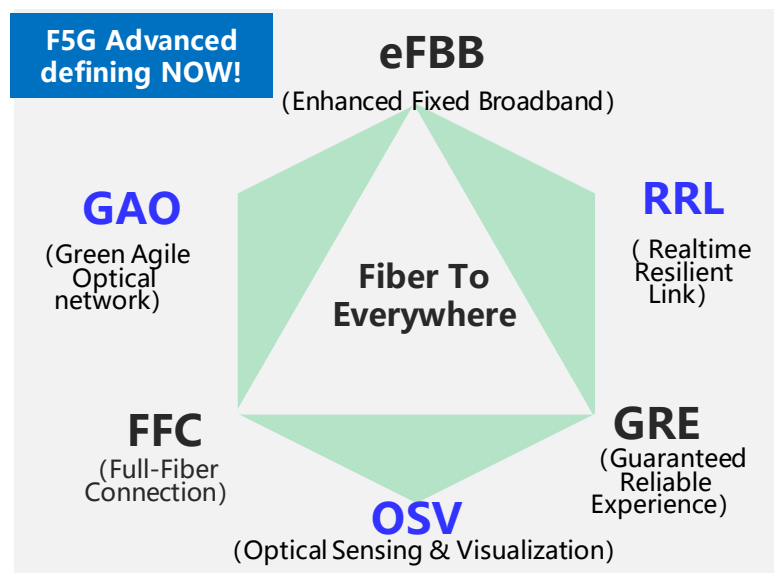
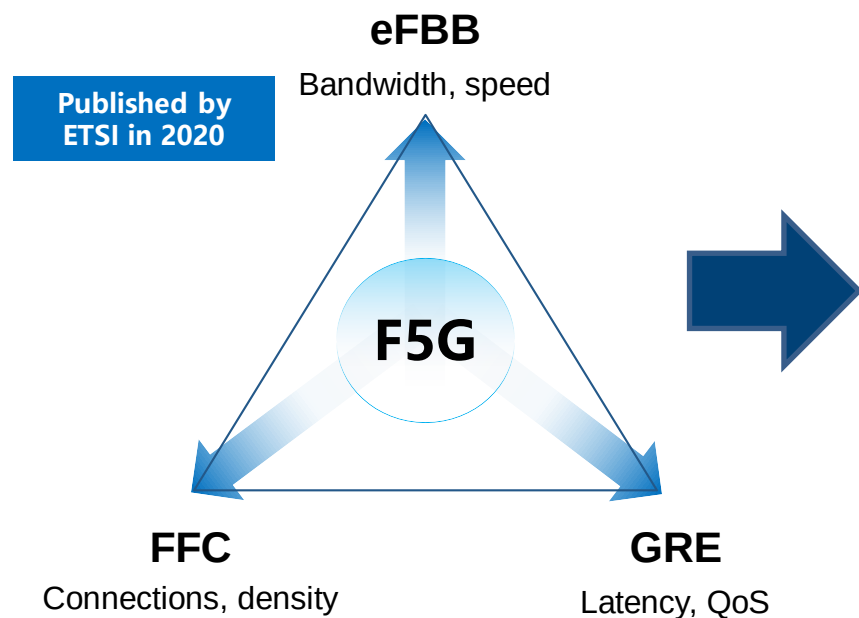
2025

F6G

2030

Extension (existing scenarios)

Expansion (new scenarios)

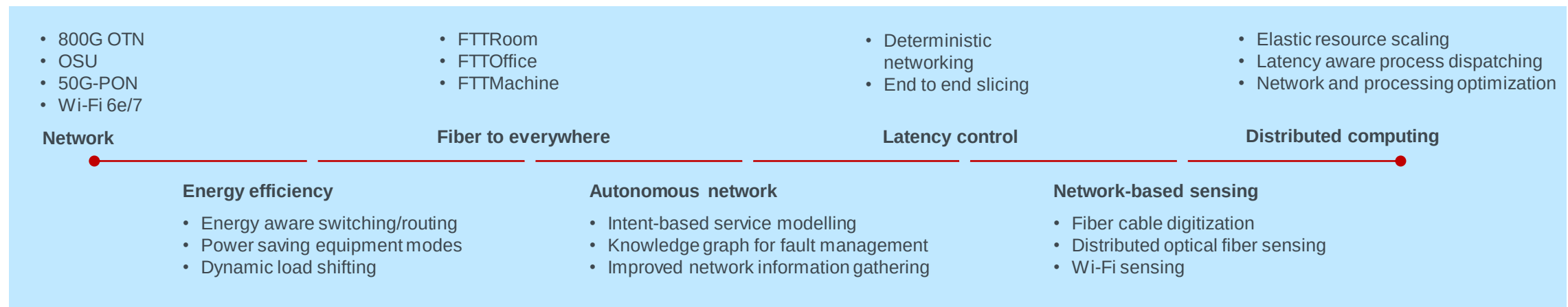


Key drivers and enabling technologies for F5G Advanced Evolution

Drivers

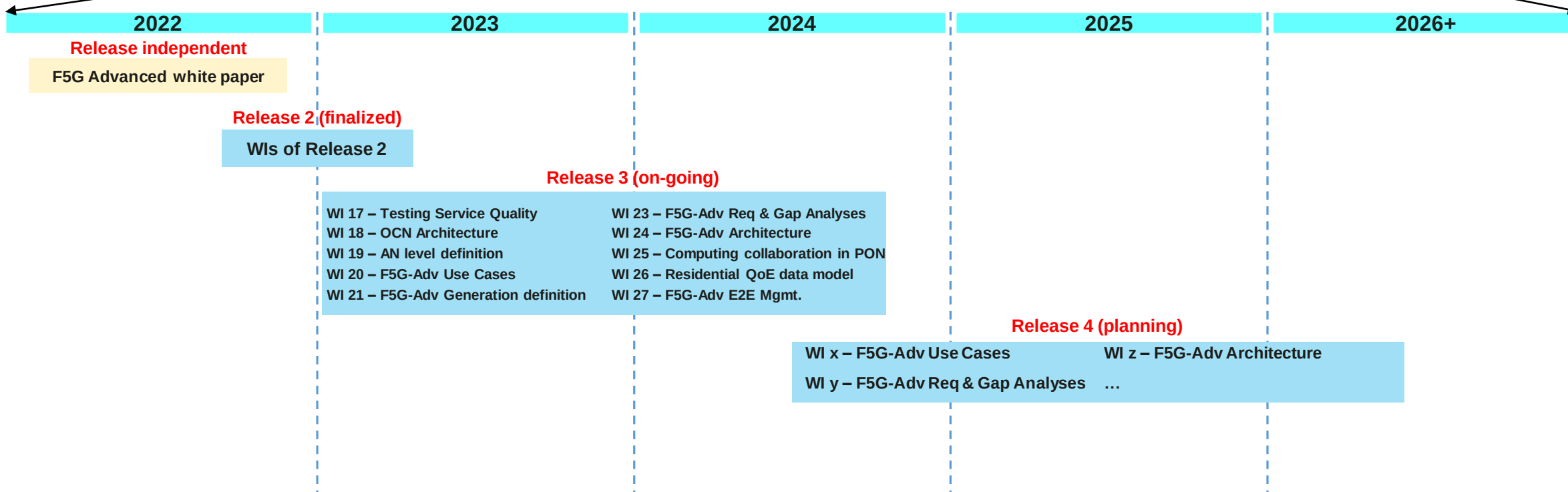
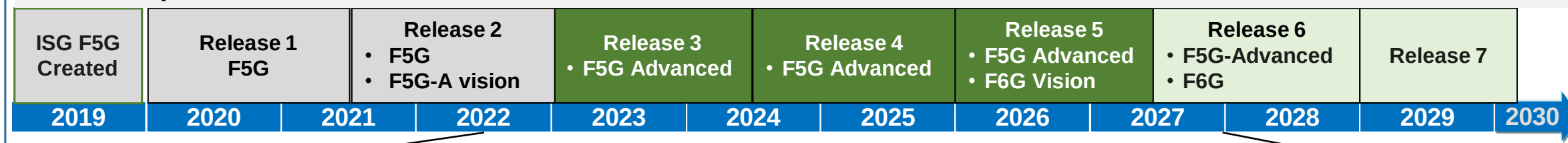


Enabling technologies

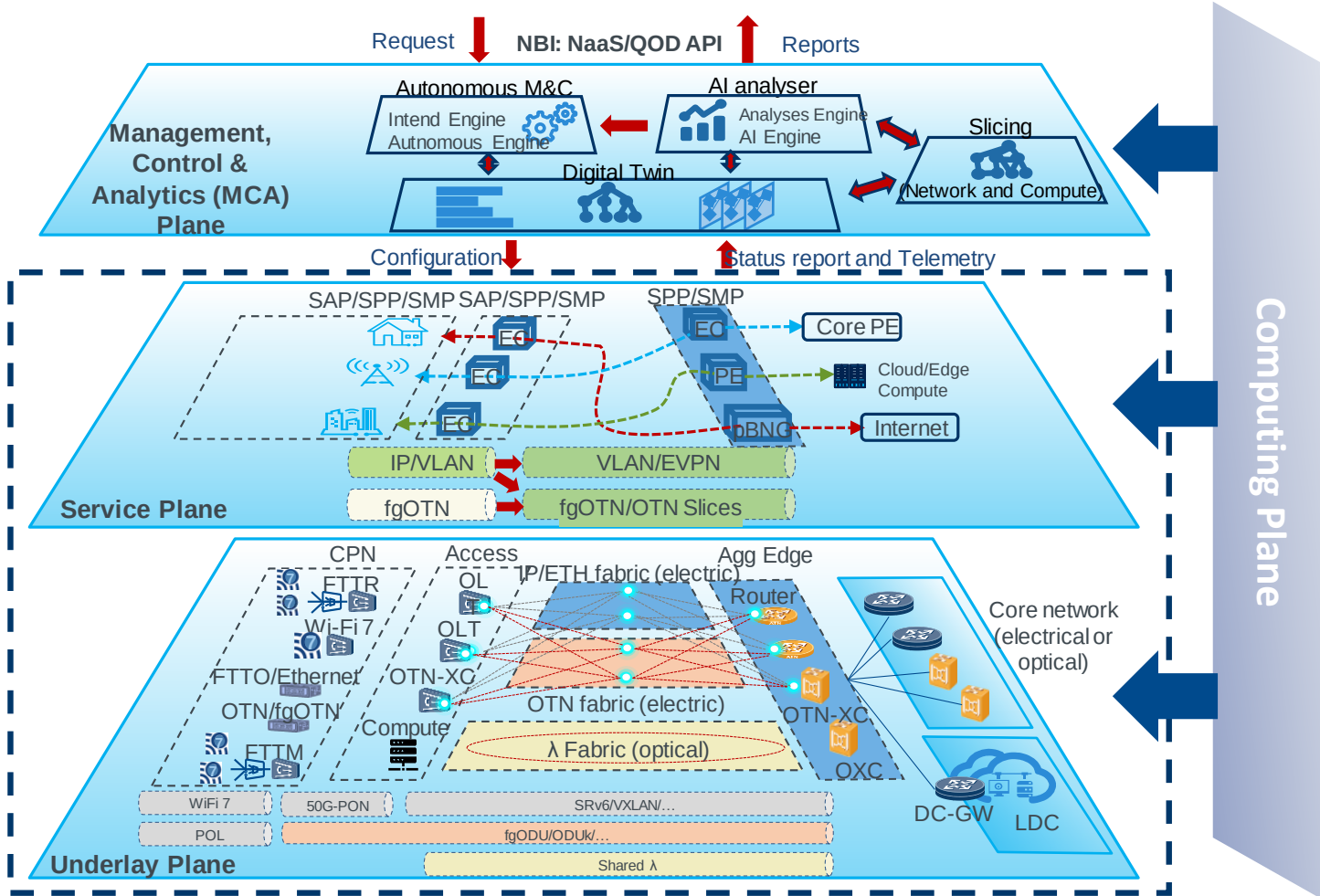


F5G Advanced: Release and Evolution Roadmap

- ISG F5G planned to finished F5G Advanced in three release and then move to F6G in 2027



F5G Advanced Architecture (in progress)



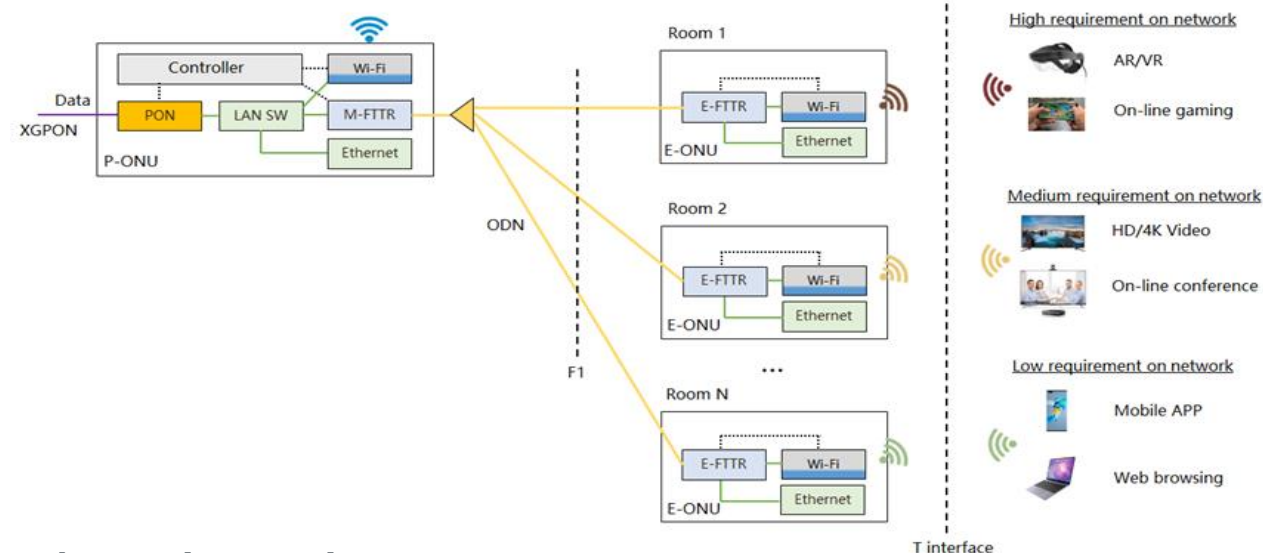
- **Underlay Plane:** OTN + IP/Eth dual plane
- **Service Plane:** decoupled, fgOTN for high-quality cloud services
- **MCA Plane:** AN L4, intelligent network operation
- **Cross-layer computing resources** for:
 - AI analyser & Digital Twin @ MCA Plane
 - Service Processing & Mapping Points @ Service Plane
 - NE-level AI training & inference @ Underlay Plane

F5G Advanced CPN: Fibre to the Room (FTTR)

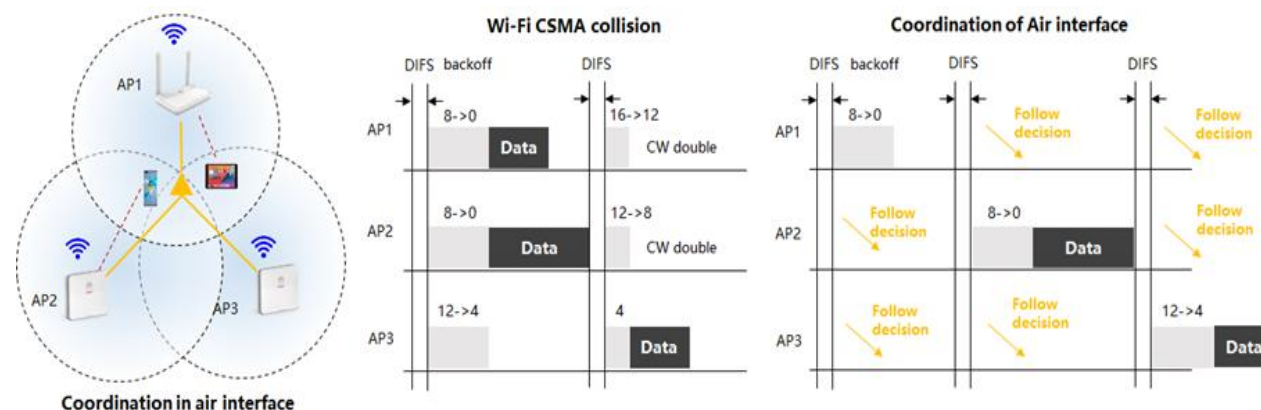
- Enhancing FTTR with coordination
- Improved QoE
- Application for Residential and SME

Reference: Dechao Zhang, Jinglong Zhu, Xiang Liu, Xuming Wu, Junwei Li, Yan Zeng, Xiaoshu Si, and Han Li, "Fiber-to-the-room: a key technology for F5G and beyond," J. Opt. Commun. Netw. 15, D1-D9 (2023)

Centralized Wi-Fi access network architecture through centralized control in FTTR

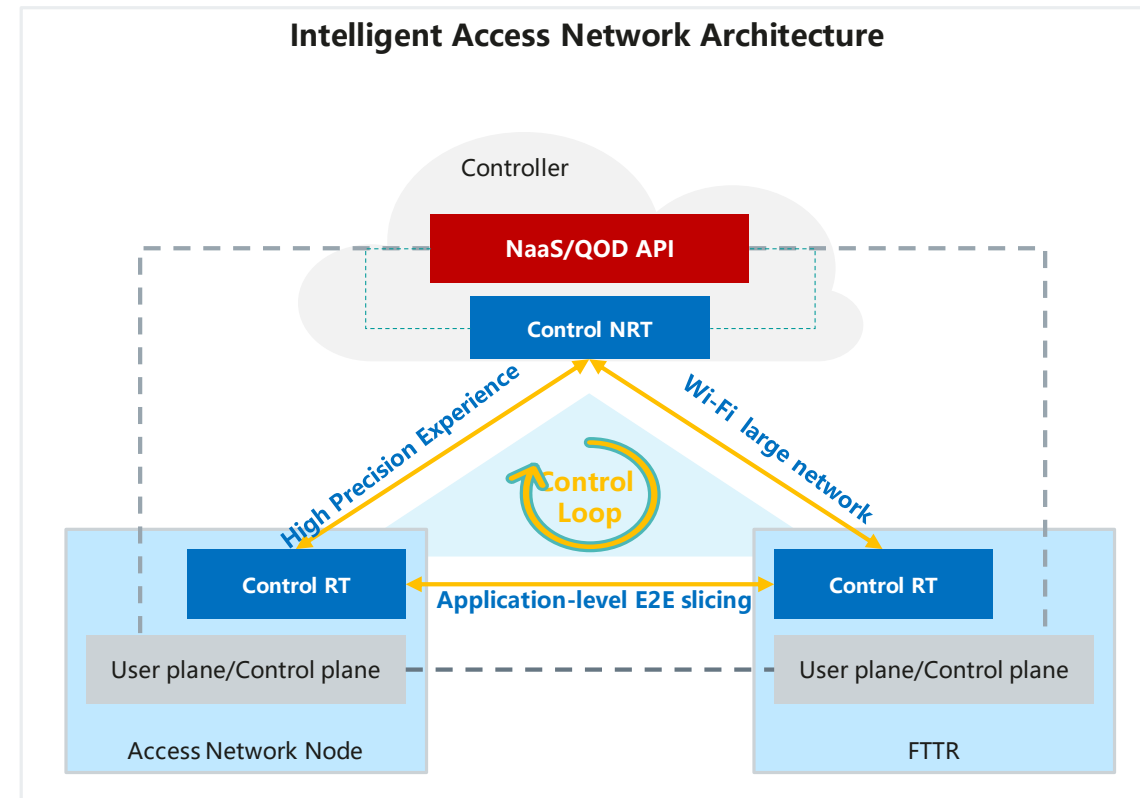


Fibre-wireless coordination



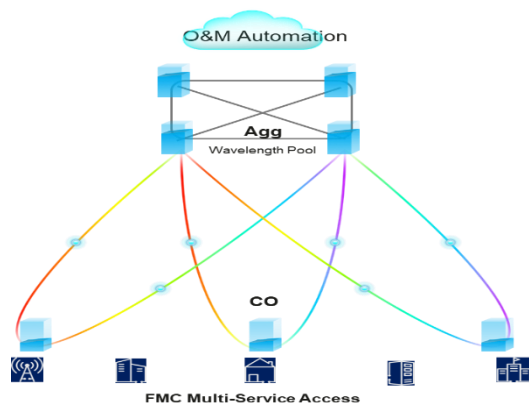
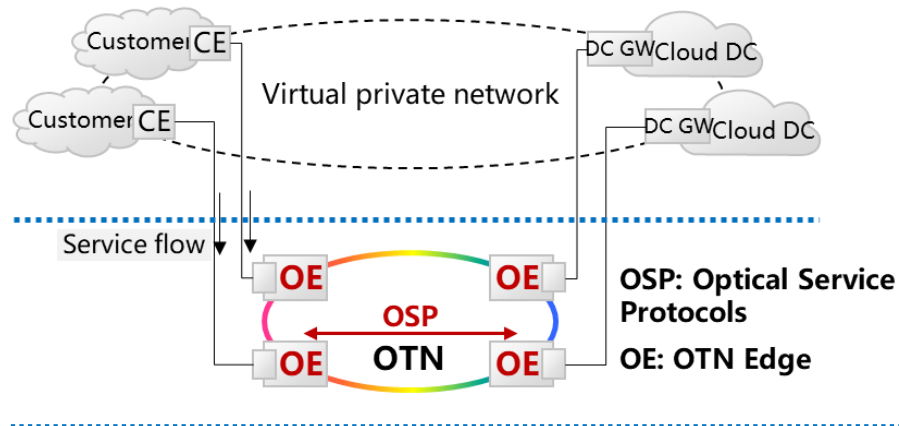
F5G Advanced Intelligent Access Networks

- Network as a Service and Quality on Demand APIs
- Separation of real-time and non-real-time control
- Integration of Access Networks and FTTR
- End-to-end Slicing



F5G Advanced Simplified Optical Transport Network for Cloud Services

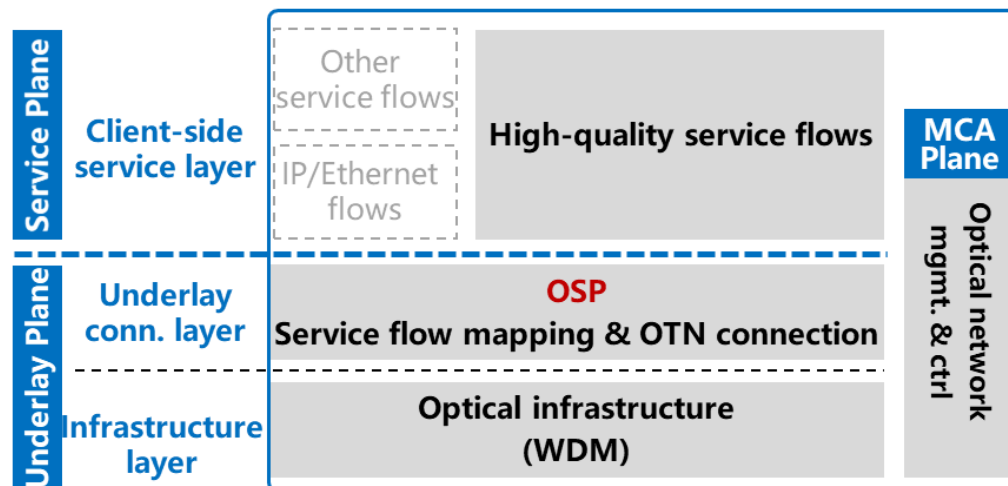
Optical Cloud Network (OCN)



Wavelength-shared WDM

Key enabling technologies:

- Using **fgOTN** for High-quality cloud services
- Innovative **OSP** protocol to enable cloud-service-driven OTN
- **Multi-λ** shared by multi access rings, dynamic re-allocation



Value-added cloud service-oriented Optical Networks

Simplified optical infrastructure with lower CapEx & OpEx

Summary

- Standardization Methodology: Use Cases, Requirements, Gaps, Architecture
- Roadmap-driven Standardization: Generations and Releases
- Release 3 specifying F5G Advanced (in progress)
- End-to-end perspective on optical networks
- F5G Driving the Green and Digital Transformation