Joint ITU/IEEE Workshop on Ethernet - Emerging Applications and Technologies

GPON Interoperability and beyond

Broadband Forum activities in supporting the expansion of Fiber Access

Robin Mersh,

CEO, Broadband Forum

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Agenda

- Broadband Forum scope
- Fiber Access Network WG scope
- GPON Interoperability
  - Issues and solutions
  - Service architecture
  - Interoperability Events
  - Testing and Certification
- Additional GPON standards
- Looking forward to XG-PON1
- Enabling new service architectures
- Monitoring and Managing the ODN
- BBF FSAN ITU-T PON specifications

Broadband Forum

Engineering smarter & faster connections

Who are we?

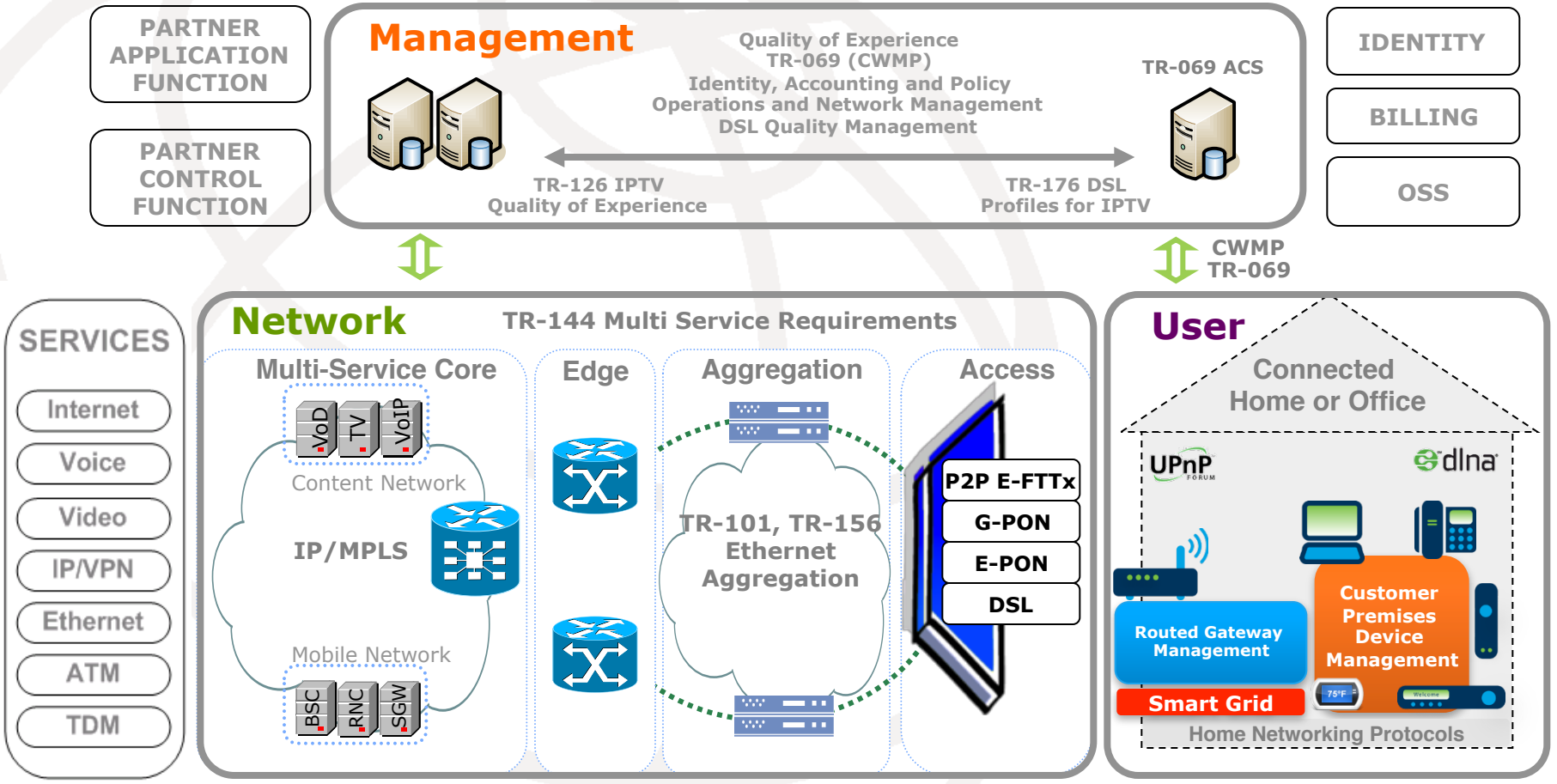
- Industry consortium made up of approximately 200 service providers, vendors, consultants, academia and test labs
- Predominant broadband industry forum since **1994**

Architecting a connected lifestyle

- Defining best practices for global networks
- Enabling service and content delivery
- Establishing technology migration strategies
- Engineering critical device & service management tools
- Redefining broadband

http://www.broadband-forum.org

Broadband Forum Scope



Multi Service Architecture & Requirements IPv6 Certification, Test and Interoperability

The FAN Working Group

Fiber Access Network

- Focus on **all types of standardized ITU-T and IEEE PONs and point-to-point optical access technologies**
- Develops technical **specifications and test plans for conformance and equipment interoperability**
- Organizes interoperability **plugfests**
- Defines **certification programs**
- Strong relationships with ITU-T, IEEE and FSAN

Chairmen:

- Alessandro Capurso (Telecom Italia)
- Regis Coat (Orange)

GPON Business requirements

- **Integration in triple play deployments**
  - Replicate over GPON the architecture adopted over DSL
  - Leverage platforms and processes used in existing deployments
  - **Support various business models and device types**
    - SFU, SBU, MDU…
    - Ethernet or DSL last drop
    - ONU and RG as separate devices or integrated into one box
    - Maximize commonality of architecture to **reduce integration costs** and guarantee interoperability
  - **OLT-ONU Interoperability**
    - Allow OLT and ONU to be provided independently
    - Facilitate competition, promote GPON as an open technology
    - Reduce complexity
    - Enable business models where the retail service provider may not operate the access network

GPON IOP: Issues and Solutions

Issues

ITU-T G.984 GPON Recommendations define the PHY layer but…

1. OMCI defined in G.984.4 was giving too many options to configure the same kind of functional and service architectures
2. an agreed functional cut between GPON OLT and ONU was missing

Solutions

1.OMCI Implementers' Guide

- **Defines the OMCI message** sequence to enable a given functionality
- Included in ITU-T G.984.4 and ITU-T G.988 (OMCI specifications)

2.BBF TR-156 - Using GPON Access in the Context of TR-101

- **Specifies the required capabilities** of GPON OLTs, ONUs and ONTs above the Physical, TC and OMCI layers (covered by ITU standards)
- Supports a variety of deployment scenarios (FTTH, FTTB, SFU, MDU, …)
- Ensures IOP between GPON OLT and ONU/ONTs for Ethernet/IP services
- Integrates GPON seamlessly into service providers' deployments

TR-156 GPON in the context of TR-101

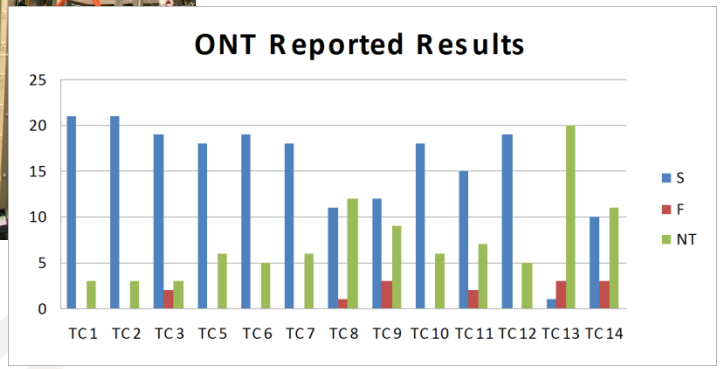
- Describes a **GPON based access architecture** in the context of an **Ethernet/IP aggregation and access network** (TR-101)
- Defines **configuration requirements** for OLT and ONU/ONT
  - **Layer 2 Bridging**
    - GEM ports - VLANs mapping; VLAN N:1, 1:1 and VBES model support
  - **Quality of Service**
    - GPON mechanisms to achieve end to end QoS
  - **Multicast traffic**
    - Multicast support, admission control and conditional access mechanisms
  - **Security considerations**
    - User-to-user communication, spoofing, flooding, …
  - **Port Identification**
    - User identification within PPPoE Intermediate agent and DHCP opt82
  - **OAM and Network Management**
    - Identifies GPON managed entities

GPON Interoperability Events

- Several **joint BBF-FSAN** GPON IOP test events **based on TR-156 service architecture**
- Allowed GPON vendors to test and fix their

Test Case	Status	Description
TC1	Preliminary	Provisioning using Registration ID method (correct Reg-ID case)
TC2	Preliminary	VLAN Architecture N:1 bridge model
TC3	Mandatory	Availability of Multicast traffic on the ONUs and Zapping tests
TC5	Mandatory	IGMP Channel Conditional access (allowed channels)
TC6	Mandatory	Channel Conditional access (Limited number of channels)
TC7	Mandatory	IGMP Channel Conditional access (Bandwidth)
TC8	Optional	IGMP counters
TC9	Optional	ONU software upgrade
TC10	Optional	MIB Synchronization
TC11	Optional	Alarms Synchronization
TC12	Optional	Provisioning using Registration ID method (wrong Reg-ID case)
TC13	Optional	Multicast traffic source specific selection
TC14	Optional	Strict priority downstream scheduling among 4 queues on ONU

picture from UNH-IOL Plugfest Space



- Currently FSAN and BBF are organizing **XG-PON1 PHY layer IOP test events**

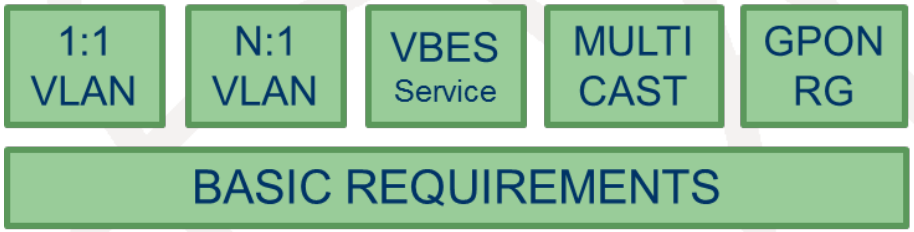
GPON IOP and ONU Certification

Standards are available… but operators need certification!

- TR-247: GPON **ONU Conformance Test Plan**
  - Defined in FAN in collaboration with FSAN IOP TG
  - Verifies ONU **conformance to TR-156 and OMCI Imp. Guide**
- **BBF.247 GPON ONU Certification Program**
  - Program based on the TR-247 test plan
  - Test plan for certification executed in BBF **accreditated Independent Test Labs (LAN – based in France)**.
  - 8 ONUs certified so far
- WT-255: GPON **Interoperability Test Plan**
  - Verifies OLT and ONU interoperability and **support of the services and architectures defined in TR-156**
  - Requires TR-247 compliance for ONU
  - Interoperability Program under discussion in BBF

BBF.247 ONU Certification

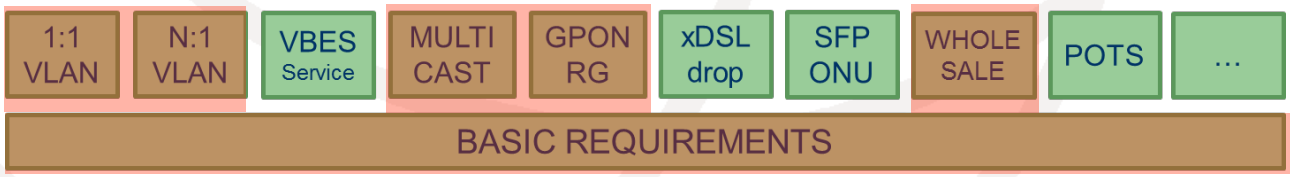
- The **modular approach** of TR-247 test plan allows the definition of **profiles** in the BBF.247 certification



Already available profiles

New profiles coming soon

- ONU can be **certified on any combination** of profiles → **every ONT can be certified** in its peculiar aspects



Example of a possible ONT certified on some profiles

Addressing not only service level IOP

- **Power saving**
  - BBF has been asked, as industry standard leader, to contribute in the definition of the power consumption of GPON/ EPON OLTs and ONUs for **EU Code of Conduct**
  - Expertise on the topic from **chipset vendor** to **system integrators** and **service provider** needs
- **Management**
  - WT-205 : GPON and XG-PON1 Management
- **Residential Gateway**
  - TR-142 : Framework for TR-069 Enabled PON Devices
  - TR-155 : GPON ONU Requirements for CPE

Looking forward to XG-PON1

ITU-T G.987 and G.988 define XG-PON1 PMD and TC

- BBF **TR-156** GPON **service architecture**
- BBF **TR-247** GPON **ONU conformance test plan**
- BBF **WT-255** GPON **IOP test plan based on TR-156**

extended to XG-PON1

NEW **BBF WT-288 XG-PON1 ONU**

- Contains requirements and **guidelines for selecting** and enabling the **specific optional functionalities** of the XG-PON1 systems
- Addresses Authentication, Payload encryption, Power Management, …
- It serves SP as a basis for the specific system requirements documents and vendors as the roadmap for implementation and testing of optional functionalities

- **BBF WT-309 XG-PON1 PHY IOP test plan**

NEW
- Compiled in FSAN; used for XG-PON1 PHY IOP test events
- Will be included in the BBF ITU-T PON IOP test plan suite

Enabling new service architectures

New BBF service architeture described in TR-178 defines business and wholesale support in addition to triple-play specified in TR-101

WT-280 ITU-T PON in the context of TR-178

- Define how services beyond those described in TR-156 as **wholesale service, "virtual unbundling", POTS, etc**. are deployed and configured with OMCI
- Give a reference in the BBF framework for **new GPON and XG-PON1 functionalities** described in the OMCI related standards.

WT-301 FTTdP - Fiber to the Distribution Point

- Define a new type of node with **fiber uplink and copper drops** to overcome issues in fiber drop installation while supporting CPE bandwidth up to 1 Gbps thanks to **G.fast** support
- **Reverse powering** of the node from CPE, **Zero Touch** and **self install** as starting requirements
- Note: A parallel study is under way to investigate FTTdP potential impact on current broadband architecture

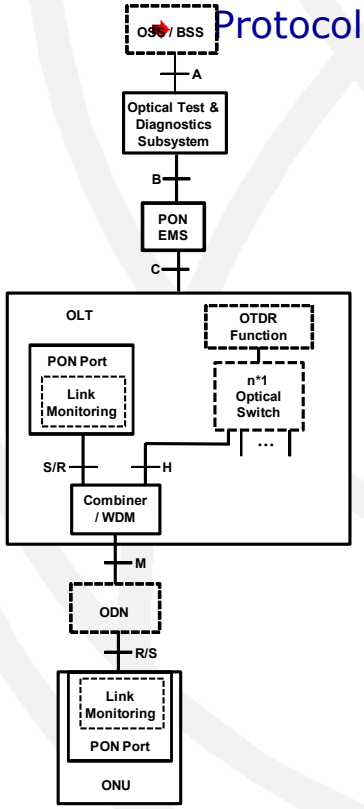
Monitoring the ODN

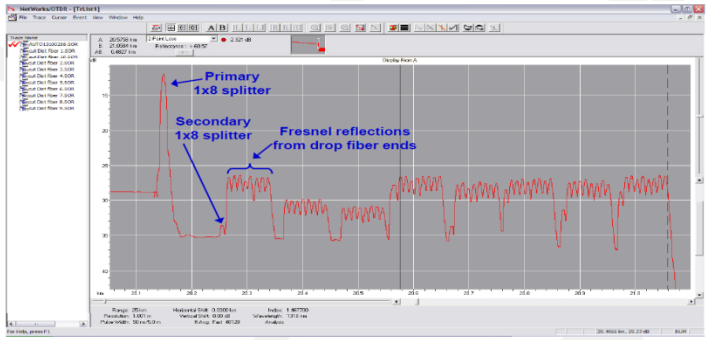
Service Providers need a standard tool to **monitor fiber access** deployments and **diagnose** the type and **identify the location** of faults to **minimize OPEX**

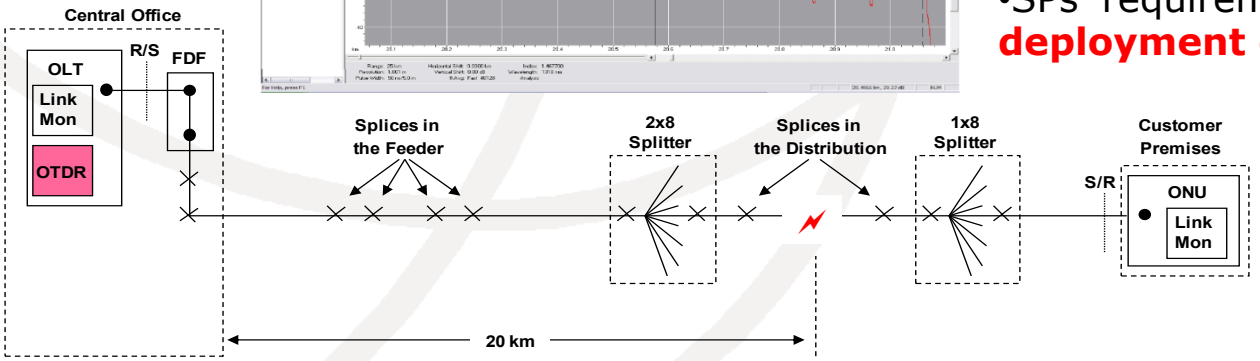
WT-287 Optical Line Monitoring

- Physical-layer performance monitoring and fault-isolation capabilities
- Define OLM **system architecture** and **interfaces**
- **Functional and performance requirements** for optical-link management functions;
- Implementation-dependent requirements (**OTDR**, RSSI optical-power monitoring, etc.);
- Protocol-neutral (applicable to both ITU-T and IEEE PON systems)

NEW







A joint effort with **FSAN** and **SIEPON**

- **Real data** comparison
- **Modelling** the faults
- SPs' requirements and **deployment experience**

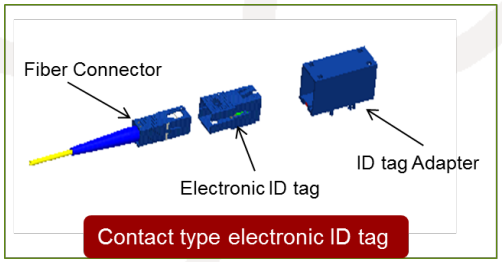
Managing the ODN

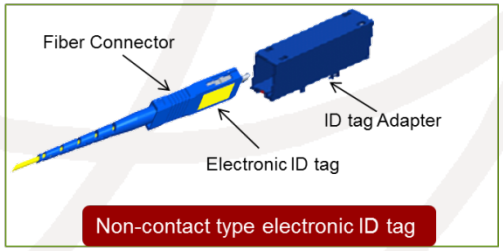
Service Providers need a standard tool to **manage and control fiber access deployments** for reliable fiber and ODF ports identification and automatic DB update

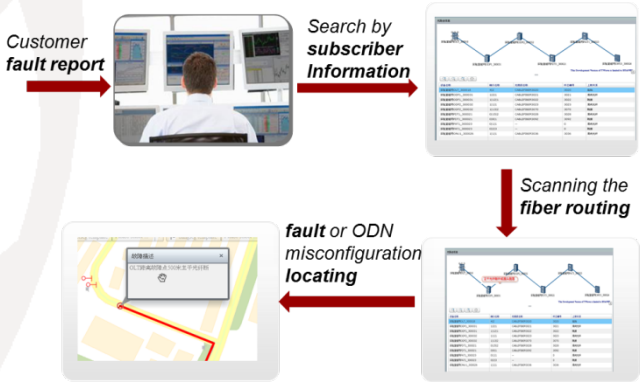
PD-311 Inteligent ODN

- **Define architecture and requirements** of intelligent ODN systems
- Develop **standardized approaches** to characterize a general intelligent ODN system
- **Identify gaps** in existing technical specifications for intelligent ODN system and components.

NEW







The BBF, FSAN, ITU-T PON *tree*

- **3 main actors**
  - ITU-T – Study Group 15 Question 2
  - FSAN (Full Service Access Network) – IOP Task Group
  - Broadband Forum (BBF) – FAN Working Group

- **Strong collaboration on ITU-T PON technology**
  - A common workshop on G-PON interoperability end of 2009
  - ITU-T SG15/Q2 in charge of technology definition standard
  - FSAN IOP Task Group in charge of Physical and Transmission Convergence layers interoperability
  - Broadband Forum Fiber Access Network Working Group in charge of upper layers interoperability
  - Regular communications/liaisons

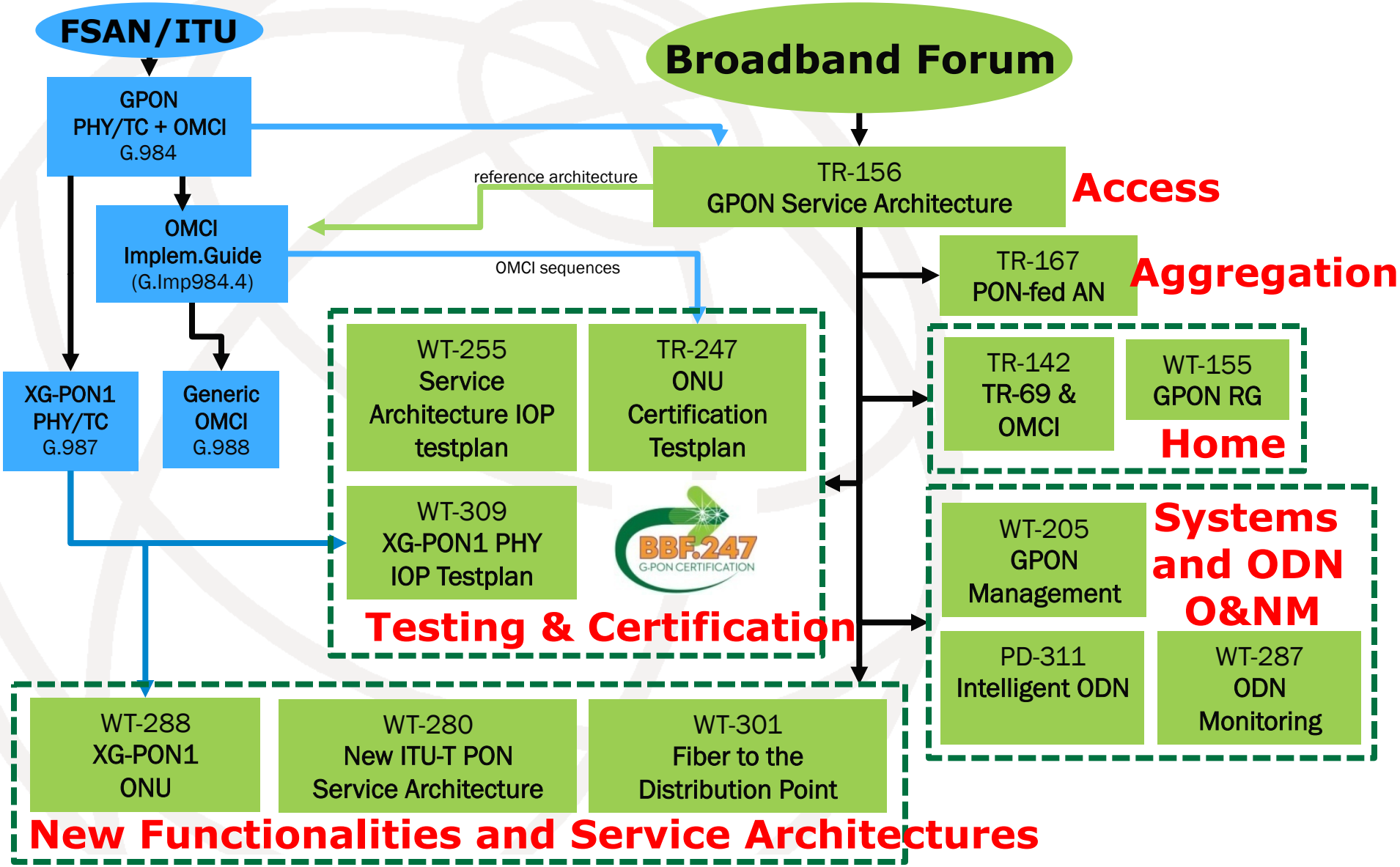
ITU-T Standards

- G.984.2amd1 (02/2006) G-PON: Physical Media Dependent (PMD) layer specification (Class B+)
- **G.984.4 (02/2008) G-PON: ONT management and control interface specification**
- G.984.3 (03/2008) G-PON: Transmission convergence layer specification (TC)
- G.984.3 amd1 (02/2009) G-PON: Transmission convergence layer specification
- **Implementers' guide G.984.4 v1 (12/2008)**
- G.984.4 amd1 (06/2009) G-PON: ONT management and control interface specification
- **Implementers' guide G.984.4 v2 (10/2009)**
- G.984.4 amd2 (11/2009) G-PON: ONT management and control interface specification
- **G.988 (11/2010) ONU management and control interface (OMCI) specification (applicability to all optical access systems)**

Broadband Forum Technical Reports

- TR-142 issue1 (03/2008) Framework for TR-069 enabled PON devices
- **TR-156 issue1 (12/2008) Using G-PON Access in the context of TR-101**
- TR-142 issue2 (02/2010) Framework for TR-069 enabled PON devices
- **TR-156 issue2 (09/2010) Using G-PON and XG-PON1 Access in the context of TR-101**
- TR-155: G-PON ONU requirements for CPE
- **OD/TR-247: G-PON ONU Conformance Test Plan**
- **WT-255: G-PON Interoperability Test Plan (TR expected in Q2 2012)**

IEEE The BBF, FSAN, ITU-T PON *tree*



Our doors are wide open

- All interested parties are encouraged to participate in our work!
- Broadband Forum Reports are freely available on our website:
  - http://www.broadband-forum.org