Optical Access Standards Progress

Session 1: Fiber Access Technology Updates

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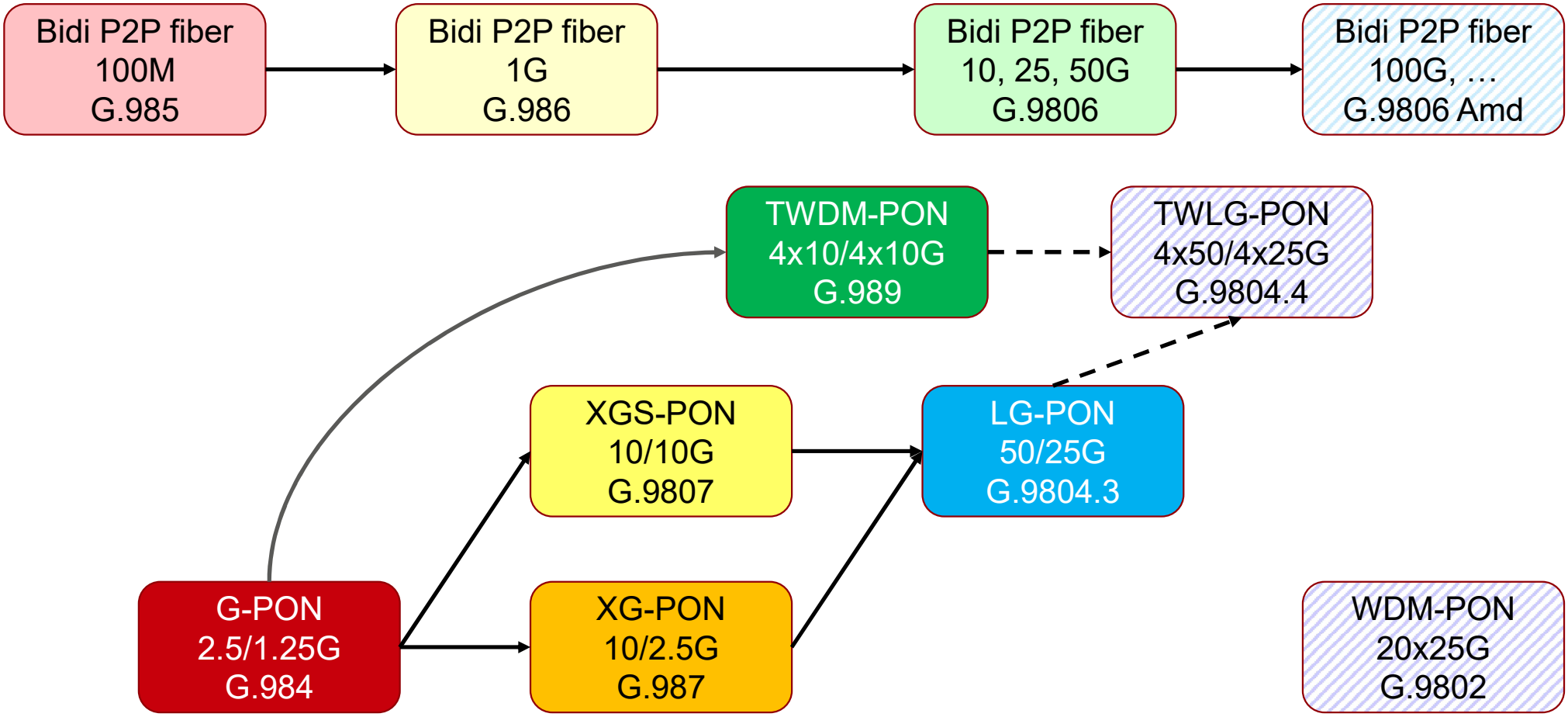
Optical access standards framework



FUTUREWEI Technologies

SG-15 Flyers are on-line

https://www.itu.int/en/ITU-T/studygroups/2017-2020/15/Pages/tflyers.aspx

Committed to connecting the world

Technical Flyers

SUSTAINABLE DEVELOPMENT GOALS

MGFast: Multi-Gigabit fast access to subscriber terminals

PON Overview: ITU-T Passive Optical Network Solutions

G.984: Gigabit Passive Optical Networks

G.984.5 Amendment: Gigabit Passive Optical Networks: Enhancement band and PON Coexistence

G.987: 10-Gigabit Passive Optical Networks

G.9807: 10-Gigabit Symmetric Passive Optical Networks

G.989: NG-PON2 Passive Optical Networks

G.988: ONU Management and Configuration Interface

G.986: 1 Gbit/s point-to-point optical access system and G.9806: Higher-speed bidirectional point-to-point

G.9802: Multiple-Wavelength Passive Optical Networks

G.9803: Radio over fibre systems

G.9804: HSP: Higher Speed Passive Optical Networks

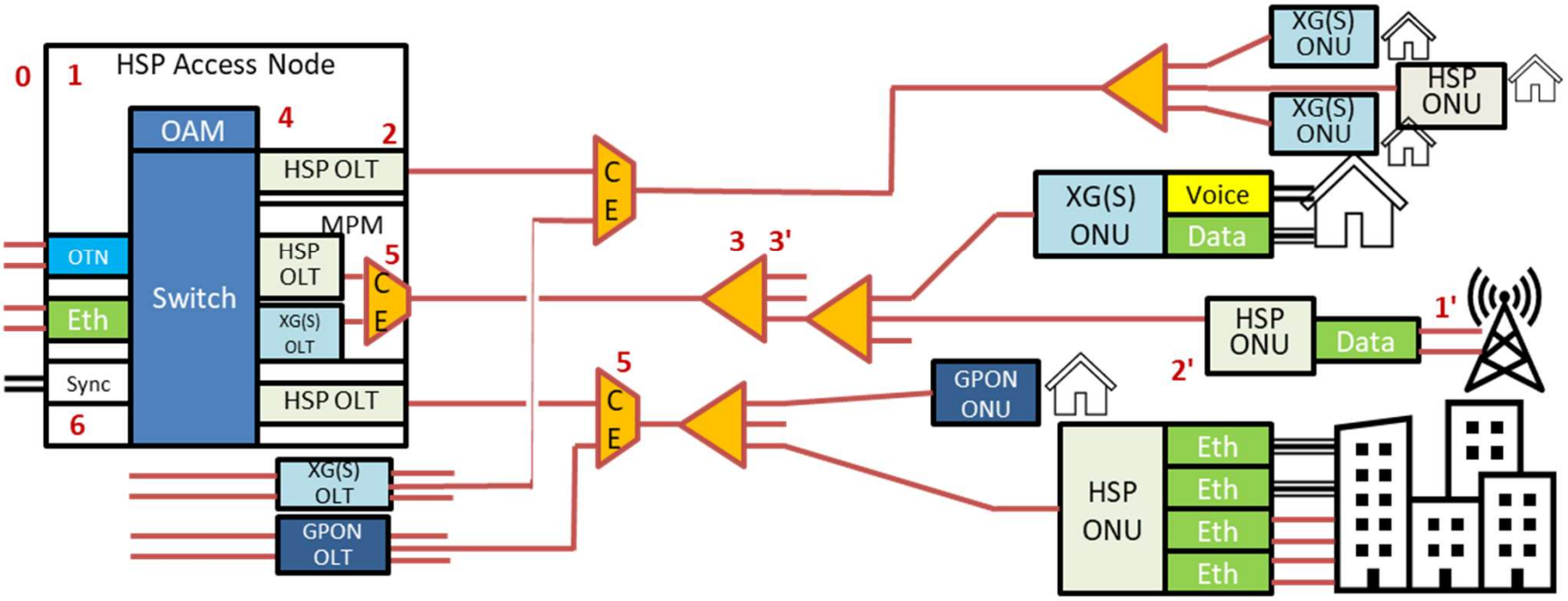
G.Suppl.66: 5G wireless fronthaul in a PON context

Expect a new batch of flyers to be released this Fall

ITU-T Study Group 15

G.9804 HSP: Higher Speed Passive Optical Networks

- Full-service support – including voice, TDM, Ethernet (10/100/1000/10G/25G BASE), xDSL, wireless xhaul
- Basic physical reach is 20 km. Logical reach of up to 60 km. System is wavelength coexistent with G-PON, XG(S)-PON, 10G-EPON
- Support for bit-rate options, 50 Gbit/s downstream and 12.5 or 25 or 50 Gbit/s upstream
- Powerful OAM&P and system protection capabilities
- providing a feature rich and reliable service management system
- Advanced security features including authentication, rogue detection, and information privacy
- Power saving features on top of the already considerable low power nature of fibre access

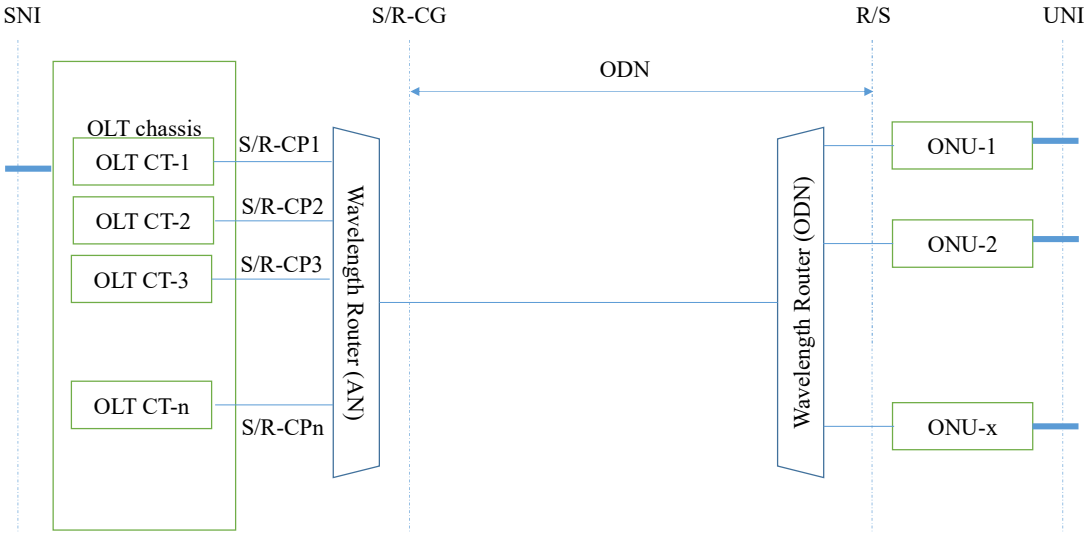


Major areas of progress

- G.9802.2: WDM-PON: PMD and TC layers
- G.9804.3: Higher speed PON: 50Gb/s upstream PMD specifications
- G.9805: PON coexistence and crosstalk issues
- G.9806 Amd.3: 100Gb/s Bidirectional point to point PHYs

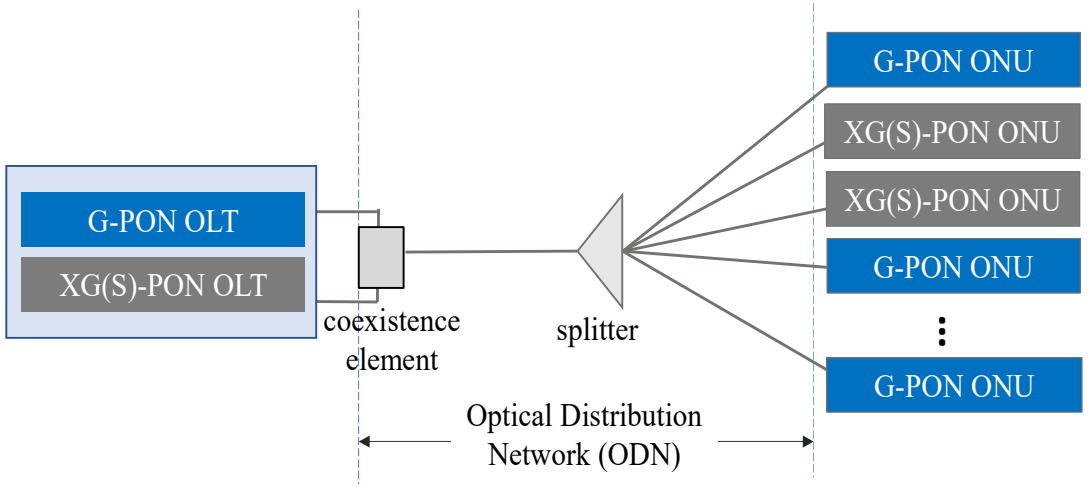
G.9802.2: WDM-PON PMD and TC layers

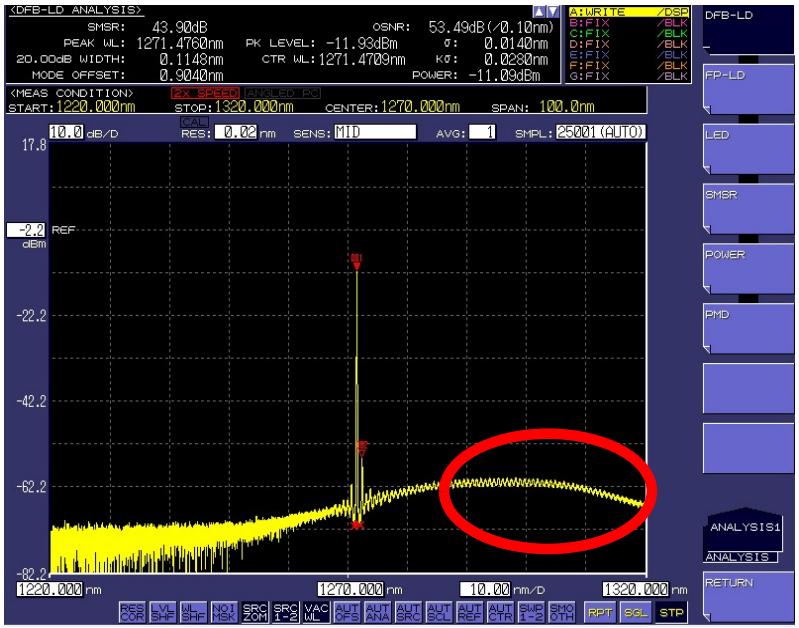
- System initially designed for 20 wavelengths in the C-band, with 100 GHz spacing
- Each channel is modulated at 10 or 25 Gb/s NRZ
- FEC follows the client signal format (no extra system FEC)

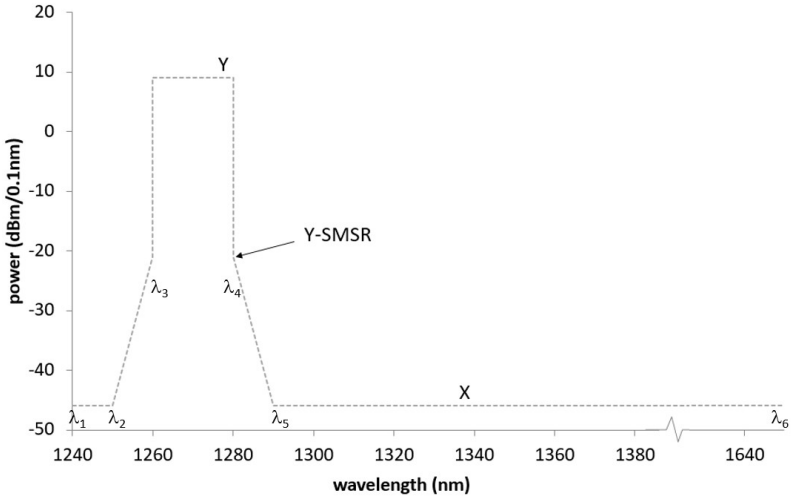


- Transmission convergence reuses XG-PON framing
  - Header-based wavelength ID
  - PLOAM for wavelength management
  - XGEM for higher layer management

G.9805: Crosstalk and coexistence issues



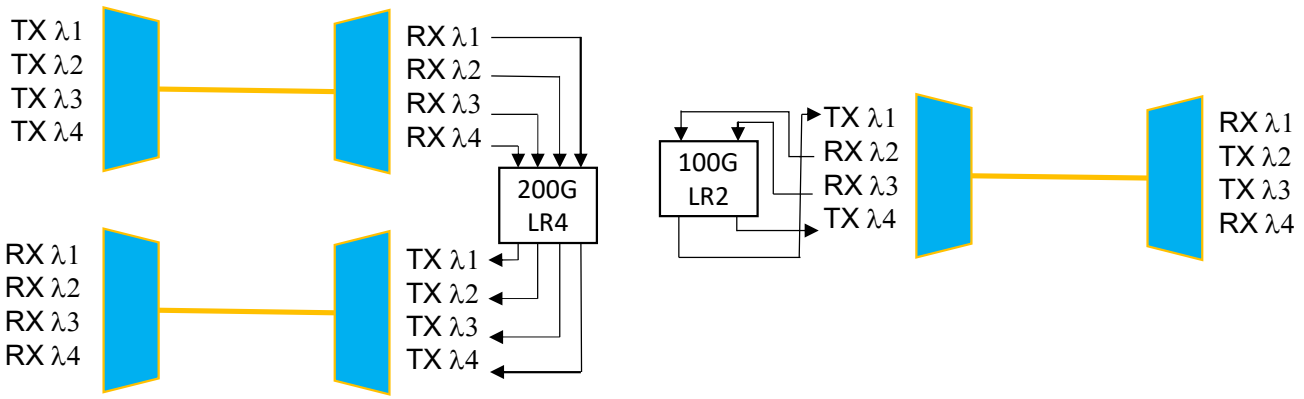




		XG 3	XG 6	XG 8	XG 7	XG 2	XG 4	XG 5	XG 1
	RSSI	-26	-24	-23.5	-20.5	-18	-17	-14	-14
G 3	-30					Error		Error	Error
G 2	-29.5							Error	Error
G 1	-29					T1	Error	Error	Error
G 4	-26						T2		Error
G 5	-20								
G 6	-15								

G.9806 Amd. 3: 100 Gb/s bidirectional point to point optics

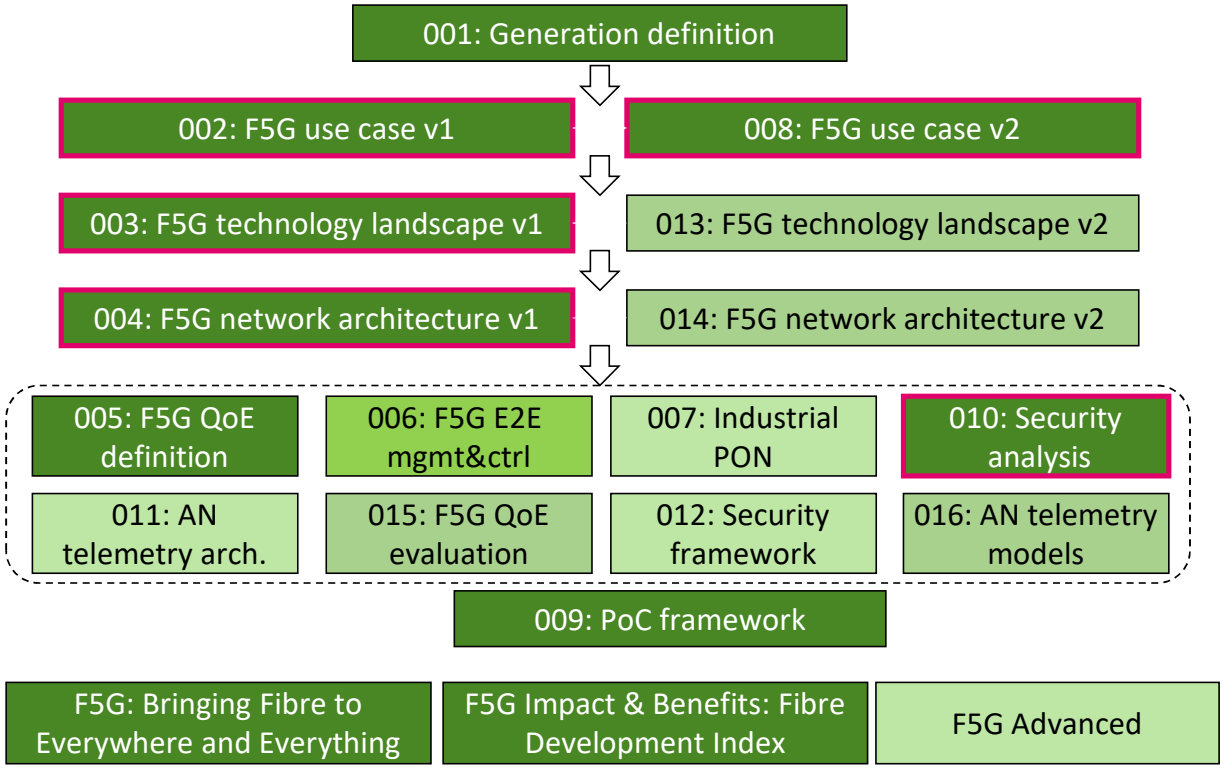
- While PON serves the vast majority of users, some applications just require so much dedicated bandwidth that point-to-point optics is the best solution
- As services increase, there is need for higher speeds
  - Currently, 25G and 50G are very popular for 5G wireless backhaul
  - 100G will be needed fairly soon, with 200 and 400G coming a few years later
- These higher speed systems will operate over the same ODN, making upgrade easier
- PMDs from the Ethernet market can be leveraged



ETSI Fixed 5th Generation project

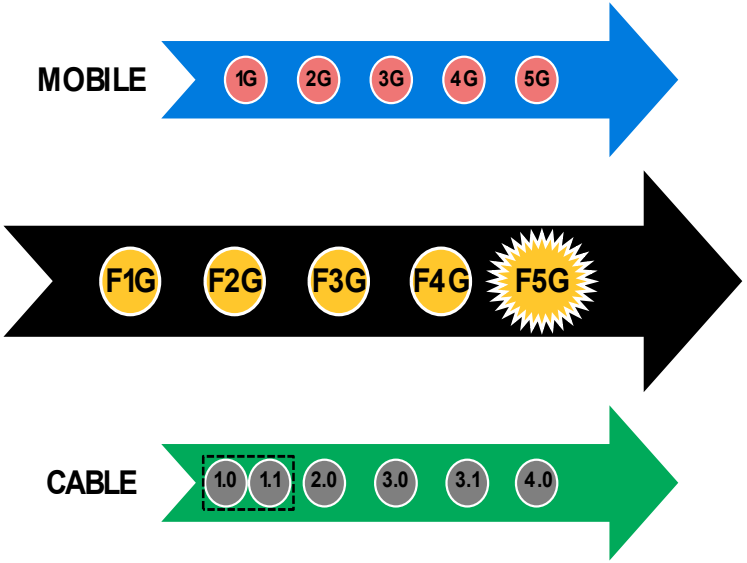
- The ETSI 3GPP project has proven to be a huge advantage for cellular wireless technology, and is key to its expansion
- Similarly, ETSI F5G runs a project to develop generations of fixed networks, their use cases, and the technology required

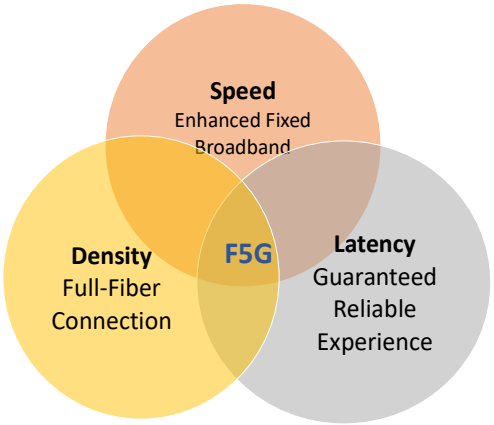
- Generations Definition
- Use Cases
- Technology landscape
- Architecture
- F5G Advanced and Beyond

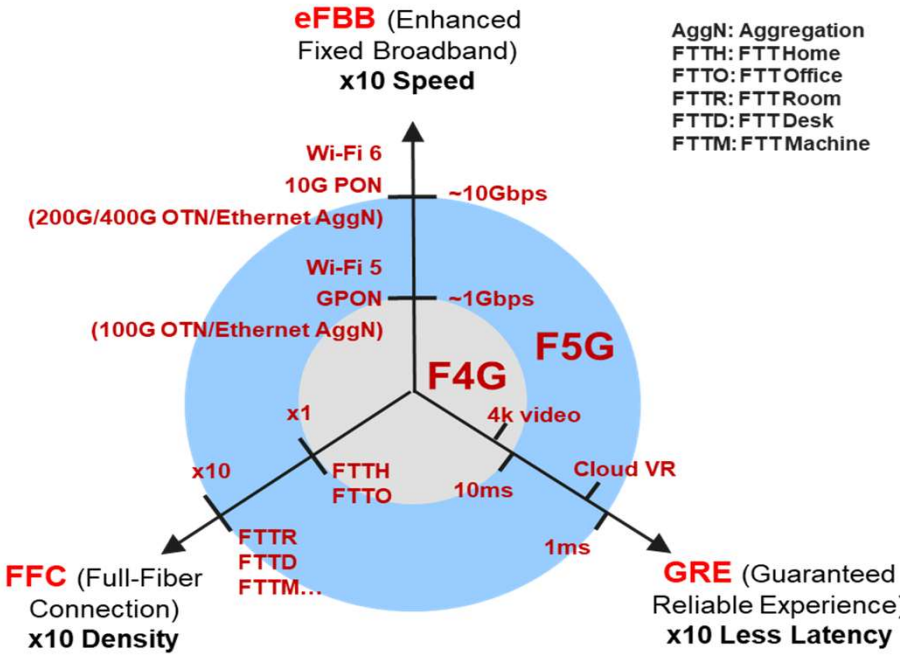


Fixed Network Generations Definition

- The evolution of wireless has benefitted from having well-defined generations
- Fixed networks have lacked this structure and definition, and has had uneven deployment over time

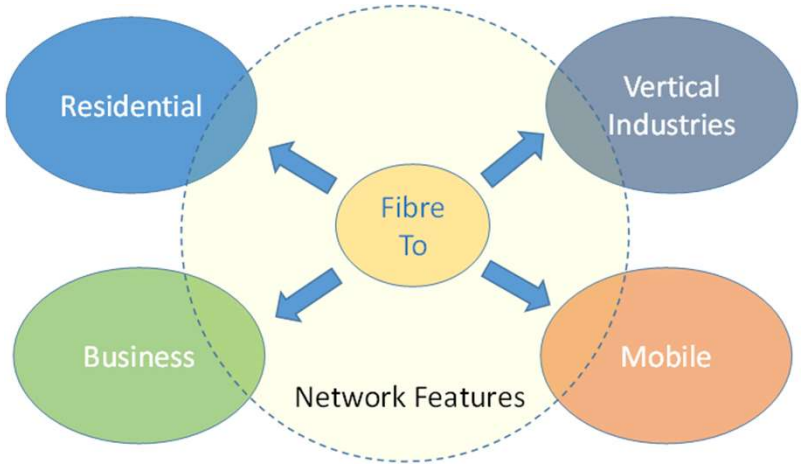






F5G Use Cases

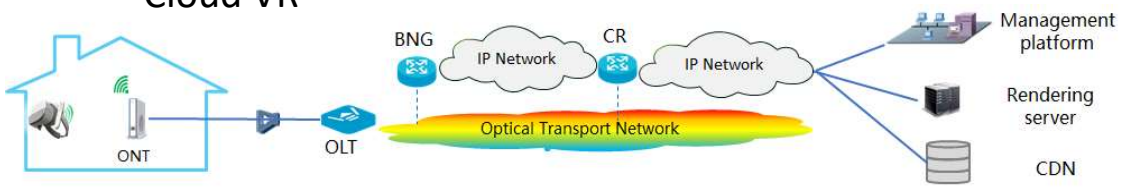
- Extending to various markets segements
- Enabling new services through new features
- Simplifying operations



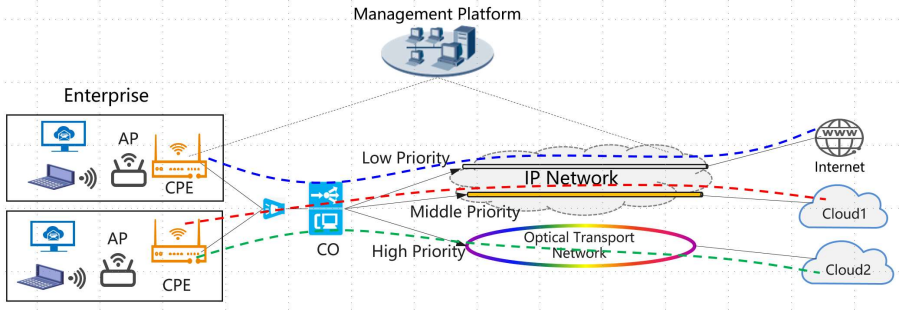
6.1	Use case #1: Cloud Virtual Reality	6.8	Use case #8: Multiple Access Aggregation over PON
6.2	Use case #2: High Quality Private Line	6.9	Use case #9: Extend PON to legacy Ethernet Uplink
6.3	Use case #3: High quality low cost private line for small and medium enterprises	6.10	Use case #10: Scenario based broadband
6.4	Use case #4: PON on-premises	6.11	Use case #11: Enhanced traffic monitoring and network control in Intelligent Access Network
6.5	Use case #5: Passive optical LAN	6.12	Use case #12: On Demand High Quality Transport for Real time applications
6.6	Use case #6: PON for Industrial Manufacturing	6.13	Use case #13: Remote Attestation for Secured Network Elements
6.7	Use case #7: Using PON for City Public Service	6.14	Use case #14: Digitalized ODN/FTTX
7.1	Use case #15: XR-based Virtual Presence	7.2	Use case #16: Enterprise private line connectivity to multiple Clouds
7.3	Use case #17: Premium home broadband connectivity to multiple Clouds	7.4	Use case #18: Virtual Music
7.5	Use case #19: Next Generation Digital Twins	7.6	Use case #20: Media Transport
7.7	Use case #21: Edge/Cloud-based visual inspection for automatic quality assessment in production	7.8	Use case #22: Edge/Cloud-based control of automated guided vehicles (AGV) .
7.9	Use case #23: Cloudification of Medical Imaging	7.10	Use case #24: F5G for Intelligent Mine
7.11	Use case #25: Enhanced optical transport network for Data Centre Interconnections)	7.12	Use case #26: Enhanced point to point optical access
7.13	Use case #27: Rural Scenarios	7.14	Use case #28: High-speed Passive P2MP Network Traffic Aggregation
7.15	Use case #29: Orchestration of B2B services in xPON networks	7.16	Use case #30: Bandwidth on Demand
7.17	Use case #31: Intelligent Optical Cable Management	7.18	Use case #32: AI-based PON optical path diagnosis

Selected Use Cases

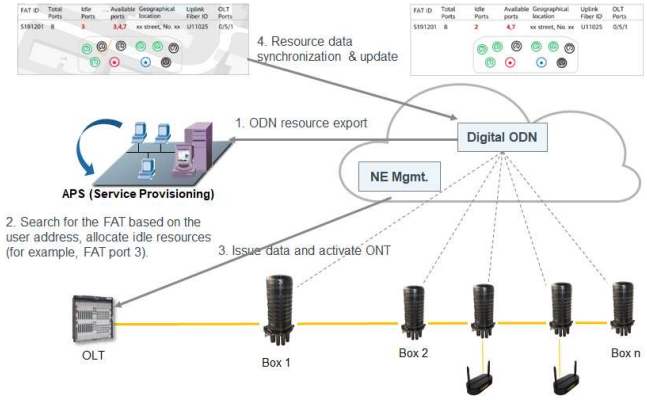
Cloud VR



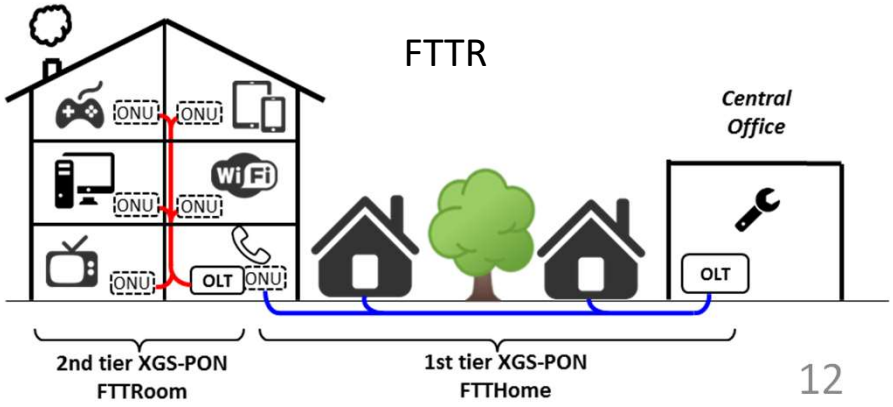
Low-Cost Premium Private Line for SME



Digitalized ODN

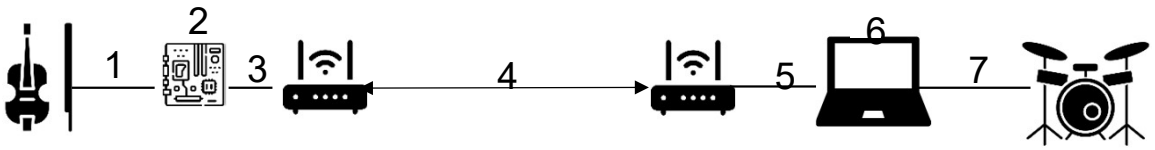


FTTR

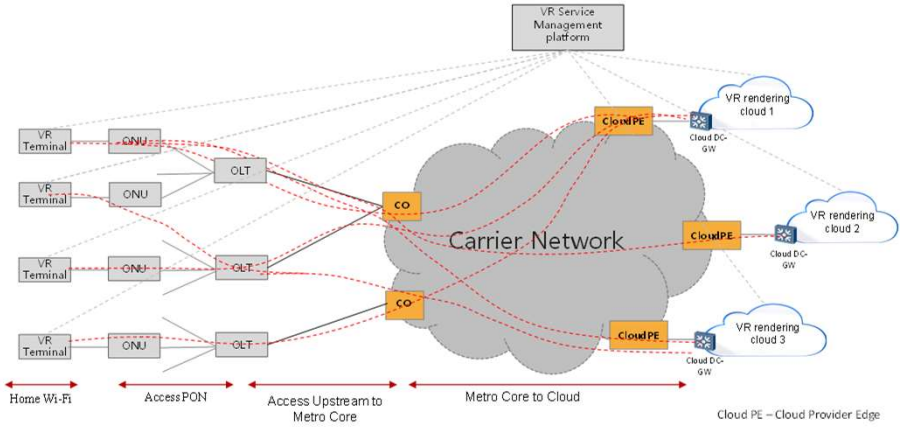


Selected Use Cases

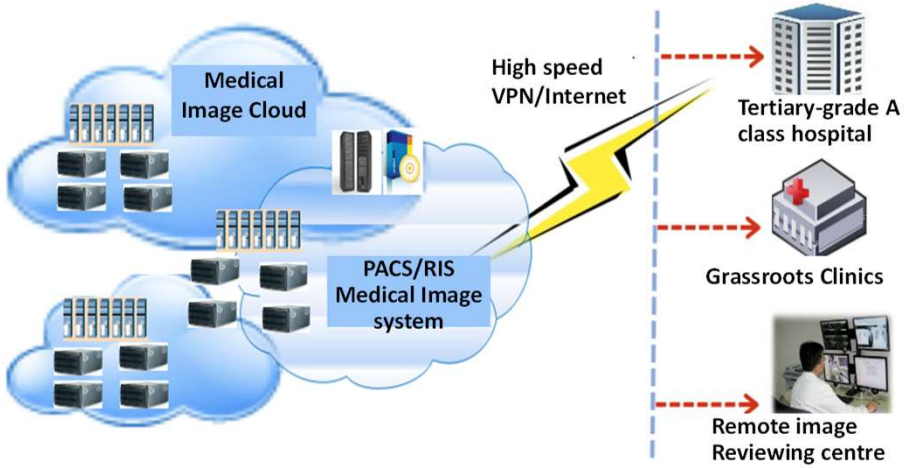
Residential: Virtual Music



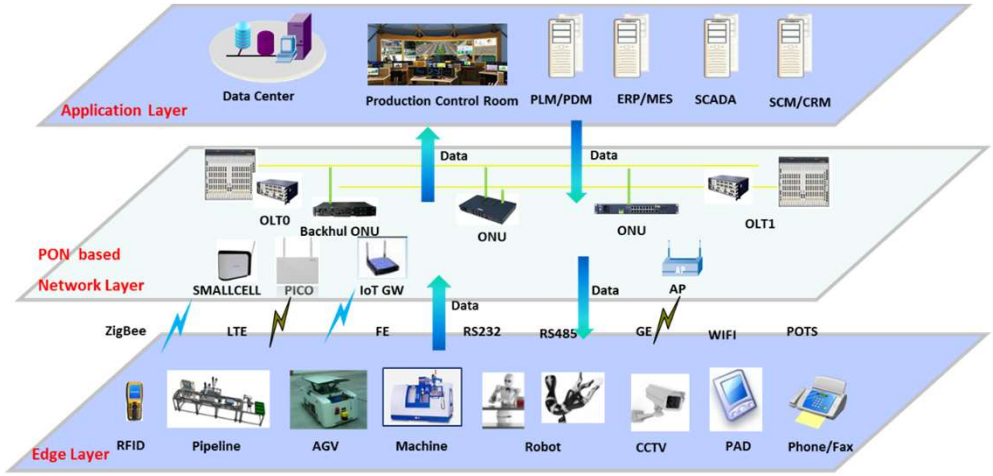
Enterprise: Optical Cloud Network to Multiple Clouds



Business: Cloudification of Medical Imaging

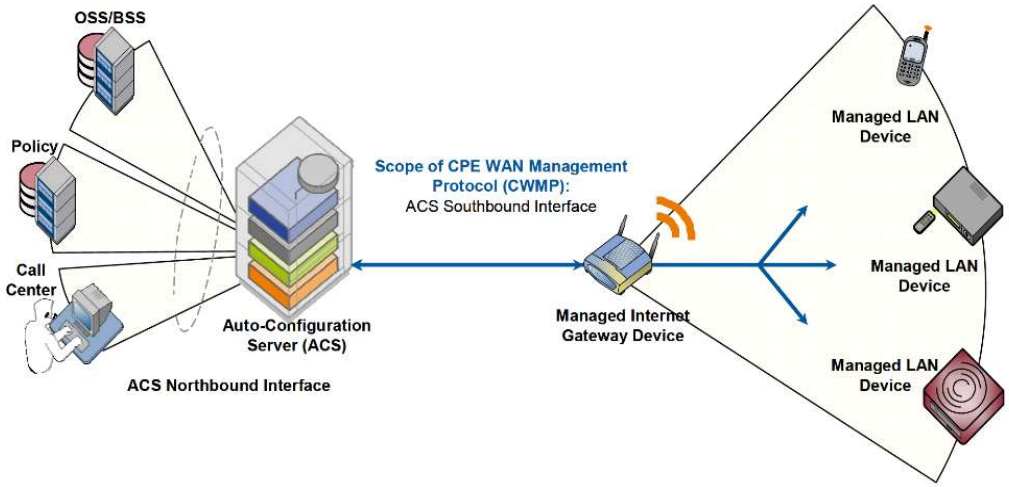


Verticals: Industrial PON



Technology landscape

- For each use case, the requirements are enumerated
- Standards from IEEE, ITU, BBF, WFA, etc. that serve these requirements are enumerated
- Analysis of any perceived gaps



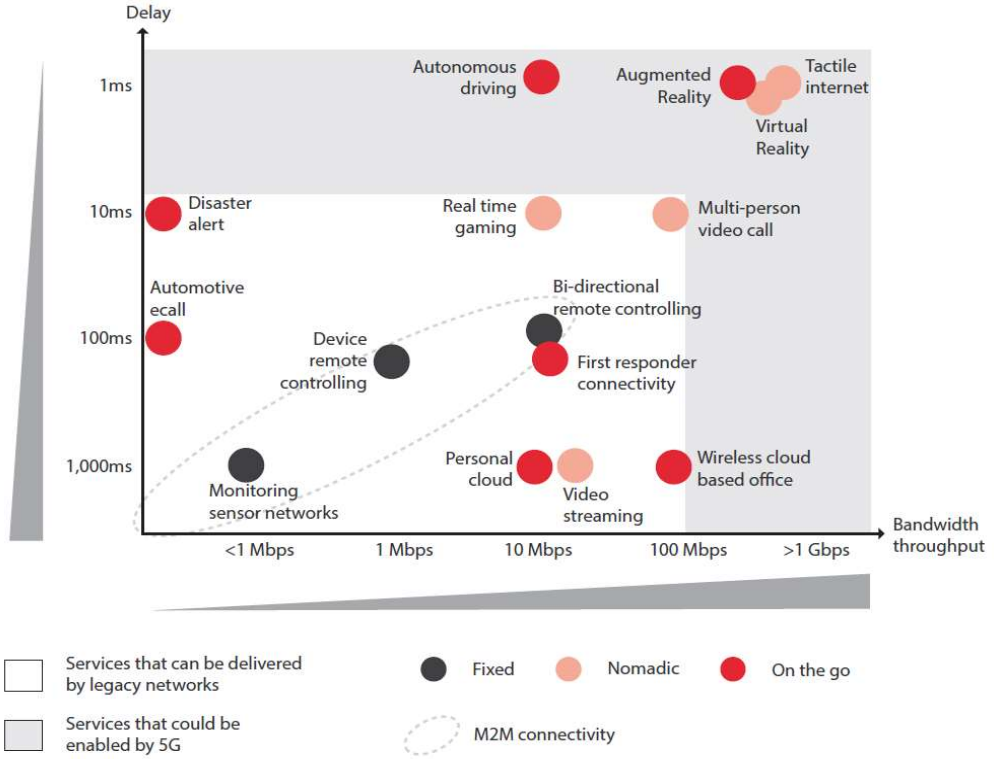
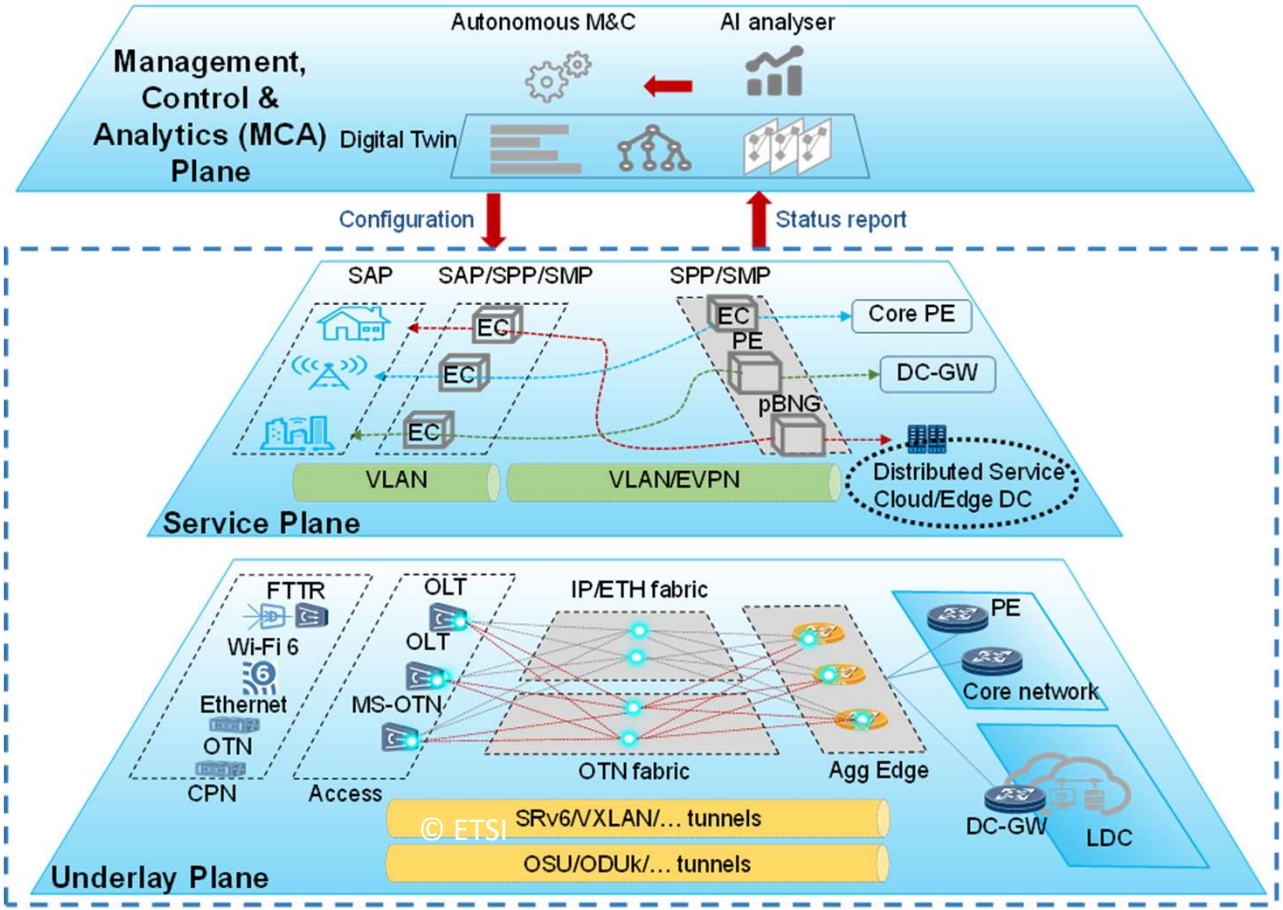


Figure 1: Bandwidth and latency requirements of potential 5G use cases

Source: GSMA Intelligence

F5G E2E Architecture



Key enabling features

- Separation of Services Plane and Underlay Plane
- Aggregation Network Fabric
  - Dual IP/Ethernet & OTN Fabric
- Network Slicing
  - Wi-Fi, PON, OTN, IP AggN Slicing
  - User Group Oriented Slicing
  - Service-Oriented Slicing
- AI-embedded Traffic Steering
- Autonomous E2E Management

https://www.etsi.org/deliver/etsi_gs/F5G/001_099/004/01.01.01_60/gs_F5G004v010101p.pdf

Summary

- The F5G effort is working to promote an all-fiber world
  - Increasing scale of deployment of advanced systems
  - Broadening the scope of F5G to cover even more applications
  - Better coordinating the standards and development
- White paper on F5G Advanced and Beyond
  - Considering what the next steps are for the project
- Please join the conversation!