ITU-T SG15

Networks, technologies and infrastructures for transport, access and home

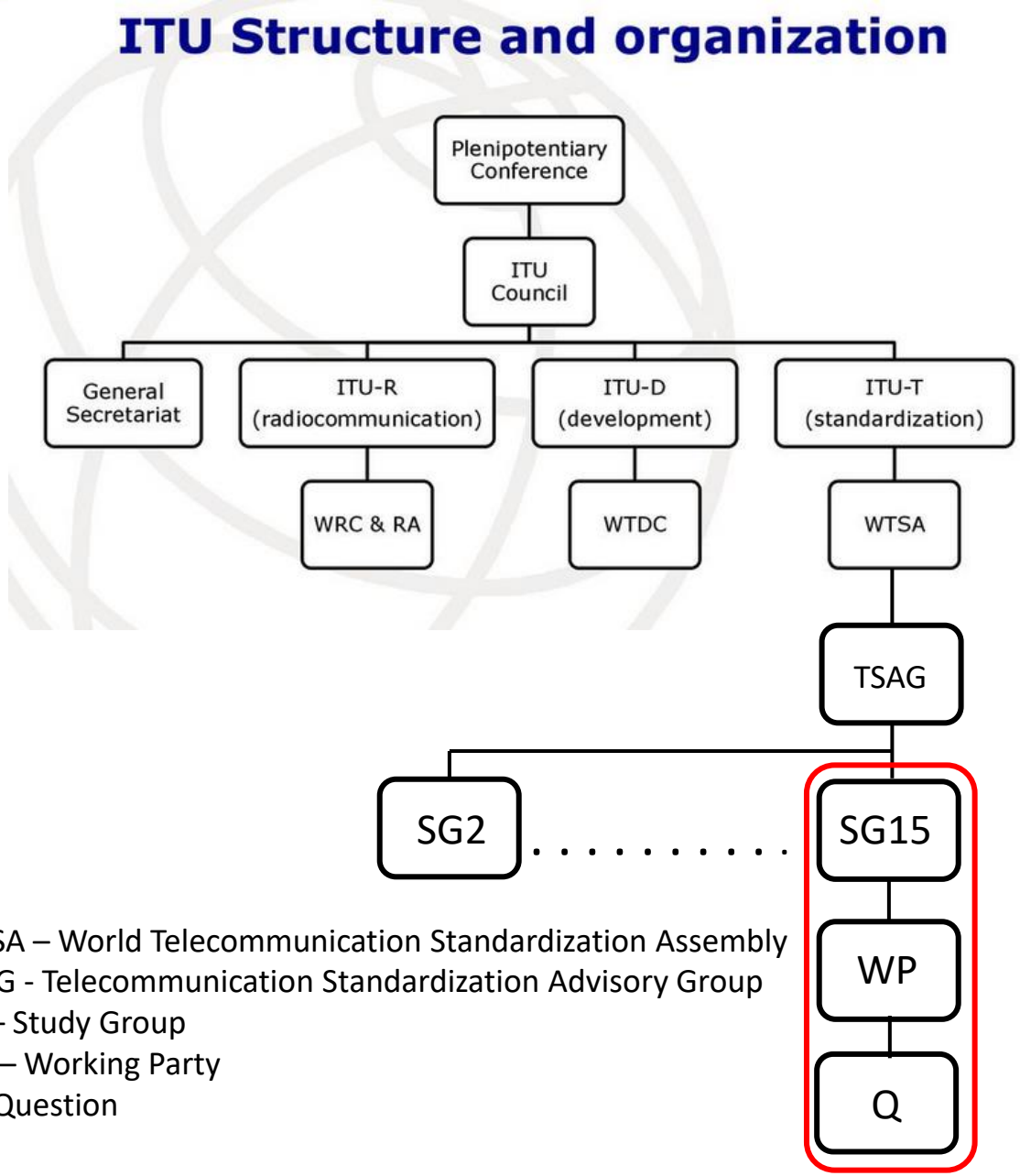
Standards Update

Tuesday, 07 March, 11:00 – 12:00

Panel

- **Moderator**
  - Paul Doolan, *Infinera, USA*
- **Panelists**
  - Frank J. Effenberger, *Fellow, Futurewei Technologies, USA*
    - *Rapporteur Q2, WP1*
  - Vince E. Ferretti, *Telecom and Ethernet Standards Manager, Corning, USA*
    - *Associate Rapporteur Q5, WP2*
  - Tom Huber, *Optical Standards Development, Nokia, USA*
    - *Vice Chairman SG15 and Vice Chairman WP3*

ITU and SG15



WTSA – World Telecommunication Standardization Assembly
TSAG - Telecommunication Standardization Advisory Group
SG – Study Group
WP – Working Party
Q - Question

Leadership of ITU

- Plenipotentiary Conference (PP-22) September and October 2022.
  - Member states elect leadership of ITU

Doreen Bogdan-Martin
Secretary-General ITU

Tomas Lamanauskas
Deputy Secretary-General ITU

Seizo Onoe
Director of the Telecommunication Standardization Bureau (TSB)

- WTSA-20 took place in March 2022.
  - Defines the next study period for ITU-T
  - Elects leadership of SGs
  - Normally 4 year cycle
- This (shortened) study period runs 2022 - 2024
- Main work products:
  - Recommendations
  - Supplements
  - Technical papers and reports

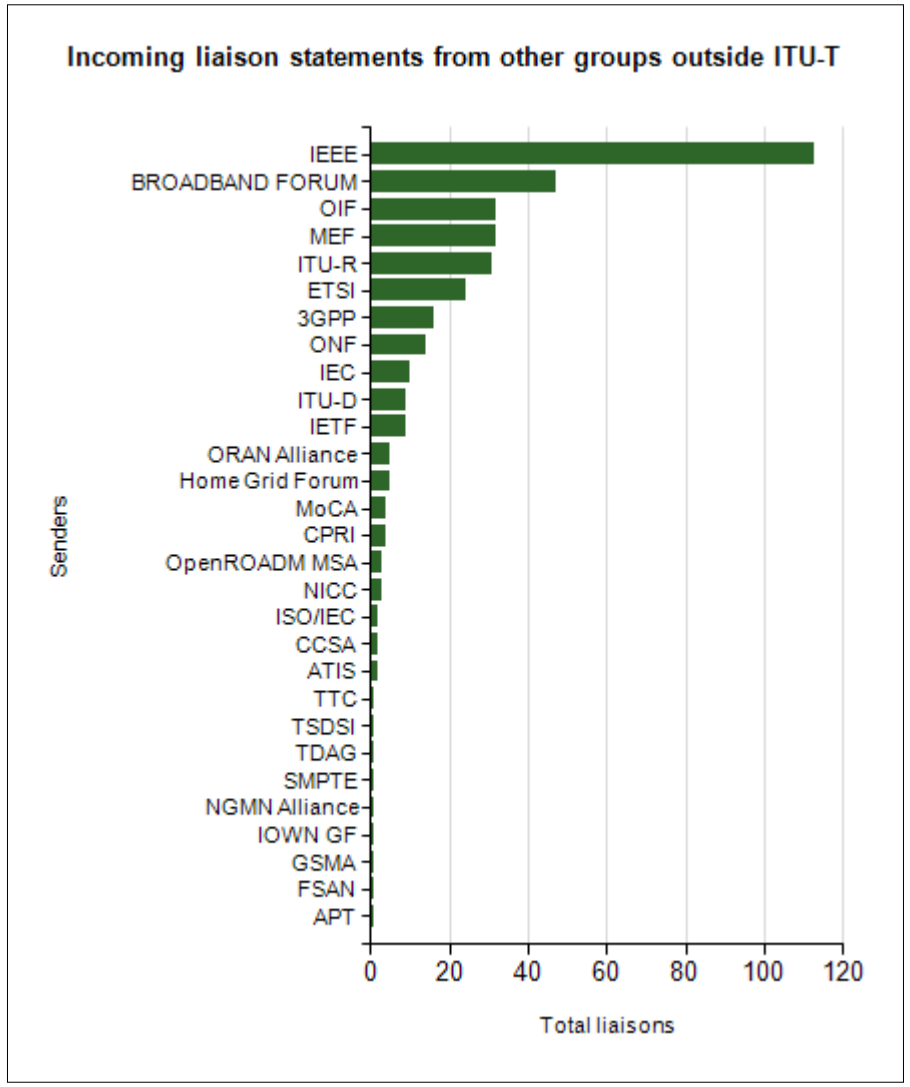
SG15 structure and Recommendations

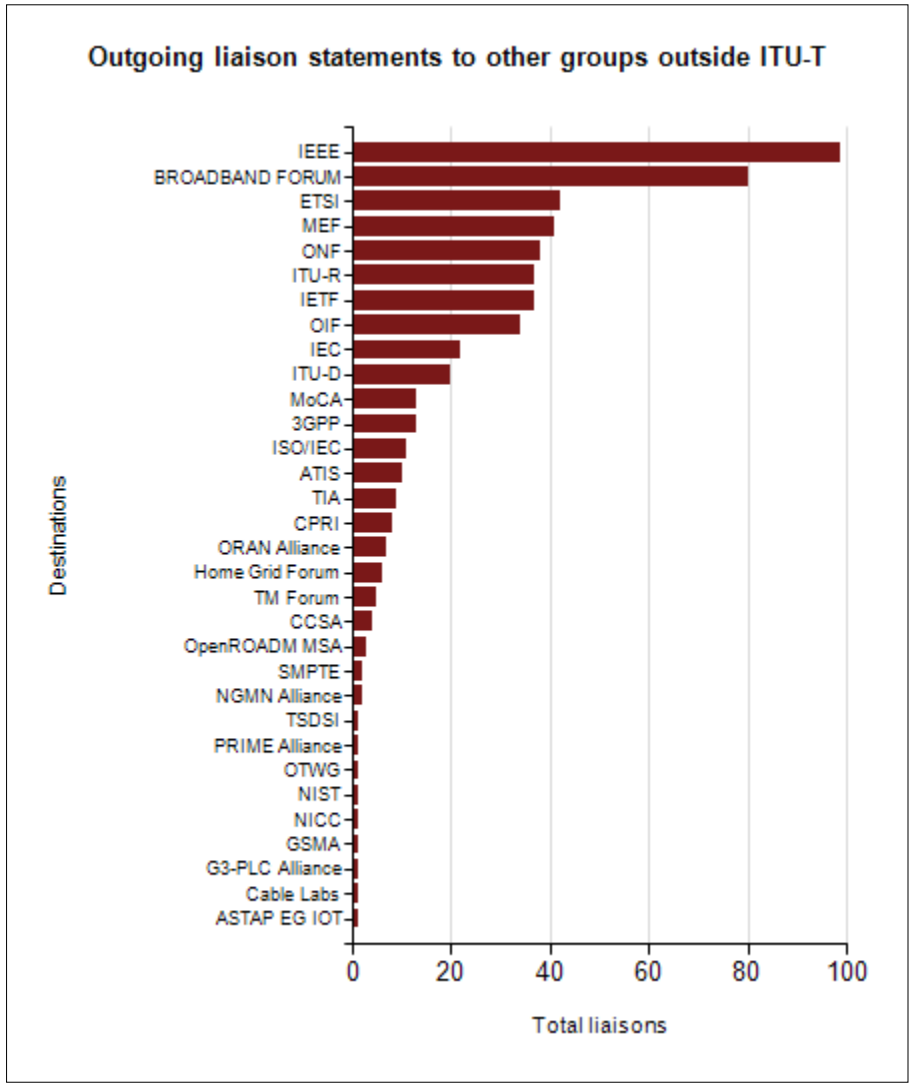
WP1/15	**Transport aspects of access, home and smart grid networks**
Q1/15	Coordination of access and home network transport Standards
Q2/15	Optical systems for fibre access networks
Q3/15	Technologies for in-premises networking and related access applications Continuation of Question 18/15
Q4/15	Broadband access over metallic conductors
WP2/15	**Optical technologies and physical infrastructures**
Q5/15	Characteristics and test methods of optical fibres and cables, and installation guidance
Q6/15	Characteristics of optical components, subsystems and systems for optical transport networks
Q7/15	Connectivity, operation and maintenance of optical physical infrastructures Continuation of Question 16/15
Q8/15	Characteristics of optical fibre submarine cable systems
WP3/15	**Transport network characteristics**
Q10/15	Interfaces, interworking, OAM, protection and equipment specifications for packet-based transport networks
Q11/15	Signal structures, interfaces, equipment functions, protection and interworking for optical transport networks
Q12/15	Transport network architectures
Q13/15	Network synchronization and time distribution performance
Q14/15	Management and control of transport systems and equipment

Main Recommendations of SG15

- G.600-G.699: Transmission media and optical systems characteristics
- G.700-G.799: Digital terminal equipments
- G.800-G.899: Digital networks
- G.900-G.999: Digital sections and digital line system
- G.7000-G.7999: Data over Transport – Generic aspects
- G.8000-G.8999: Packet over Transport aspects
- G.9000-G.9999: Access networks
- G supplements: Supplements to ITU-T G-series Recommendations

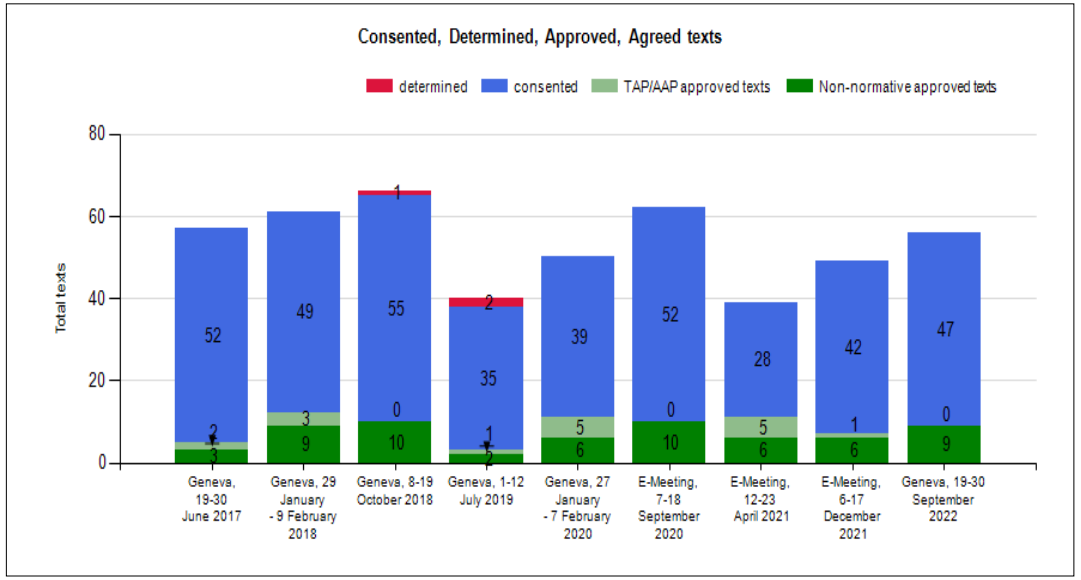
SG15 – a collaborative player in the ecosystem

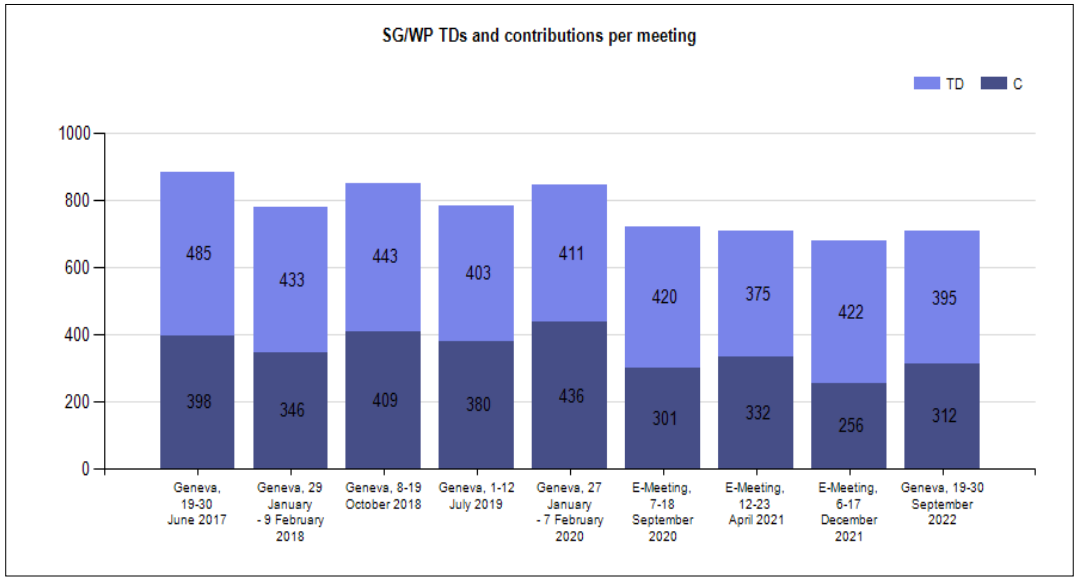


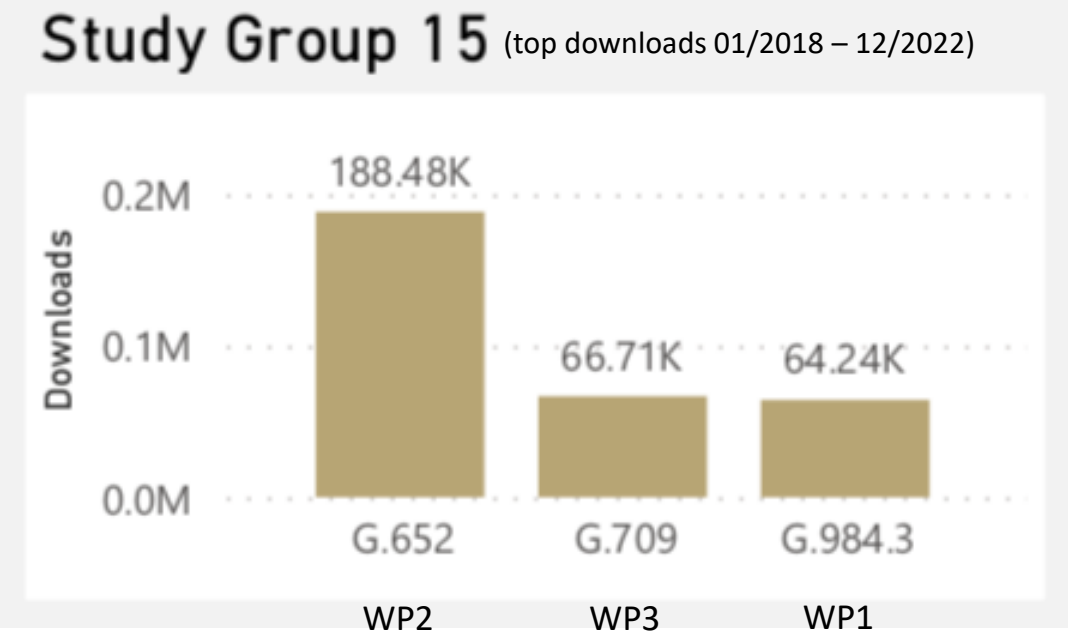


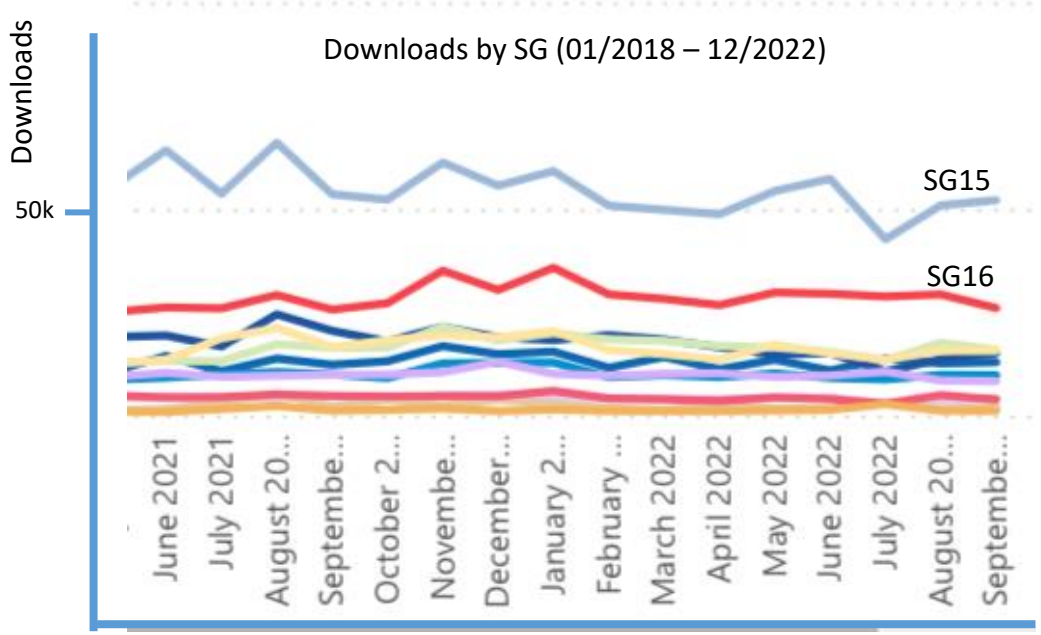
Liaison data Jan 2017 through Dec 2022

SG15 by the numbers









ITU-T SG15 Working Party 1:
Optical Networks for Access and Home

Work program review

Frank Effenberger
Rapporteur, Q2/15

OFC
IEEE ComSoc IEEE Communications Society
IEEE Photonics Society
OSA The Optical Society | 100 Since 1916

WP1 optics by application area

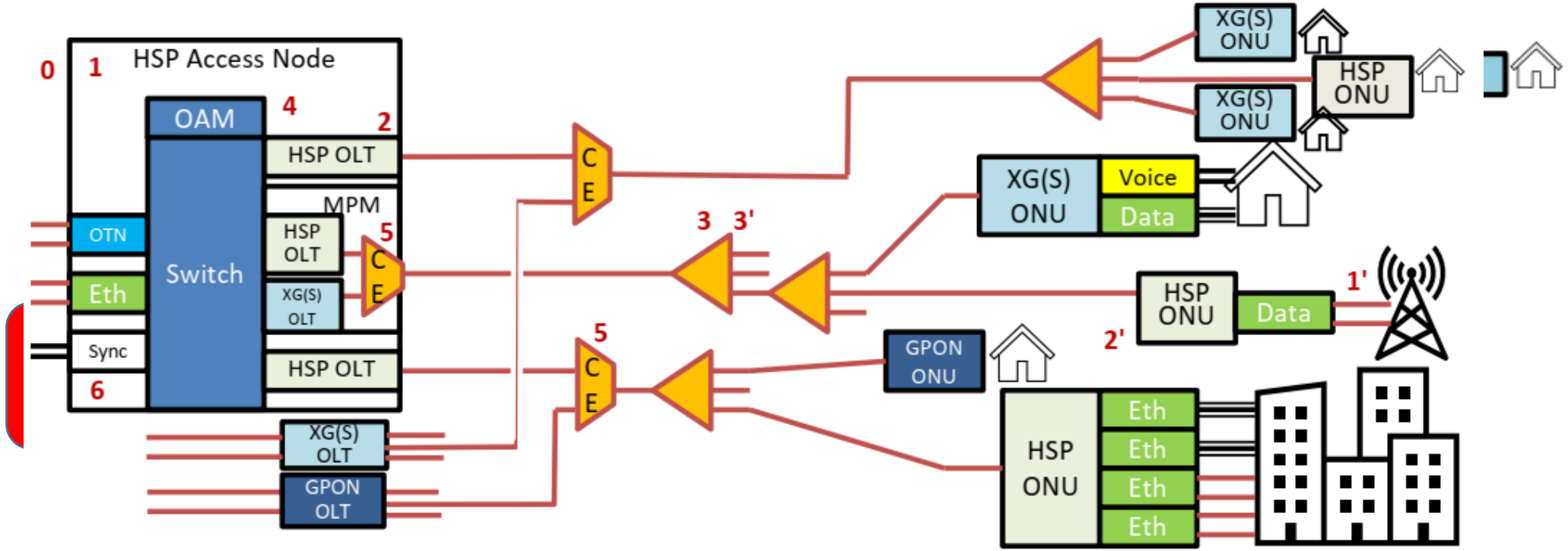
- The largest application of WP1 optics is to provide broadband access to home and small business users, where the emphasis is on low-cost high-volume solutions
  - There is a long history of PON system specifications, which have followed the growth of technological and service bandwidths
  - Along the way, various basic infrastructure components have been built up as well
- Starting from this core position, there are two major expansion areas
  - Wireless applications that require more than what the conventional broadband network can. New systems or improvements to existing systems can work to address these requirements
  - As access bandwidth improves, the in-home network becomes the bottleneck. Optics can be used to supercharge the home network to overcome this

Optica

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



Key

ITU-T Study Group 15

G.9805 Coexistence of Passive Optical Network Systems

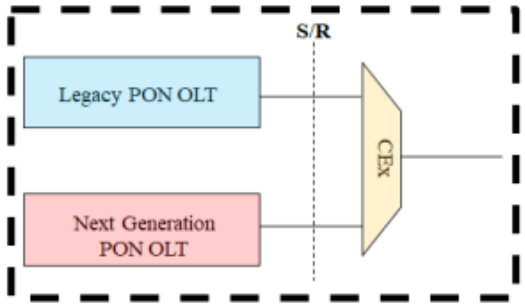
ITU-T G.9805 describes the methods and parameters for PON coexistence, where two or more PON systems share a common ODN, including

- Reference diagram of coexistence element, and sample parameters of a discrete WDM filter that enables PON evolution
- Multi-PON modules with integrated WDM to support legacy PON and NG-PON coexistence
- Methods for calculating required isolation for WDM/CE/CEM devices
- Filter considerations for XG(S)-PON/10G-EPON and HSP OLT.

0

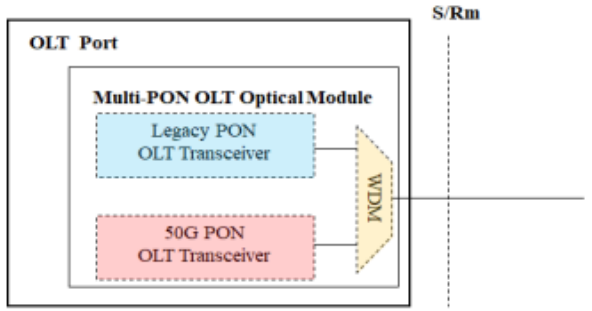
Two methods support for PON evolution: External CEx and MPM

1



External CEx

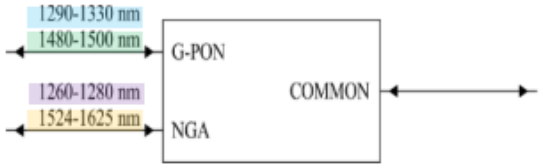
2



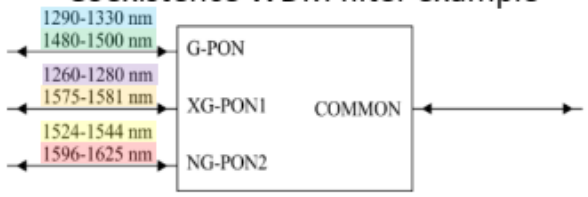
MPM

3

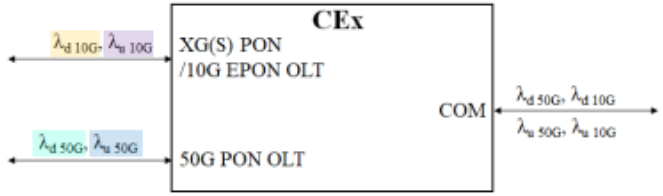
GPON and XG(S)-PON Coexistence WDM filter example



GPON , XG(S)-PON and NG-PON Coexistence WDM filter example



XG(S)-PON/10G EPON and 50G-PON Coexistence WDM filter example

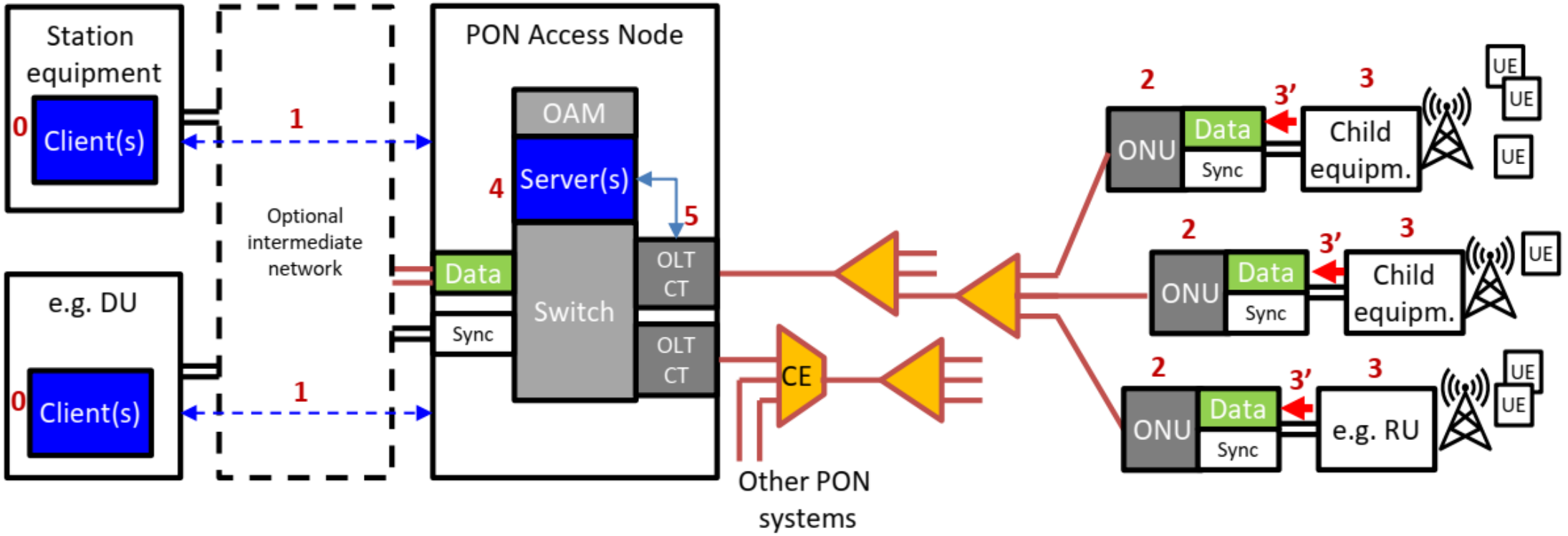


The detail specification of the coexistence filter and the calculation method are defined in G.9805

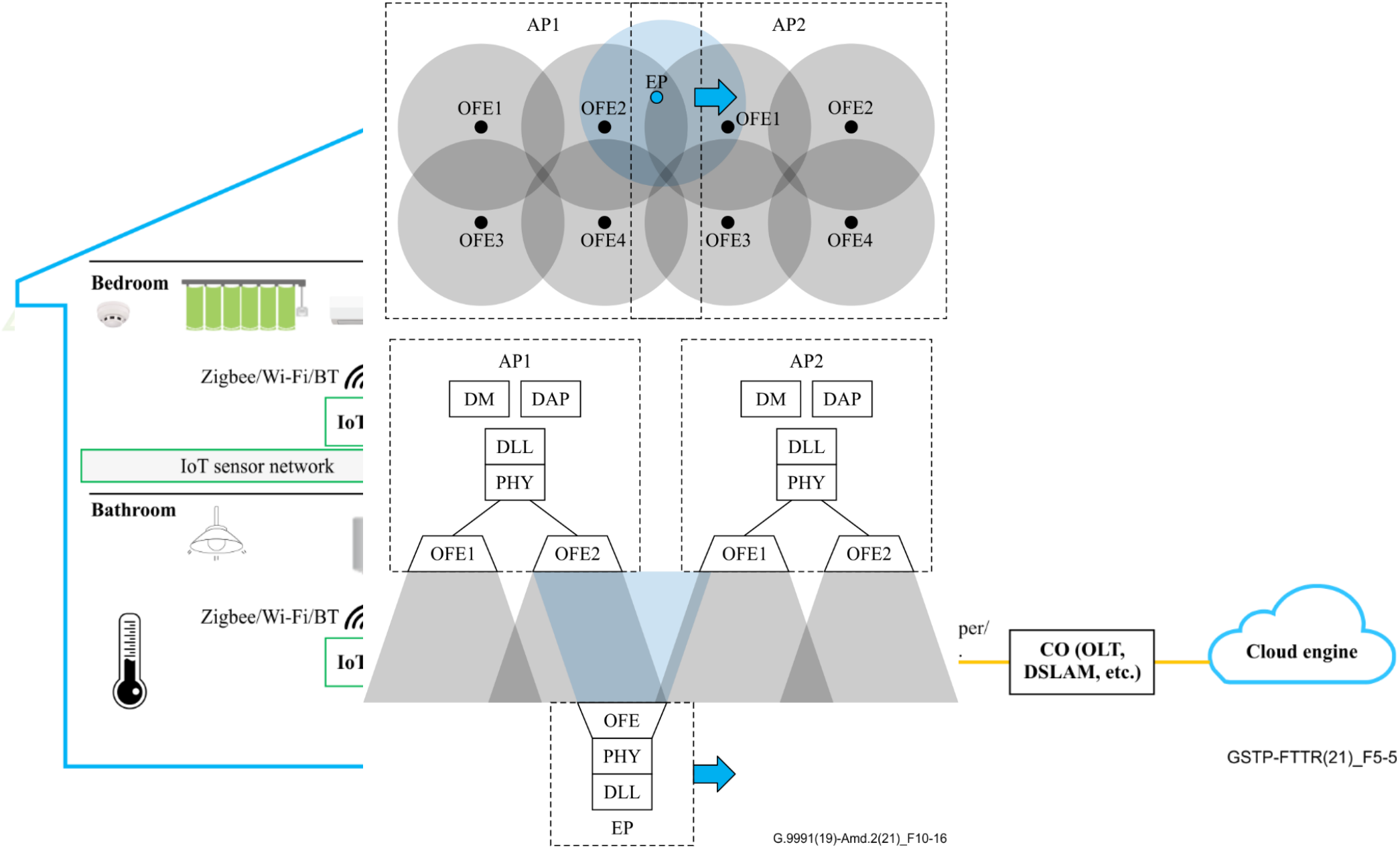
ITU-T Study Group 15

G Suppl. 71 Cooperative Dynamic Bandwidth Allocation

- Cooperative DBA (CO DBA) is a method to reduce the upstream latency in a TDM PON when applying variable bandwidth allocations to follow a variable bitrate traffic pattern, while keeping multiplexing gain.
- CO DBA is notified with information about this traffic from an external entity (station equipment) to the optical line termination (OLT). With this information the OLT applies bandwidth allocations targeted in time and size.
- External entity can be northbound of OLT (as per figure below) or connected to ONU. CO DBA as such is independent of the TDM PON technology.
- The supplement provides an interpretation of the OLT capabilities that are needed to support CO DBA; some are generic, some are specific per use case.
- The use case elaborated in the supplement is Mobile Fronthaul (MFH) using O-RAN's Cooperative Transport Interface (CTI) between OLT and Distributed Unit (DU).



Optical In-home applications



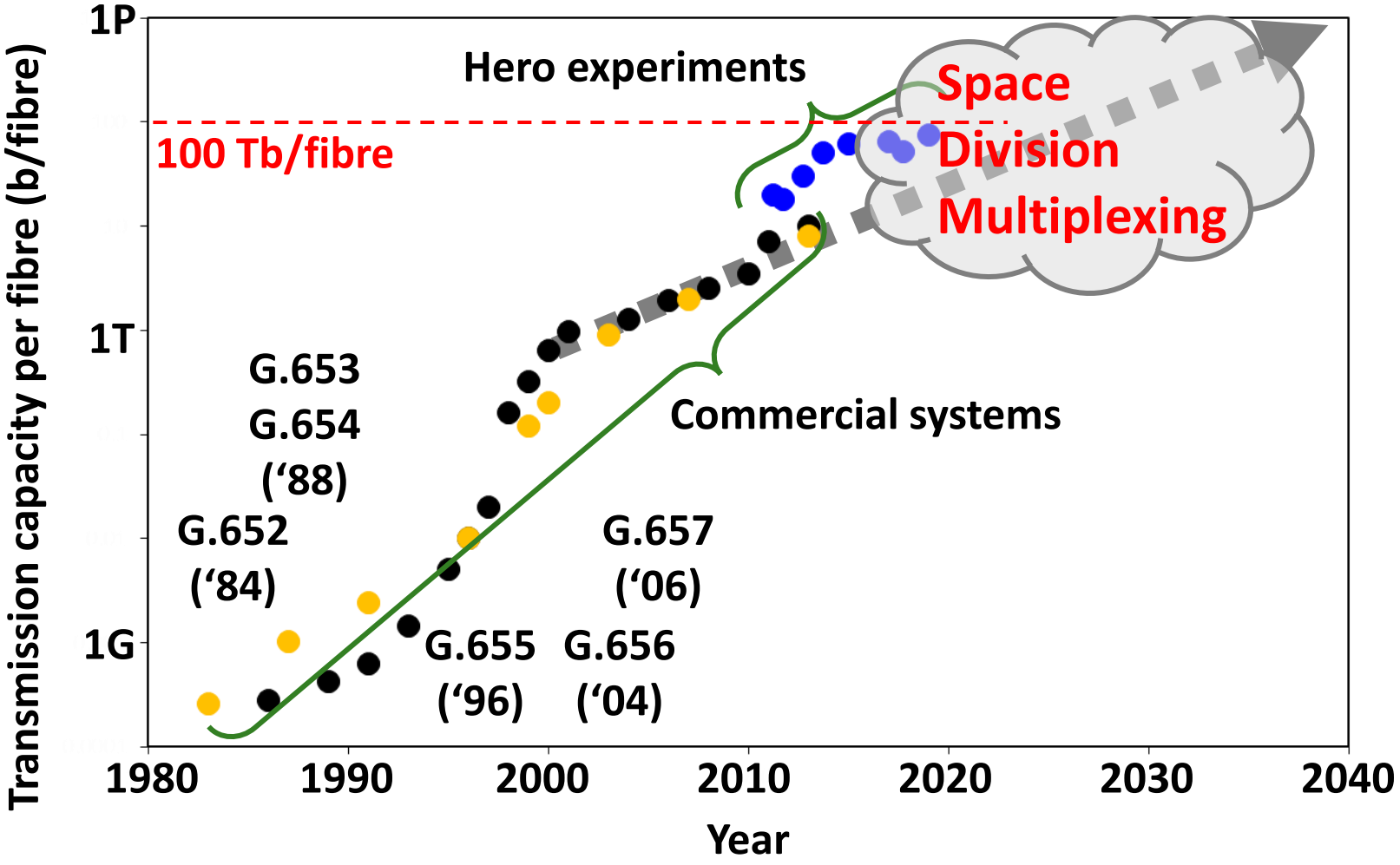
ITU-T SG15 Working Party 2: Optical technologies and physical infrastructure

Q5 Technical report on Space Division Multiplexing

Vince Ferretti
Vice Chair P&C, Associate Rapporteur Q5

OFC
IEEE ComSoc IEEE Communications Society
IEEE Photonics Society
OSA The Optical Society | 100 Since 1916

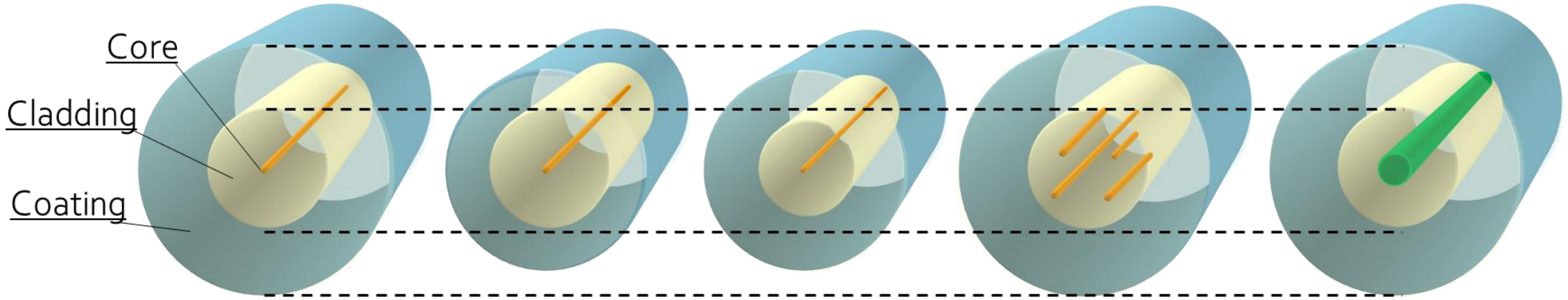
History of Optical Fibre Standards



What is SDM?

SDM Optical Fibre Cable can:

- **improve a spatial density of optical fibre in a unit cross section,**
- **increase the number of spatial transmission channels in a common cladding**



Traditional

Reduced Coating Diameter Fibre

Reduced Cladding Fibre

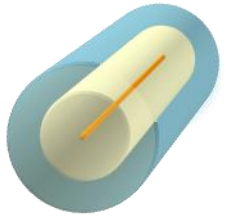
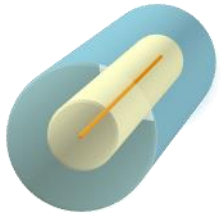
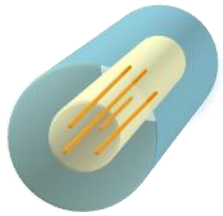
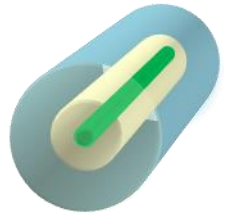
Multi Core Fibre

Few Mode Fibre

ITU SDM Technical Report Published

- SDM optical fibre and cable technology is expected to be a key enabler for realizing the full connected world in a sustainable manner
- ITU-T SG15 has just published a new technical report, GSTR-SDM, for SDM optical fibre and cable technology to analyse the technical status and to show the roadmap for future deployment and standardization
- First technical report on SDM published with industry concensus

SDM Advantages/disadvantages at a glance

	RCDF	RCF	MCF	FMF
				
Advantages	Fiber density, 125 µm cladding compatibility, No SDM components	Fiber density, compatibility, No SDM components	Increased core density in a limited cross-section, Can be designed to support compatibility with G.65x fibre	# of SDM channels in a 125 µm cladding diameter >> than MCF, Easier splicing/ connectorization than MCF
Disadvantages	May require better cable design and handling, Limited to <4X density	May require better cable design Adaptation required to 125 µm cladding, Limited to <4X density	125 µm cladding limits number of cores, Needs SDM components such as FIFO Connectorization and splicing more difficult	Needs advanced digital signal processing, Requires mode mux/demux

Other WP2/15 Work recently published

Work item	Question	Subject / Title
L.109.1	Q5/15	Type II optical/electrical hybrid cables for access point and other terminal equipment
L.210	Q7/15	Requirements for passive optical nodes: optical wall outlets and extender boxes
LSTP-GLSR	Q7/15	Guide on the use of ITU-T L-series Recommendations related to optical technologies for outside plant

Other WP2/15 work currently under development (1)

Work item	Question	Subject / Title	Timing
G.650.1	Q5/15	Definitions and test methods for linear, deterministic attributes of single-mode fibre and cable	2023
G.654	Q5/15	Characteristics of a cut-off shifted single-mode optical fibre and ca	2024
L.109	Q5/15	Construction of optical/metallic hybrid cables	2024
L.250	Q7/15	Topologies for optical access network	2023
L.340	Q7/15	Maintenance of telecommunication underground facilities	2023
L.312	Q7/15	Optical fibre cable maintenance support, monitoring and testing system for optical fibre cable networks carrying high total optical power	2024

Other WP2/15 work currently under development (2)

Work item	Question	Subject / Title	Timing
G.698.1 addition of 25G	Q6/15	Multichannel DWDM applications with single-channel optical interfaces	2023
G.698.4 addition of 25G	Q6/15	Multichannel bi-directional DWDM applications with port agnostic single-channel optical interfaces	2023
G.owdm 2	Q6/15	Alternative approach for multi-channel bi-directional MWDM applications with single-channel optical interfaces in the O-band, optimized for 5 km distances.	2023
G.owdm	Q6/15	Multichannel bi-directional WDM applications with single-channel optical interfaces in the O-band	2023
G.959.1	Q6/15	Add application codes for 100G per lane OTN equivalents of 100GBASE-FR1 and 100GBASE-LR1	2023

Other WP2/15 work currently under development (3)

Work item	Question	Subject / Title	Timing
G.971	Q8/15	General features of optical fibre submarine cable systems	2024
G.972	Q8/15	Definition of terms relevant to optical fibre submarine cable systems	2024
G.976	Q8/15	Test methods applicable to optical fibre submarine cable systems	2024
G.978	Q8/15	Characteristics of optical fibre submarine cables	2024
G.dsssc	Q8/15	Dedicated scientific sensing submarine cable system	2024
G.smart	Q8/15	Scientific Monitoring And Reliable Telecommunications submarine cable systems	2024
G.Suppl.41	Q8/15	Design guidelines for optical fibre submarine cable systems	2024

ITU-T SG15 Working Party 3:
Transport Network Characteristics

Work program review

Tom Huber
Vice Chair SG15, Vice Chair WP3

OFC
IEEE ComSoc IEEE Communications Society
IEEE Photonics Society
OSA The Optical Society | 100 Since 1916

Hot topics in WP3/15

OTN beyond 400G

- 800G FlexO interfaces, including Ethernet-optimized interfaces
- 800GE client mappings

Synchronization

- PTP telecom profile evolution
- Timestamping accuracy of optical modules
- Network resilience and monitoring

Management and control

- Management of optical media and synchronization

FlexO enhancements for 800G (Q11, Q12)

Target completion: April 2023

- Definition of FlexO with 800G physical interfaces (FlexO-8)
  - Extends existing FlexO frame format for use with OTUC8 clients
- Definition of Ethernet-optimized 800G interfaces (FlexO-8e) for point-to-point applications
  - Reduces FlexO-8 bit rate for 800GE client (aligned with OIF 800ZR rate)
  - Supports GMP mapping of 100G, 200G, 400G, and 800G Ethernet directly to the FlexO-8e frame
- FEC frames for both FlexO-8 and FlexO-8e will be defined later (December 2023)
  - FlexO Recommendations will be reorganized to separate common aspects from FEC frame-specific aspects
- Additional enhancements to support regeneration applications are under study

Aligns FlexO Recommendations with 800G extensions that have been done in other organizations

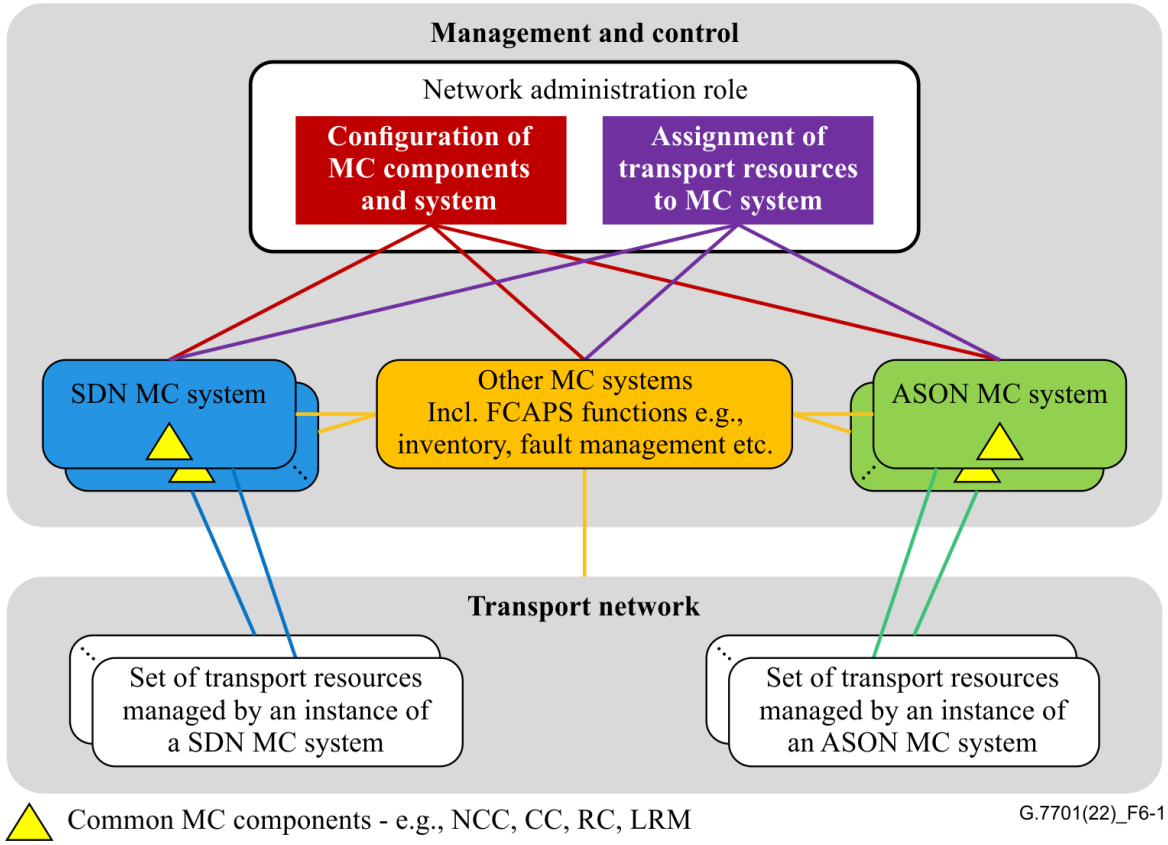
800GE client mappings to OTN (Q11)

- IEEE P802.3df has defined a reference point for mapping 800GBASE-R to OTN
- Q11 will define two mappings:
  - Mapping to ODUflex, supporting full OTN networking applications
  - Mapping to FlexO-8e, supporting point-to-point applications
- Similar new mappings will be needed for 1.6T Ethernet being developed in IEEE P802.3dj

Synchronization (Q13)

- Evolution of the PTP Telecom profiles (e.g., management, security, robustness)
- Synchronization network performance monitoring
- Synchronization network resiliency (e.g., against loss of GNSS)
  - ePRTC holdover enhancements (1 month)
  - “cnPRTC” (network of PRTCs)
- Timestamping accuracy of optical modules
  - Addresses fronthaul network needs
  - Related to work done in MOPA

Management and control (Q12, Q14)



- Development of generic management/control architecture
- Specification of management requirements and information models for the optical media layer
  - Includes management of amplifiers, ROADMs, etc.
  - The management information models are specified through pruning/refactoring the common core information model and extended with technology-specific properties
- Specification of management requirements and information models for synchronization

WP3/15 Recommendations related to optical transport networks

Topic	Common	OTN	Media	Transport Ethernet	Sync
Transport Architecture	G.800, G.805	G.872	G.807	G.8010	G.826x G.827x
Interfaces	-	G.709 G.709.x	G.698.x	G.8012 G.8013	G.703 G.8271
Protection	G.808.x	G.873.x	-	G.803x	-
Equipment	G.806	G.798	-	G.8021 G.8023	G.781 G.781.1
DCN	G.7712	G.7712	-	G.7712	-
Management and Control Architecture	G.770x	-	-	-	-
Management Requirements	G.7710 G.7716 G.7718	G.874	G.876	G.8051	G.7721
Management Info Model	G.7711 G.7719	G.875	G.876	G.8052 G.8052.x	G.7721 G.7721.1

http://www.itu.int

Questions ?