In-premise fibre-based communication standard progress in ITU-T SG15

Tony Zeng
Associate Rapporteur of ITU-T SG15 Q3

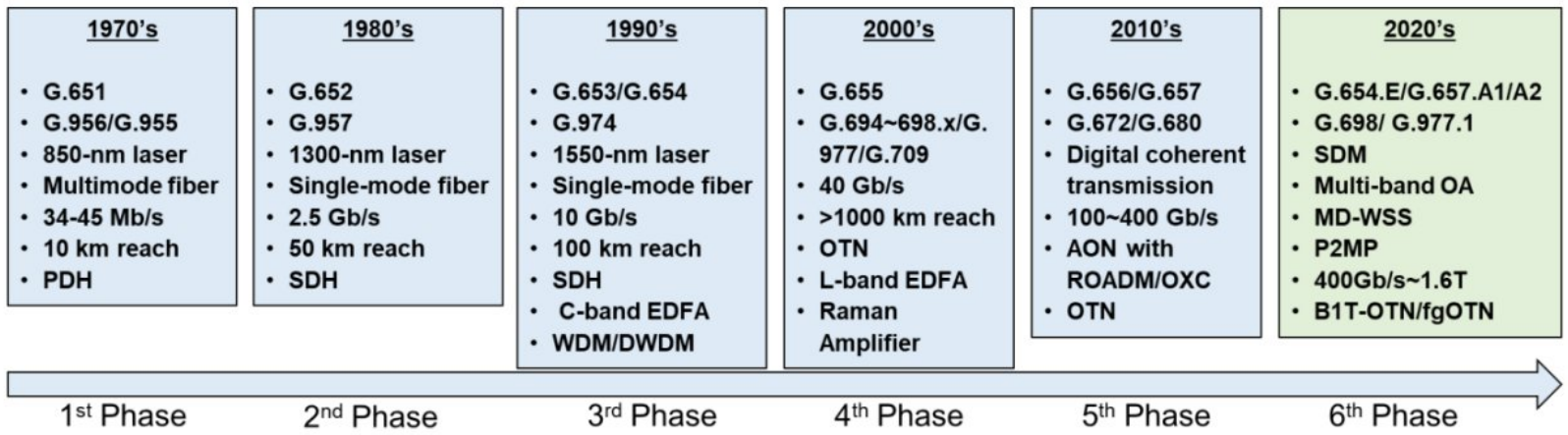
Presentation for 2024 Joint IEEE 802 and ITU-T Study Group 15 Workshop

Roadmaps from ITU-T, IEEE and ETSI-F5G

ITU Workshop on "The Evolution of Transport and Access Networks to Support IMT 2030/6G"

Programme

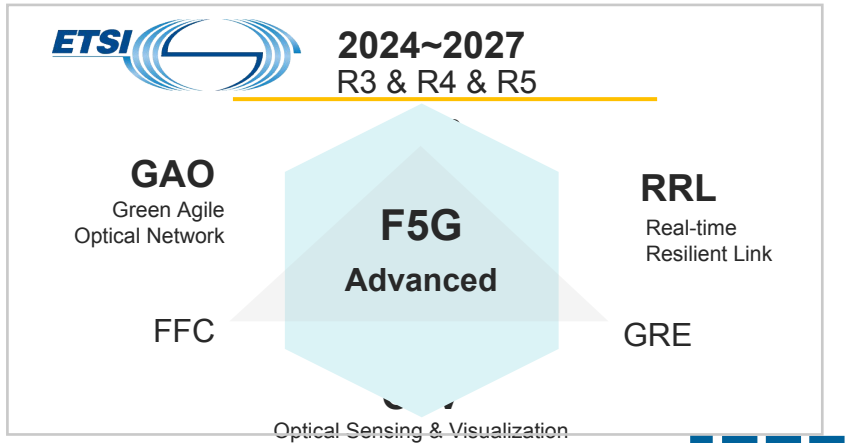
14:00 - 14:05	Opening Remarks Glenn Parsons, Chair, ITU-T SG15 I Ericsson, Canada [Presentation]
14:05 - 14:15	Summary of GSTR-TNSG Stephen Shew, Rapporteur Q12/15 I Ciena, Canada [Presentation]
14:15 - 14:45	Ven Sampath, ITU-R SG5/WP5A Vice-Chair I Ericsson, Canada: *ITU-R IMT-2030* [Presentation]
14:45 - 15:05	Jordan Melzer, Telus [Presentation]
15:05 - 15:25	Bhushan Padhiar, AT&T [Presentation]
15:25 - 16:00	Coffee Break
16:00 - 16:20	Kazuhide Nakajima, Rapporteur Q5/15 I NTT [Presentation]
16:20 - 16:40	Li Han, China Mobile [Presentation]
16:40 - 17:00	Ian Horsley, WP1/15 Vice-Chair I BT [Presentation]
17:00 - 17:20	Shen Shikui, China Unicom [Presentation]
17:20 - 17:50	Panel Discussion Moderators: Paul Doolan WP2/15 Chair [Presentation] & Malcolm Betts WP3/15 Chair
17:50 - 18:00	Closing Remarks Glenn Parsons, Chair, ITU-T SG15 I Ericsson, Canada



[1] Technical Report ITU-T TR-OFCS, under preparation by WP2 of ITU-T SG15.

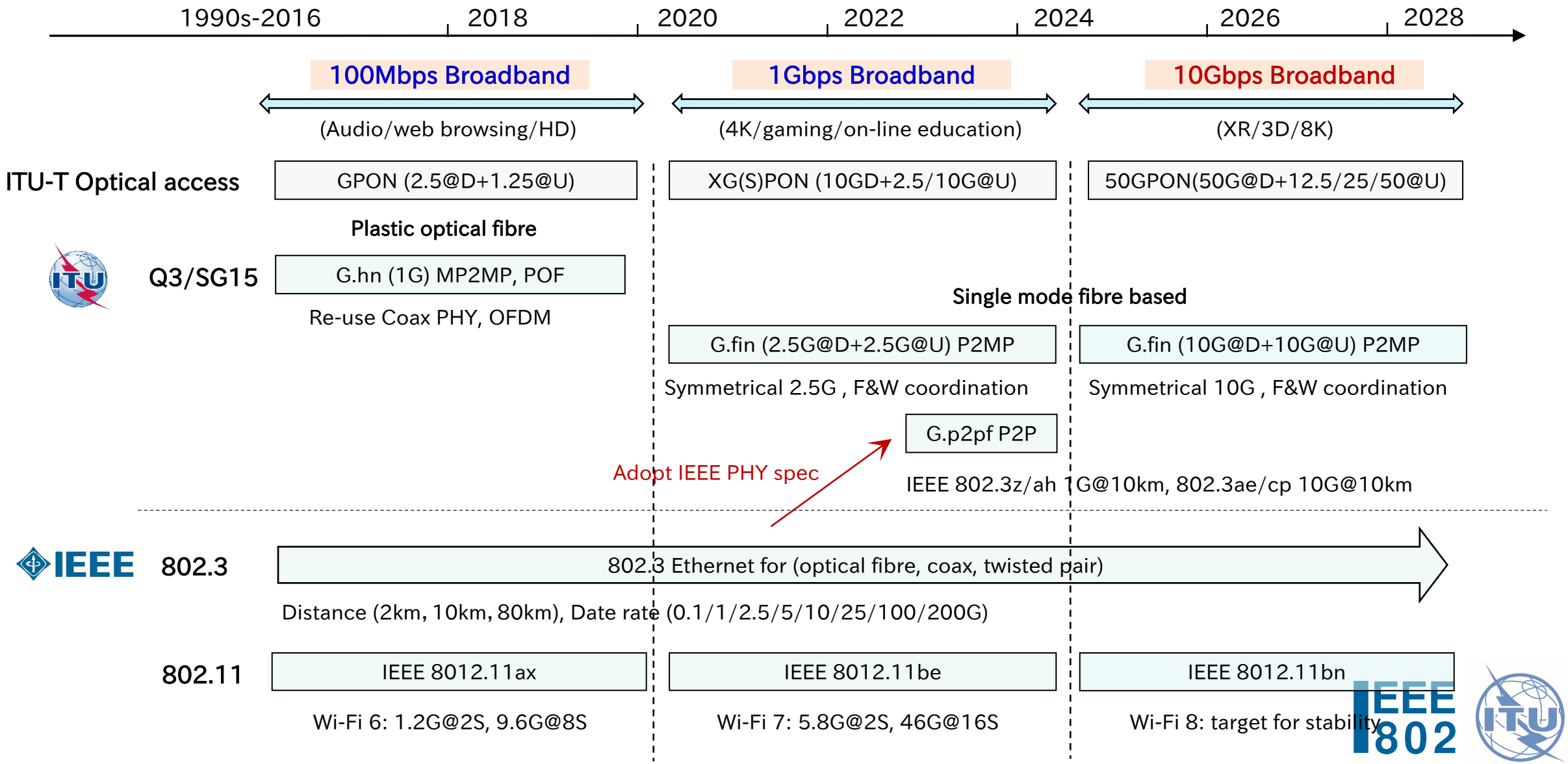
- **PON Technology Evolution and Standard Trends**

1. 2000s: GPON/EPON 1Gbps
2. 2010s: XG(S)PON, NGPON, 10GEPON
3. 2020-2025: 50GPON, 50G EPON, 25GS-PON MSA
4. 2025s: Future PON



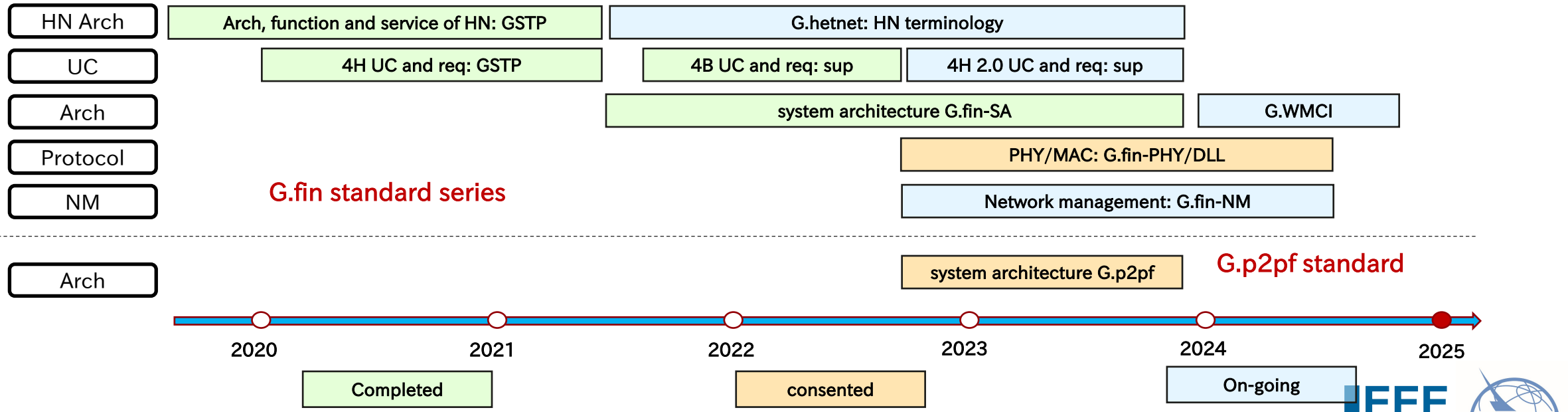
➢ **Cooperation with other SDOs to define optical networks towards 2030**

ITU-T SG15 Standard Roadmap for Fibre In-premises Network



Standard Series of ITU-T SG15 Q3

- G.fin recommendations (High speed fibre-based in-premises transceivers)
  1. **Use case & requirement:** TP of 4H (published), supplement of 4B (published), supplement of 4H 2.0 (on-going)
  2. **System Architecture (G.9940 approved):** priority of P2MP, centralized fibre & wireless coordination
  3. **Physical layer (G.9941, consented) and data link layer (G.9942, consented):** common agreement in frame design
  4. **Network management (G.9943):** on-going
  5. **Fibre & Wi-Fi coordination (G.wmci):** on-going
- G.p2pf recommendation (High-speed point-to-point-fibre-based in-premises transceivers)



Use cases & network characteristic for home applications

	Wi-Fi backhual	Seamless roaming	Stable Wi-Fi	Wi-Fi + mmW	Dense depart	IoT support	Low latency	Fibre deploy	Network slicing	East to West	Multi service	FIP diag	NAS	Security threat
Throughput	●		●	● ●	●	●	●		● ●	●	●			
Latency			●				●		● ●					
Connectivity	●				●			● ●	● ●			●	● ●	
Roaming		● ●		●										
Security & green					● ●	● ●							● ●	●
O&M						●						●	● ● ●	

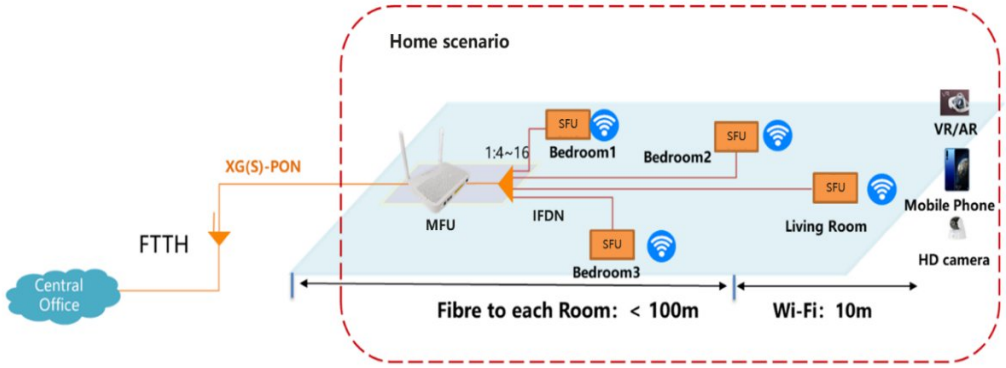
Source: ITU-T G.Suppl.FIP4H, "Use case & Requirements of Fibre-based In-premises networking for Home Application (FIP4H) "

Use cases & network characteristic for SME applications

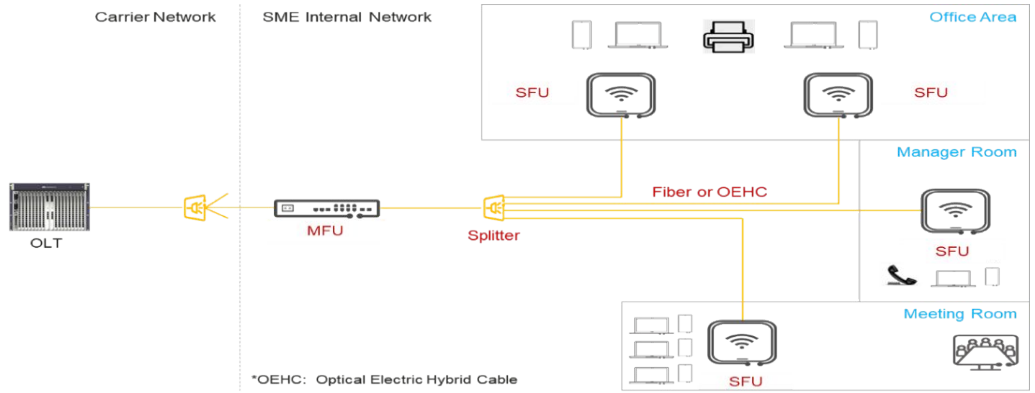
	Live application	Smart office	Small service hall	School	Business buildings	Leisure	Advertising	Workshop	Smart community
Stability	●●●	●			●●	●	●		●
Throughput	●	●●				●	●		●
Connectivity		●		●					●
Cloudification			●	●●				●	
Security				●●					
O&M		●●●	●●	●●●	●●			●	

Source: ITU-T G Suppl. 78,"Use case and requirements of fibre-to-the-room for small business applications "

In-premises fibre networking (G.fin) for Gigabit Broadband

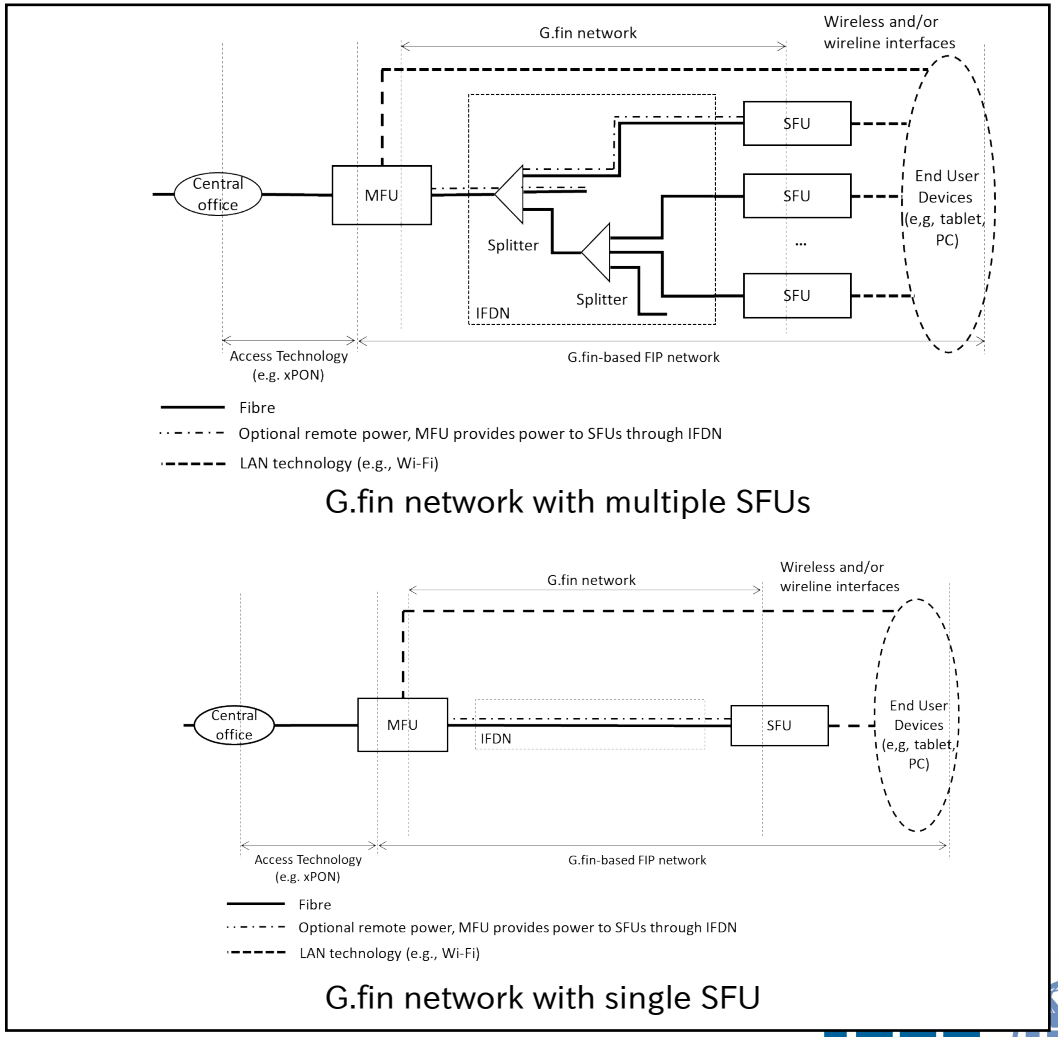


- Home environment

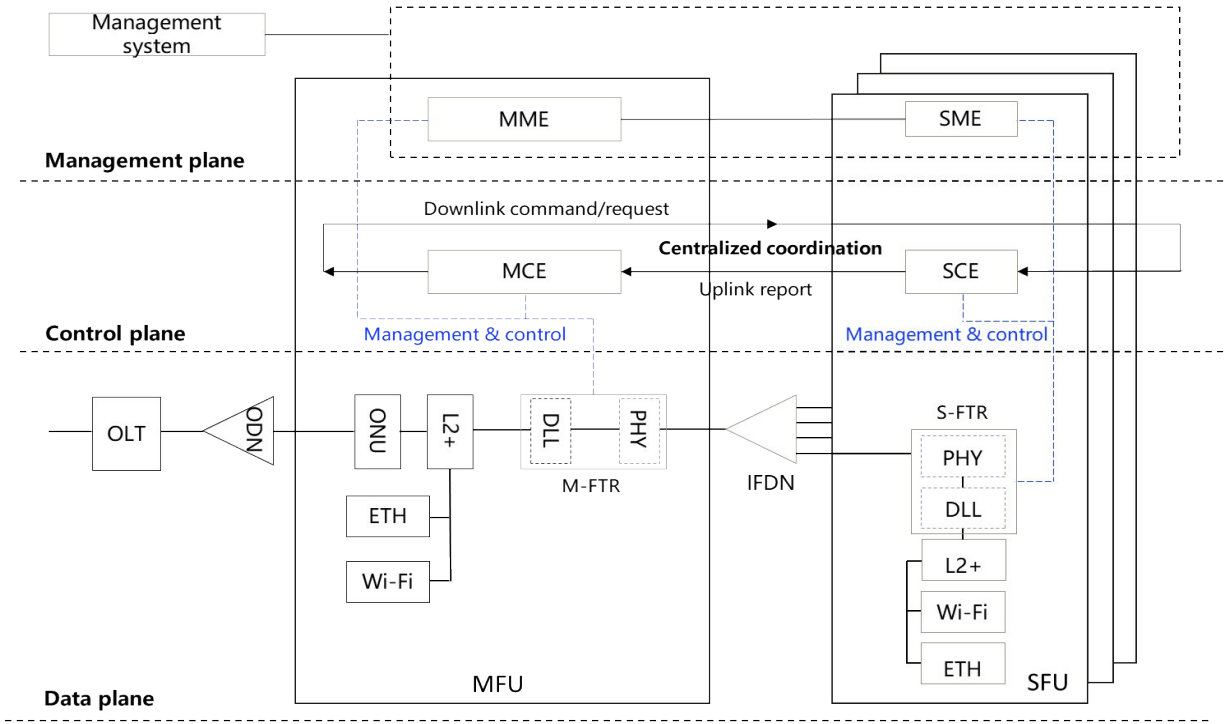


- Business environment

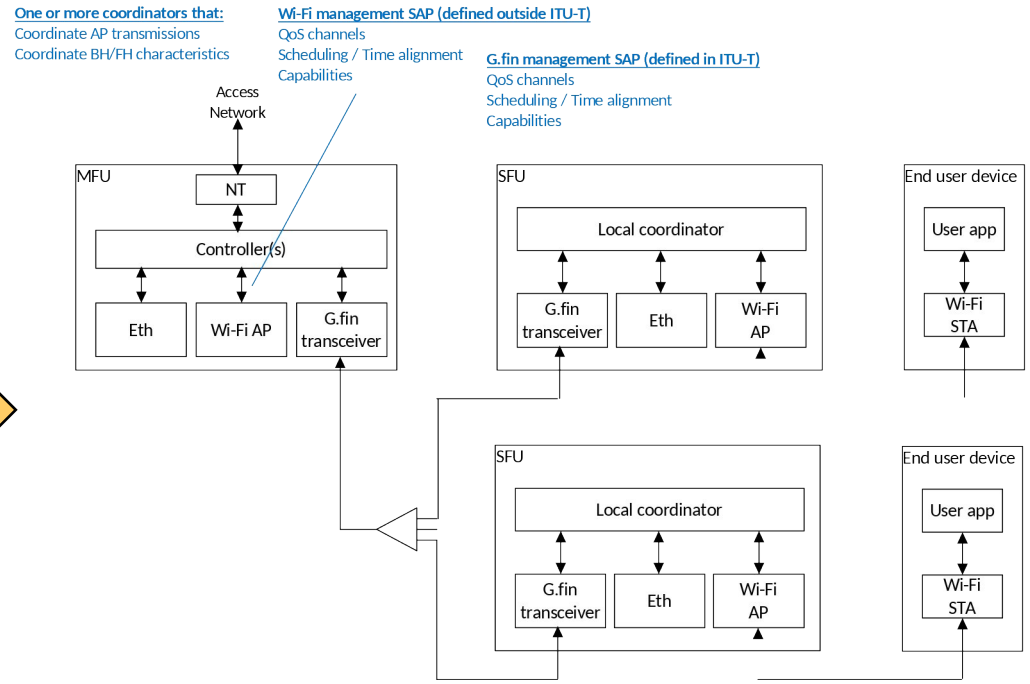
Source: *ITU-T G.9940, approved December 2023*



G.fin system architecture



Functional framework of G.fin system



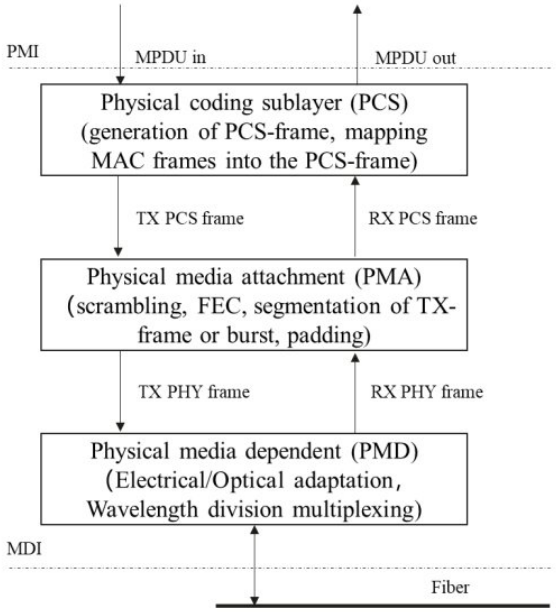
Fibre & wireless coordination of G.fin system

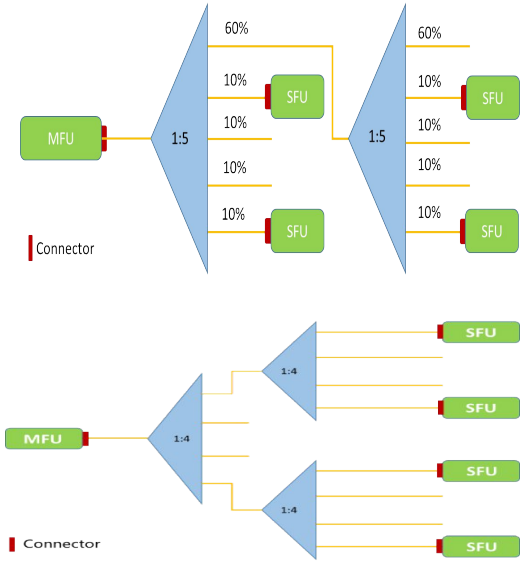
1. Identify service flow and differentiate the service QoS
2. MFU dynamically collects the Wi-Fi and network relevant information such as data buffer, link status, etc.
3. The MFU controller does analysis and makes decision
4. The decision is sent to each SFU through the fibre network

Source: *ITU-T SG15 Q3, G.wmci, new project initiated in Nov plenary of 2023*

G.fin physical layer (PHY) & data link layer (DLL)

PHY: symmetric rate, optimized link budget, flexible splitting

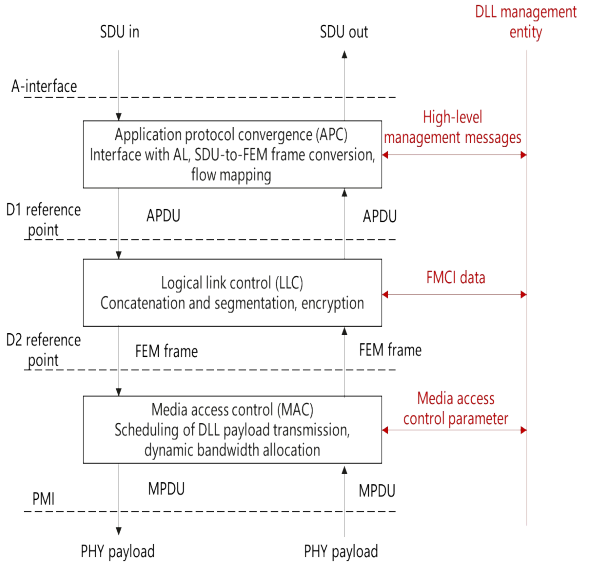


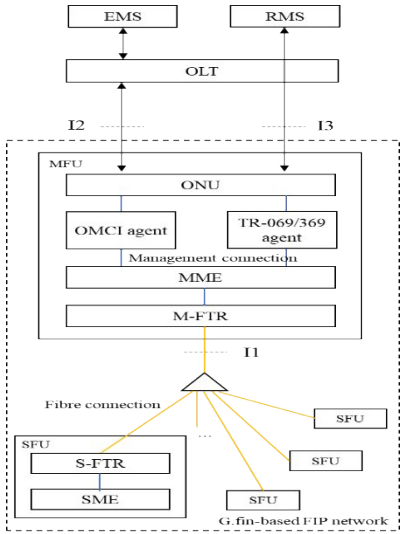


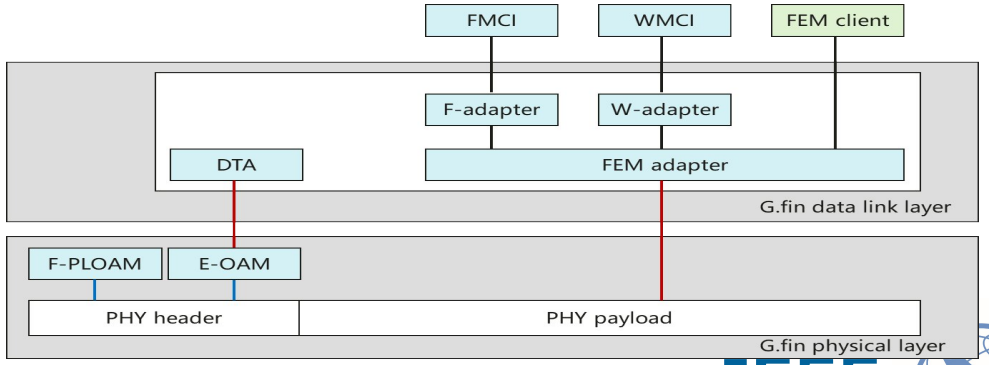
Optical link budget	Typical splitting ratio	Upstream/downstream wavelength set	
		2.5/2.5 Gbit/s	10/10 Gbit/s
0-18 dB (home)	1:8	Up: 1300-1320 nm Down: 1480-1500 nm	Left for further study
13-28 dB (SME)	1:32	Up: 1300-1320 nm Down: 1480-1500 nm	Option 1: Up: 1300-1320 nm Down: 1480-1500 nm Option 2: Up: 1260-1280 nm Down: 1567-1587 nm

Source: *ITU-T SG15 Q3, G.9941, consented in Nov plenary of 2023*

DLL: TDMA, F/WMCI dynamic control, OLT enabled management

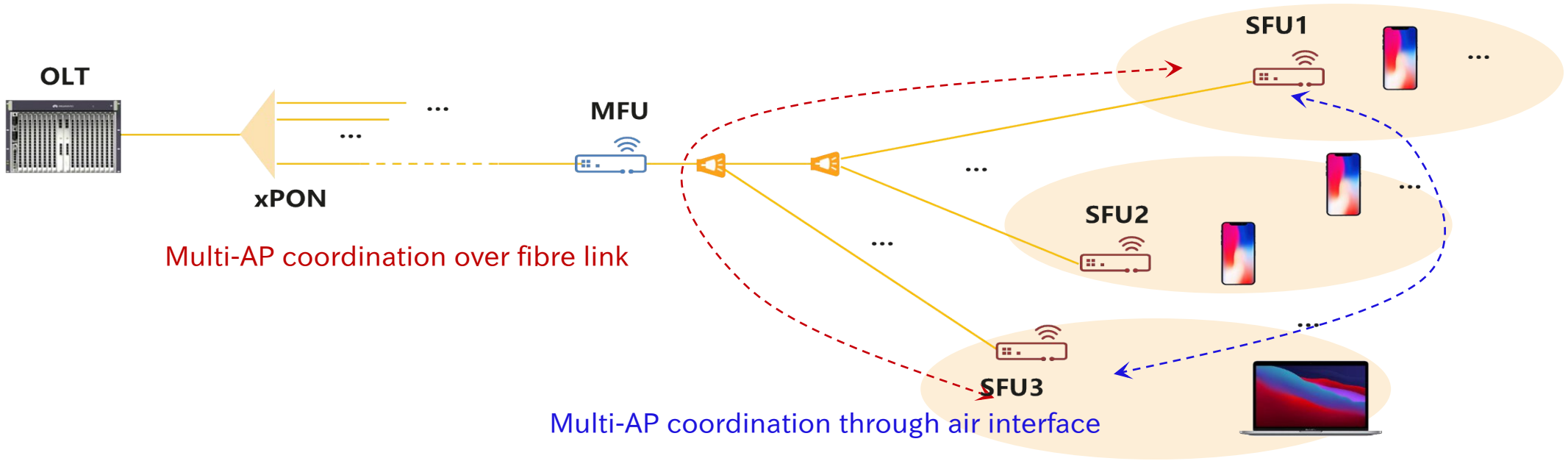






Source: *ITU-T SG15 Q3, G.9942, consented in Nov plenary of 2023*

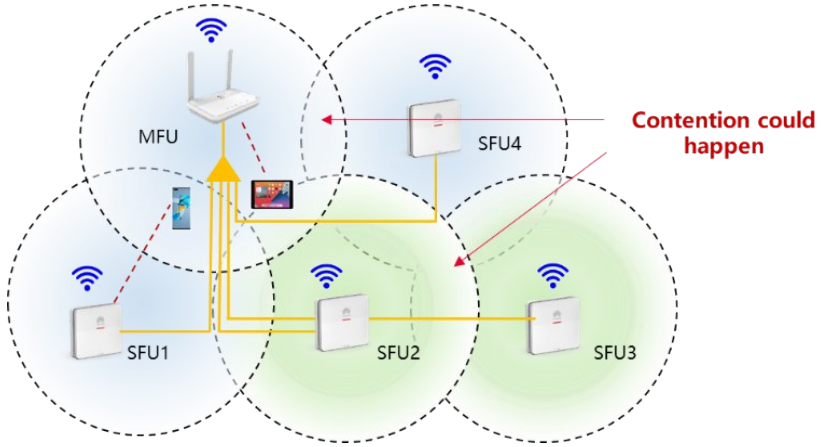
WLAN management & control interface (WMCI) complements to UHR



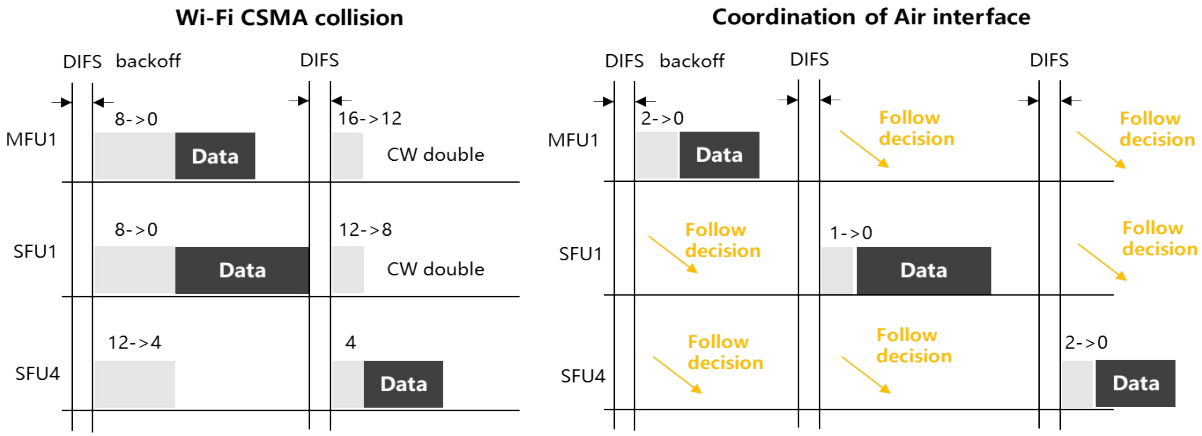
- **Fibre link should be a complement way for multi-AP coordination in UHR**
  - Guaranteed low latency channel for control message exchange in PHY and DLL
  - Data are well coordinated by TDMA scheme for uplink and broadcasting in downlink
  - Tree topology, in which controller is set in MFU
  - High throughput backhauling over fibre, best for Co-BF & Joint transmission
  - Nature high synchronization over fibre network (OOK modulation over 2.5G/10G)

Source: *IIEEE 802.11 WNG, 11-23-1186-00-0wng-multi-AP-over-fibre*

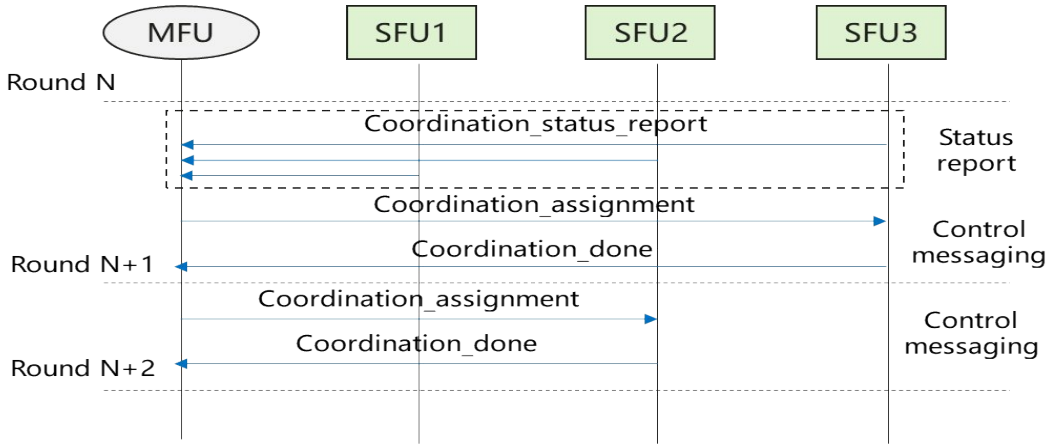
Coordinated Wi-Fi transmission in domain based on G.wmci

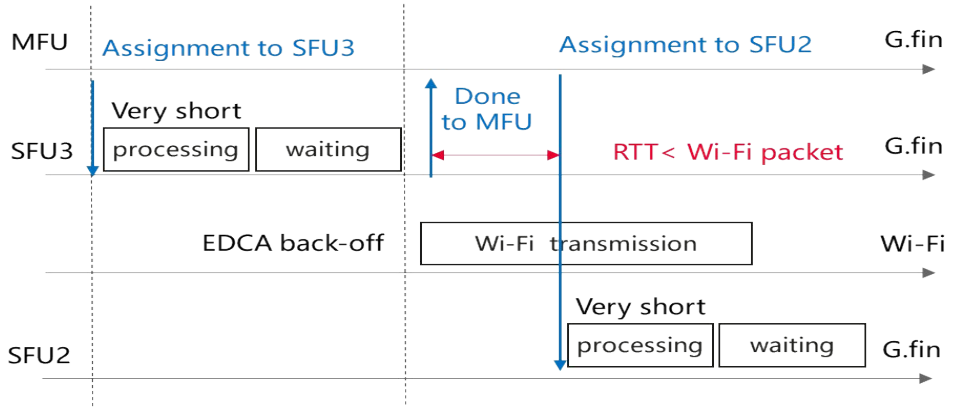


Coexistence of multiple AP scheme



Coordination of air interface in time domain





Concept of coordination procedure

Source: *ITU-T Jan RGM, Q3/15-C9 (240122)*

G.p2pf system architecture

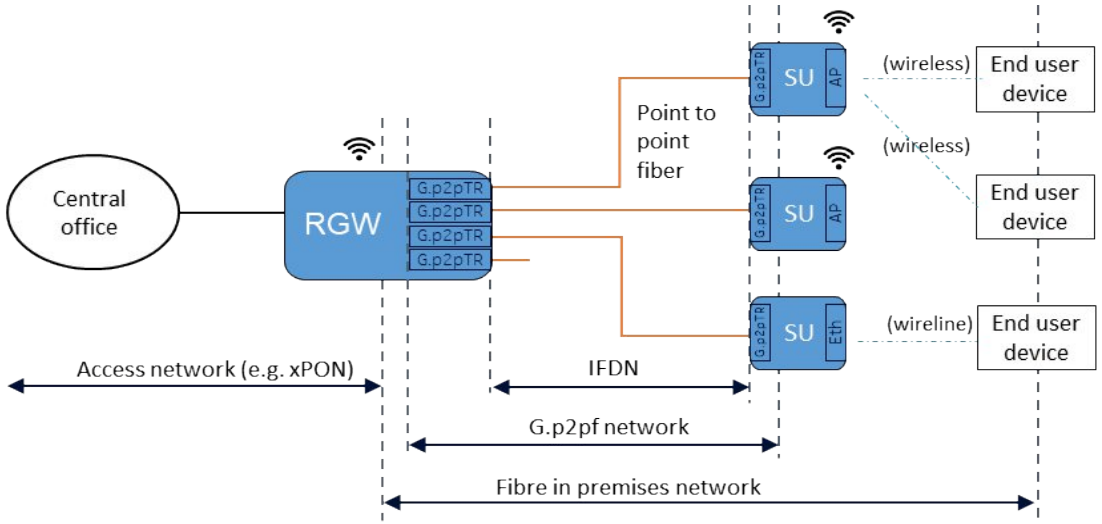


Illustration of a G.p2pf-based FIP network

G.p2pf option	Nominal line rate	Single or dual fibre	Fibre length supported by	Optical link budget	Wavelength (nm)	Referenced IEEE 802.3	Ethernet PMD types
Option 1	1 Gbit/s	Dual fibre	10km	8dB	1270-1355	[IEEE 802.3] Clause 38	1000BASE-LX
Option 2	1 Gbit/s	Single fibre	10km	5.5dB	DS: 1480-1500 US: 1260-1360	[IEEE 802.3] Clause 59	1000Base-BX10
Option 3	10 Gbit/s	Dual fibre	10km	6.3dB	1260-1355	[IEEE 802.3] Clause 52	10GBASE-LR
Option 4	10 Gbit/s	Single fibre	10km	6.3dB	DS: 1320-1340 US: 1260-1280	[IEEE 802.3] Clause 158	10GBASE-BR10

Summary of G.p2pf PHY options based on IEEE 802.3

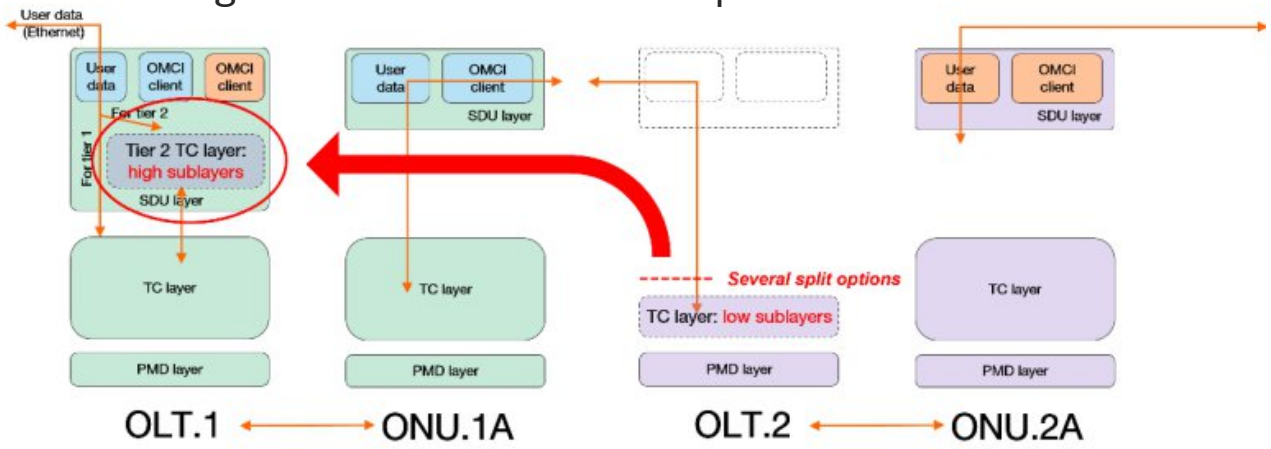
Description

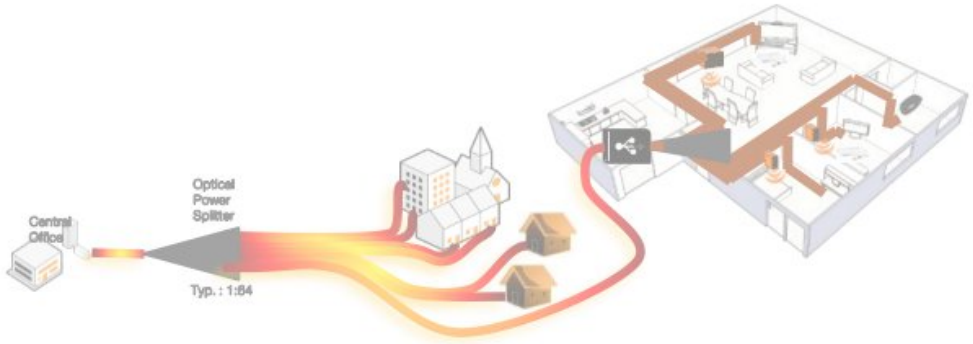
- Optical Ethernet connections are used for connecting RG and subtended unit (SU)
- Two types of connectivity:
  - RG/SUs are connected directly to the fibre infrastructure (IFDN) using devices with optical outputs
  - RG/SUs are connected to external optical/electrical converters using Ethernet. In this case, an external switch is needed on the RG side

Source: G.9930 draft – Under review in the approval process

Further consideration: deep integration over fibre or Wi-Fi

Integration over access or in-premises





C-FAN Centralised-FAN (Fixed Access Network)

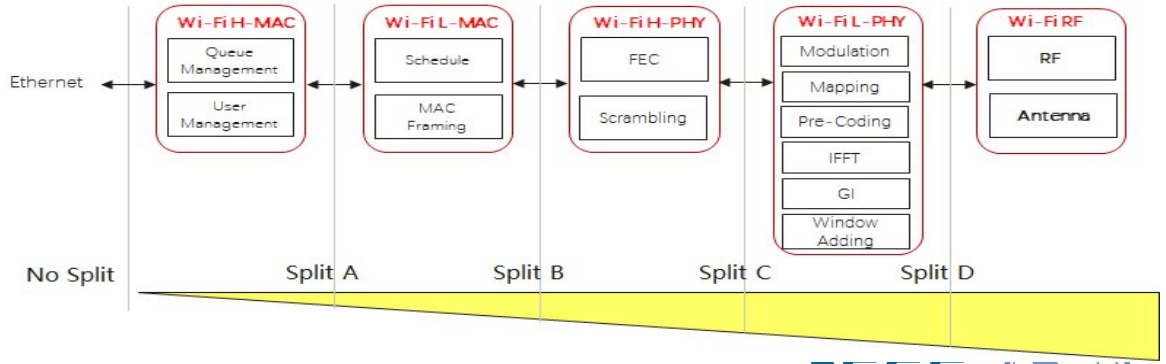
-> Simplified G.fin devices

-> Centralized control in central office

Source: 2nd FTTR joint workshop, 2022, Orange

Integration betwen multiple AP

Source: ITU-T SG15 Q3, T22-SG15RGM-Q3-230131-C-0019, Maxlinear, 2023



Source: ITU-T SG15 Q3, T17-SG15-C-2773!!MSW-E, Huawei, 2021

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