Broadband World Forum 2015
London, UK
20 October 2015

Standardization of broadband access networks in ITU-T SG15
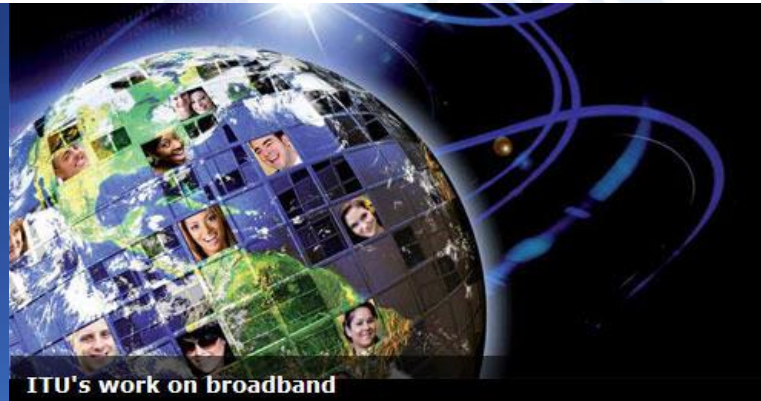
Hiroshi OTA, Advisor for SG15
ITU/TSB

Overview of ITU

ITU: UN Agency for ICTs

ITU : enabling communication since 1865

1865   2015

ITU: a unique Membership

193 Member States and regulatory bodies

750+ companies

Business associations

90+ Universities and Research Establishments

International organizations

NGOs

ITU's 3 Sectors: Standards, Radiocommunications and Development
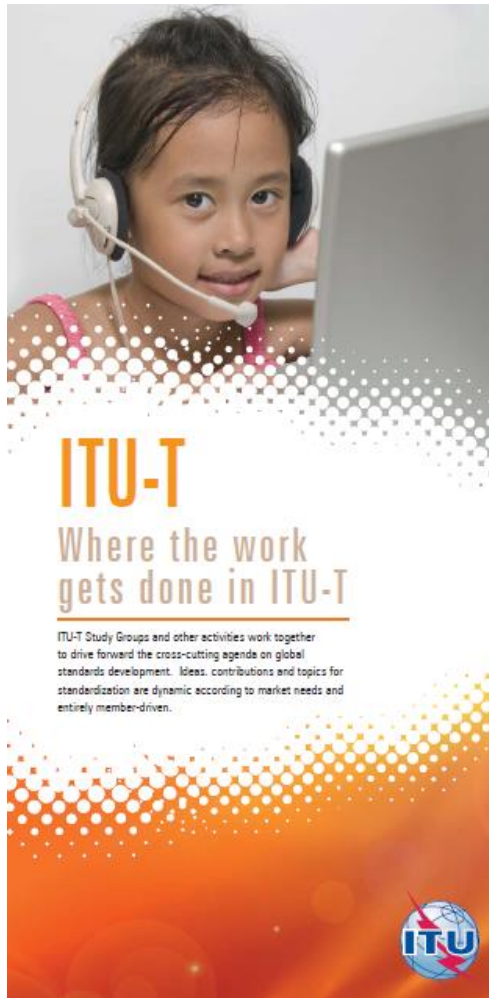

ITU-T Standardization

ITU-D Development

ITU-R Radiocommunication

ITU-T Study Groups

SG2 Operational aspects
SG3 Economic and policy issues
SG5 Environment and climate change
SG9 Broadband cable and TV
SG11 Protocols and test specifications
SG12 Performance, QoS and QoE
SG13 Future networks & clould
SG15 Transport, access and home
SG16 Multimedia
SG17 Security
SG20 IoT and applications, smart cities   **New!**

ITU-T
Where the work
gets done in ITU-T

ITU-T Study Groups and other activities work together to drive forward the cross-cutting agenda on global standards development. Ideas, contributions and topics for standardization are dynamic according to market needs and entirely member-driven.

ITU-T SG15: Networks, Technologies and Infrastructures for Transport, Access and Home

- Optical transport networks and access network infrastructures
- Optical and other infrastructures, systems, equipment, fibres, control plane technologies
- Customer premises, access, metropolitan and long haul
- Lead SG for:
  - access network transport
  - optical technology
 - optical transport networks
  - smart grid

Details are at http://www.itu.int/en/ITU-T/studygroups/2013-2016/15

ITU-T SG15

Example "Hot Topics"
(out of ~150 active work items)

- G.fast – 1 Gb/s DSL
- 40 Gigabit PON (G.989 series)
- Home Networking
- Communications for Smart Grid
- Optical Fibers and Cables
- Submarine Cable Systems
- Optical components and optical physical interfaces
- OTN, including evolution of OTN beyond 100G
- Dynamically responsive transport networks
- Application of SDN to transport networks

Broadband access standards

- High speed access through fibre - PON (Passive optical networks)

- DSL (Digital Subscriber Line) – broadband access using existing copper infrastructure

- G.fast/FTTdp - To provide the best aspects of 'fibre to the home' and 'ADSL'

High speed access through fibre - PON (Passive optical networks)
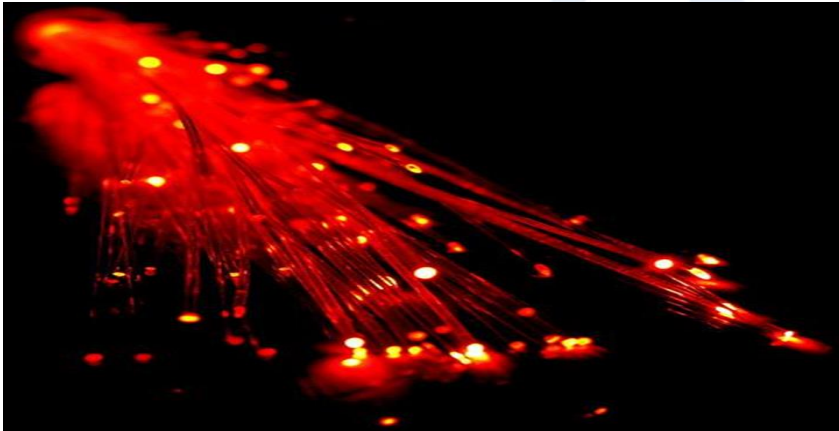
| Type	ITU-T	Initial approval	Max down
BPON	G.983	1998	622 Mbps
GPON	G.984	2003	2.5 Gbps
XG-PON	G.987	2010	10 Gbps
NG-PON2	G.989	2013	40 Gbps

Capacity Trend for PON
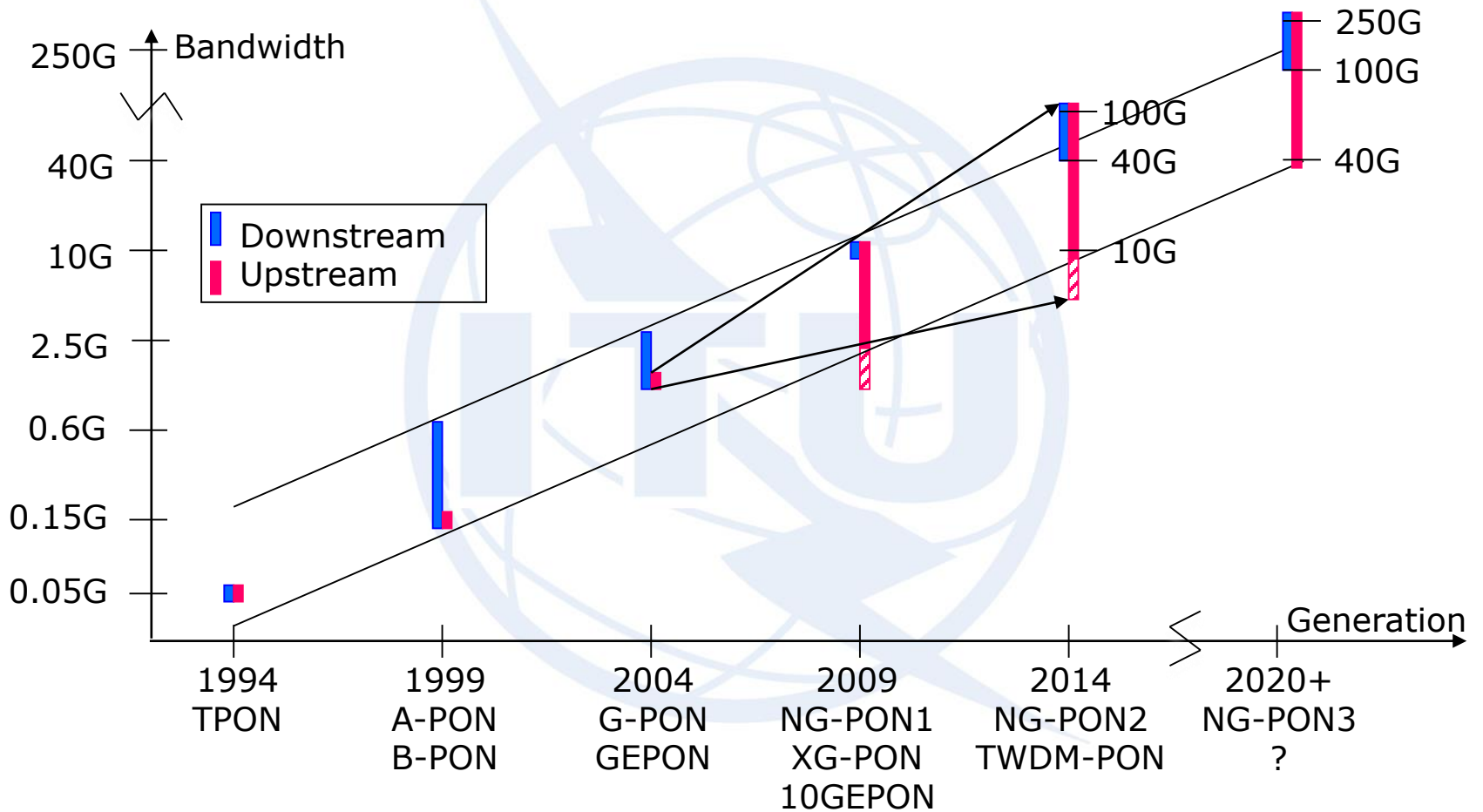
G-PON: Widely deployed

- G-PON: Gigabit-capable passive optical networks

- System defined in the Recommendation ITU-T G.984 series

  – Recommendation ITU-T G.984.1: System requirements

  – Recommendation ITU-T G.984.2: PMD specifications

  – Recommendation ITU-T G.984.3: TC specifications

  – Recommendation ITU-T G.984.4: OMCI - Subsumed by Recommendation ITU-T G.988

    • Now used for all ITU PONs and P2P systems

  – Recommendation ITU-T G.984.5: WDM matters for the future

  – Recommendation ITU-T G.984.6: Reach extension

  – Recommendation ITU-T G.984.7: Long reach

  – Plus supplements…

- Standards considered stable and mature

- Minor optional enhancements continue even now

XG-PON

- XG-PON: 10-Gigabit-capable passive optical networks
- System defined in the Recommendation ITU-T G.987 series
  - Recommendation ITU-T G.987: Definitions, abbreviations and acronyms
  - Recommendation ITU-T G.987.1: General requirements
  - Recommendation ITU-T G.987.2: Physical media dependent (PMD) layer specification
  - Recommendation ITU-T G.987.3: Transmission convergence (TC) layer specification
  - Recommendation ITU-T G.987.4: Reach extension

XG-PON system (ITU-T G.987 series) coexisting with G-PON
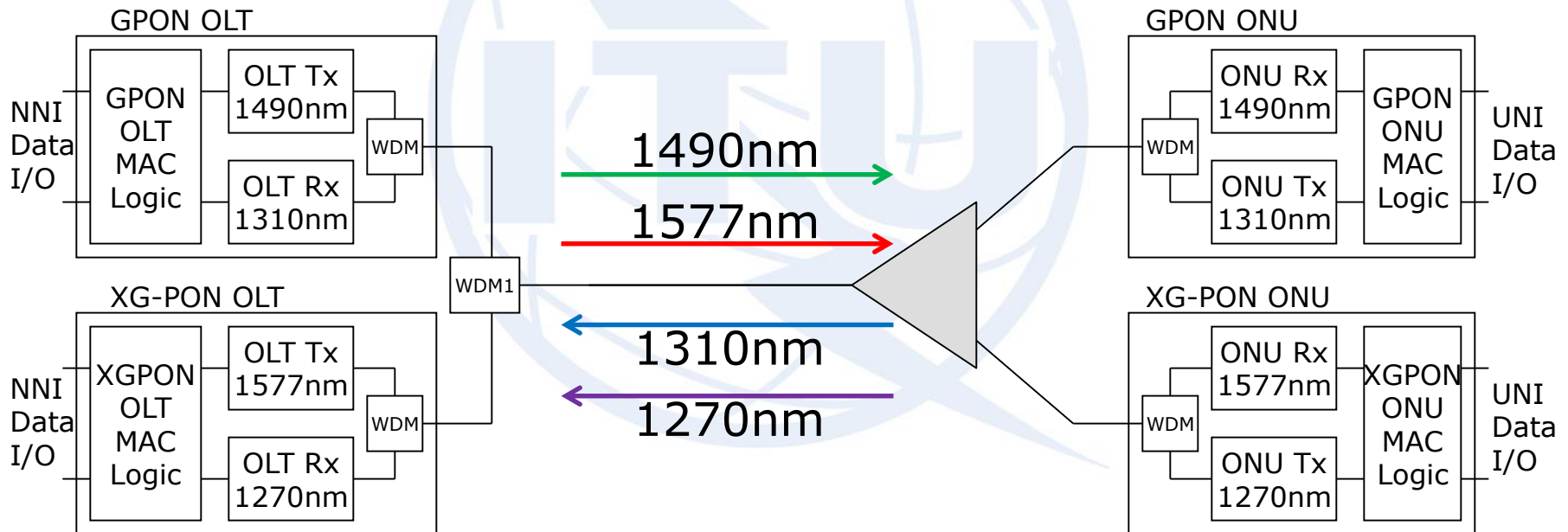
NG-PON2

- NG-PON2: 40-Gigabit-capable passive optical networks

- System defined in the Recommendation ITU-T G.989 series

  - Recommendation ITU-T G.989 : Definitions and conventions (under approval process)

  - Recommendation ITU-T G.989.1: General requirements

  - Recommendation ITU-T G.989.2: Physical media dependent (PMD) layer specification

  - Recommendation ITU-T G.989.3: Transmission convergence (TC) layer specification (under approval process)

    - Based on G.987.3, with wavelength control and 10G upstream added

  - Recommendation ITU-T G.9802 (ex. G.multi) = Wavelength control layer

    - Meant as a general framework for TWDM-systems, of which G.989 is one

  - Recommendation ITU-T G.984.5 = Wavelength coexistence

  - Recommendation ITU-T G.988 = ONU management and control interface

    - Standard in force, can be easily reused for TWDM

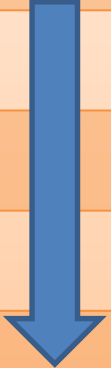# Evolution in the recommendation for Recommendation ITU-T G.652 fibers

- Existing Recommendation ITU-T G.652.D category is already optimized to be used with G-PON and XG-PON systems, with the necessity to define attenuation attribute in the range of interest (1260 nm - 1625 nm)
- A new category has been proposed with enhanced behavior in attenuation and bending loss for both transport and access networks applications (under discussion)
- Proposals under evaluation:
  - to reduce the existing MFD range in order to improve the compatibility with other single mode categories (e.g. Recommendation ITU-T G.657)
  - to improve the geometrical requirements in order to enable the use of low cost connectors or splicing machines in access network
  - necessity to define attenuation attribute in the range of interest in access network: 1260 nm - 1625 nm

Evolution in the recommendation for Recommendation ITU-T G.657 fibers

- Optimization of B2/B3 categories (not necessary compliant with Recommendation ITU-T G.652) has been developed:
  - improved compatibility with other Recommendation ITU-T G.657 categories and with Recommendation ITU-T G.652 with the reduction of MFD range (Minimum typical MFD was modified from 6.3 mm to 8.6 mm)

- Definition of methods to measure MPI in Recommendation ITU-T G.650.1

- It was accepted to reduce existing MFD range also for A1/A2 subcategories in order to improve the compatibility with other single mode categories (e.g. Recommendation ITU-T G.652) and to harmonize with Cenelec standards on connectors.

- Proposal under evaluation:
  - Necessity to go deep in the study of mechanical reliability related to the FTTH installation conditions
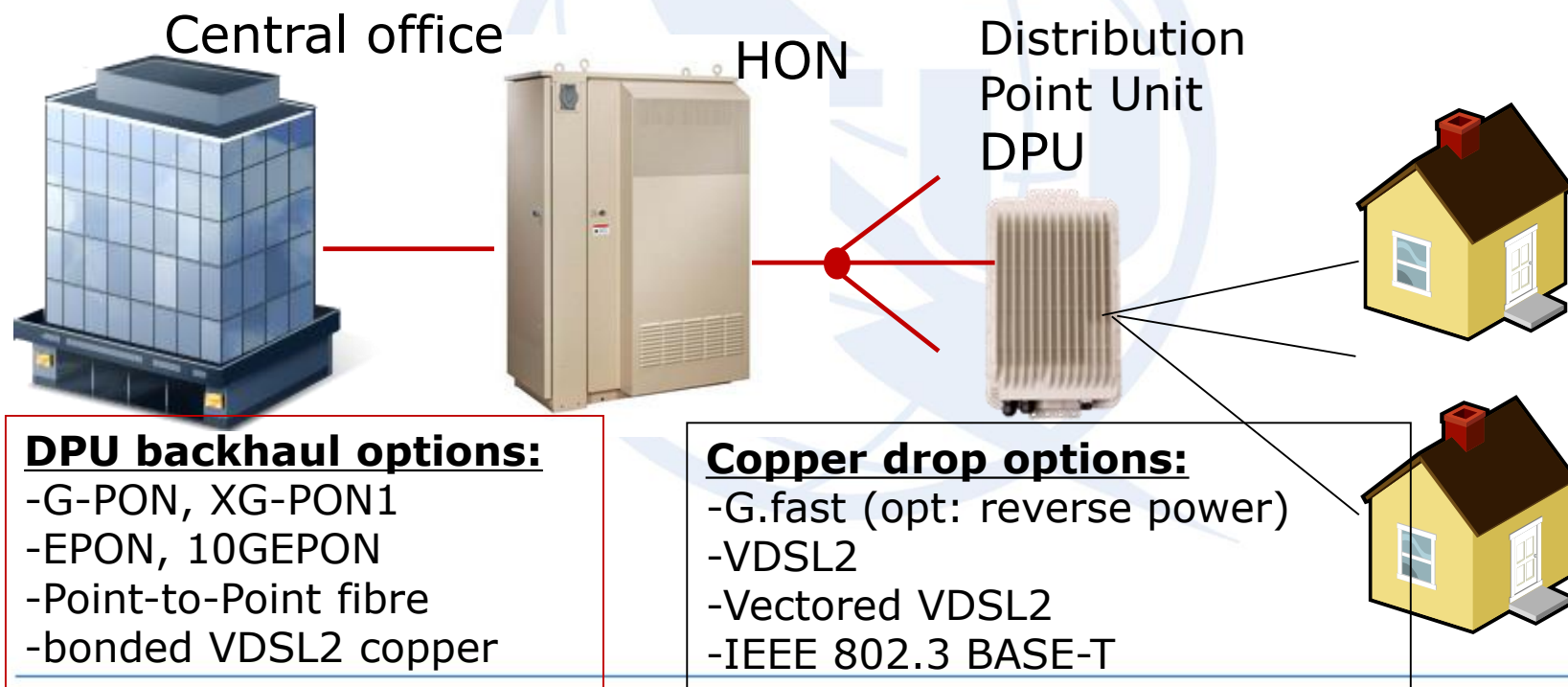
DSL: Breathing new life into existing copper infrastructure

Type	ITU-T	Initial approval	Max up/down
HDSL	G.991.1	1998	2 Mbps
ADSL	G.992.1	1999	
SHDSL	G.991.2	2001	
ADSL2	G.992.3	2002	
VDSL	G.993.1	2004	
VDSL2	G.993.2	2006	100 Mbps
G.fast	G.9701 / G.9700	Dec 2014 / April 2014	1 Gbps

G.fast/FTTdp: Fibre To The distribution point

One FTTdp architecture benefit is that the DPU equipment typically serves 1-20 lines, making it small enough to place on a pole, in a hand-hole or in a small pedestal

Central office

HON

Distribution Point Unit DPU

DPU backhaul options:
-G-PON, XG-PON1
-EPON, 10GEPON
-Point-to-Point fibre
-bonded VDSL2 copper

Copper drop options:
-G.fast (opt: reverse power)
-VDSL2
-Vectored VDSL2
-IEEE 802.3 BASE-T

What is FTTdp ?

- A broadband access solution taking fibre to a distribution point (FTTdp) very close to the customers premises, with total wire length to the customers' transceiver up to 400m.
  - It is expected that the bulk of the loop lengths may be in the order 30 to 50m. On 30 m loops, aggregate data rates up to 750 Mb/s should be supported on a single pair.

FTTdp key aspects

- Provides the best of both worlds:
Fibre to the home and ADSL
  - Fibre-to-the-home (FTTH) bit-rates
  - Customer self-installation like ADSL
- Complements FTTH:
  - Customer is unwilling to have his property excavated or interior redecorated to install fibre
  - Customers do not follow through with FTTH orders due to their unavailability or service issues
- Enhances FTTC:
  - Cabinets can move closer to the premises.

Service rate performance targets

- 500-1000 Mb/s for FTTB deployments @<100m

- 700 Mb/s at 100m

- 500 Mb/s at 200m

- 200 Mb/s at 400m

- Aggregate service rates ≥500 Mb/s with start frequency of 23 MHz and VHF and DAB bands notches

G.9700 - Power Spectral Density

- G.fast uses up to 106 MHz - Power spectral density specification is critical
- Designed with ITU-R so that G.fast does not interfere any existing radio services
- Combination of the following masks are used:
  - limit PSD mask (LPM);
  - subcarrier mask (SM);
  - PSD shaping mask (PSM);
  - notching mask (NM); and
  - low-frequency edge stop-band mask (LESM).

Applications

- Next-generation IPTV service at well over 100 Mb/s

- Access to small and medium business sites at well over 100 Mb/s

- Backhaul for very small wireless cell sites, including HetNet

- Backhaul for WiFi hotspots

Standards body cooperation

- Close cooperation between standards groups is needed:
  - ITU-T Q4/15 for G.fast transceiver aspects
  - ITU-T Q2/15 for PON related aspects
  - Broadband Forum (Fiber Access Network and Architecture & Migration Work Areas) for architectural aspects
  - Broadband Forum addresses certification and interoperability testing of equipment based on ITU-T G-PON and DSL Recommendations, and
  - ETSI TC ATTM TM6

Thank you