Introduction

- The BBF has been driving the evolution of Broadband Network Architecture for the last 12 years – this has involved all the major stakeholder in the industry
- During this period network operators have faced evolving challenges and so different technical solutions have been introduced to support new services and business models
- BBF TR’s have played a critical role in helping the industry face the new challenges
- Interoperability testing and certification programs are helping to promote a multi-vendor environment
Access and Network Evolution at the Broadband Forum

- **1999**: TR-25
- **2003**: TR-59
- **2006**: TR-101
- **2008**: TR-156
- **2009+**: TR-145

- **ADSL**
- **ADSL2+**
- **VDSL**
- **PON**
- **Ethernet Aggregation**
- **ATM Aggregation**
- **MPLS or Carrier Ethernet Aggregation**
- **Distributed AN**
- **BAS**
- **BRAS**
- **BNG**
- **Video BNG**
- **IPTV**
- **VOIP**

- **Internet**
- **Internet & QoS**
- **Other**
Challenges faced by Network Operators

- Providing Multi-Service support
- New Business Requirements & service models
- Augmenting xDSL with Fibre access
- Providing Cloud services
- Moving from ATM to Ethernet based Access
- Introducing Fixed-Mobile convergence

Multi-Service Broadband Architecture
Motivations for a Multi-Service Architecture - I

- **Support for different customer types, markets and services:** residential, retail, business, wholesale, fixed, mobile, cloud/virtualized services over a common network architecture
- **Simplification of network architecture:** an end-to-end architecture based on IP/MPLS and Ethernet with a well-defined migration path;
- **Multi technology Access support:** xDSL, Ethernet, xPON, Microwave wireless, legacy voice, wavelength access for business customers, TDM circuits
- **Multi-Edge support:** the ability to source traffic to a given subscriber from multiple, different, Service Edges;
- **Enhanced Scalability:** moving IP Edge Nodes closer to customers allows the connection of more customers to the aggregation network
Motivations for a Multi-Service Architecture - II

- **Enhanced availability**: use of OAM and an appropriate control plane for automatic protection and/or restoration
- **Seamless connectivity**: integration of access, aggregation and core networks
- **Operational enhancements**: the migration to a converged packet based access and aggregation network can improve the end-to-end provisioning process by minimizing the provisioning points
- **Enhanced support for Wholesale services**: to meet regulatory requirements (e.g. Active Line Access) and support non-vertical business models
- **Fixed-Mobile Convergence (FMC)**: allows a user to use a single handheld device for both fixed and mobile access
Roles played by BBF Reports

- Providing Multi-Service support
  - TR-101
  - TR-221

- Introducing Fixed-Mobile convergence
  - WT-300

- Augmenting xDSL with Fibre access
  - TR-156
  - TR-167

- Providing Cloud services
  - MR-275
  - WT-302

- New Business Requirements & service models
  - TR-144
  - WT-178

- Moving from ATM to Ethernet based Access
  - TR-101

- Multi-Service Broadband Architecture
  - TR-145
  - TR-203
  - TR-291
  - TR-144
TR-101 Scope and Content

Migration from ATM to Ethernet Broadband Aggregation

- VLAN architecture
- Multicast options
- Use of a video-optimised Service Router (next to a ‘traditional’ TR-59 type BRAS)
- Resilience in the Ethernet Aggregation Network
- QoS in the Ethernet Aggregation Network
- Ethernet OAM
- Support for PPPoA and IPoA (aka interworking between XoA and XoE)

Note: TR-101 introduces the term Broadband Network Gateway (BNG) to differentiate this from the legacy 'BRAS' term
Multi-Service Architecture Suite

- **TR-144**: *Broadband Multi-Service Architecture & Framework Requirements*:
  - describes business drivers and requirements

- **TR-145**: *Multi-service Broadband Network Functional Modules and Architecture*:
  - defines reference architectures and functional modules
  - The functional module decomposition enables a variety of deployment options, i.e. different ‘boxing-up’

- **WT-178**: *Multi-service Broadband Network Architecture and Nodal Requirements*:
  - describes a set of architectures, re-using the functional modules provided in TR-145, and specifies detailed nodal requirements
From xDSL to Fiber Access

- Want to support the introduction of deeper fibre without changing the basic architecture
  - Allows a smooth migration

GPON in the Access Network: TR-156

- TR-156 specifies the required capabilities of GPON OLTs, ONUs and ONTs
  - Above the Physical, TC and OMCI layers, which are covered by FSAN/ITU standards

- Supports a variety of deployment scenarios with a converged technical solution
  - FTTH (Fiber To The Home), FITH (Fiber Into The Home), FTTO (Fiber To The Office), MDU (Multi-Dwelling Unit), MTU (Multi-Tenant Unit)

- Aims to ensure interoperability between GPON OLTs and ONUs/ONTs
TR-156 Network Architecture

- The entire GPON system performs the role of an Access Node as specified by TR-101
  - U and V reference points remain unchanged
- Aims to integrate seamlessly into broadband service providers’ deployments
GPON in the Aggregation Network: TR-167

- Defines the required capabilities for a GPON system (OLT/ONU) used to feed a TR-101 compliant access node
  - The GPON system is performing the role of an aggregation node as specified by TR-101 – no effect on the access node.
  - Does not define the physical layer attributes of the system
Cloud Services and Beyond

- The Cloud is changing the way that businesses deliver and people consume services
  - enables IT to be delivered as a service
- Cloud Computing will play a key role in generating new business opportunities as Broadband Service Providers can move into the IT services market using their existing assets
- **WT-302** provides a framework and requirements to support Cloud services in Multi-Service Broadband Networks
- **TR-145/WT-178** already support some tools to address Cloud services such as:
  - capability to *scale* and *grow on demand*: nodes can be grouped in virtual clusters and functions can be moved from centralized to distributed locations and potentially new components/entities
  - “*on-demand*” configuration and provisioning: supported for both Layer 2 and Layer 3 services
- **MR-275** describes how to use enhanced IP/MPLS tools (E-VPN, PBB-EVPN) to provide Datacenter Interconnect
FMC – BBF - 3GPP Interworking

- **TR-203** describes Interworking use cases based on 3GPP UE devices moving between the 3GPP Mobile Network and the fixed broadband network and vice versa.
WT-291 builds on TR-203 and provides the nodal requirements for solutions associated with the TR-203 architecture and use cases.

Evolving from completely separated networks to an interworking architecture.
FMC – Policy Convergence

- Summarizing **WT-300** reference architectures

**Common functions:**
- Access control
- Fair usage policies
- Re-directions
- ...

**Mobile access**
- SGSN
- GGSN
- MME
- PGW
- SGW
- BSC, RNC or eNodeB
- BRAS / BNG

**Wireline access**
- BNG / BRAS
- Router
- DPI

**Business support systems**
- BPCF / PCRF
- Business support systems
- Service layer
- Control Plane
- User Plane
- Service layer
Conclusions

- The BBF has a long and successful history in Broadband Network architecture
- The initial focus on mass-market residential wireline services has now been greatly expanded to include business services, multiple edges, FMC and the Cloud
  - a true multi-purpose, multi-service, multi-edge network
  - and capable of taking advantage of ideas like NFV and SDN
- This has led to a suite of architecture documents
  - necessary to support migration and a range of solutions
- Technology migration (change management) is a huge issue for the broadband industry, because at the same time new services are developed old ones need to be preserved
Thank You