Access and Transport Architecture

Note: For work and wiki pages predating the January 2019 formation of the Access and Transport Architecture Work Area, see the retired Architecture and Migration Work Area and the Routing and Transport Work Area wiki pages.

2. ATA Work Area Project Streams and Projects

2.1. ATA New Project Initiation Forms (NPIFs)

Project Page: ATA New Project Initiation Forms (NPIFs)

Work Area Director: David Sinicrope (GM), Ericsson

Description: Proposed new projects for ATA or combination of Work Areas including ATA.

2.2. ATA Non-PS Assigned Projects

Project Stream Page: ATA Non-PS Assigned Projects

Work Area Director: David Sinicrope (GM), Ericsson

Description: Projects that don't fit under the scope of an existing Project Stream or if they fit under the scope of more than one Project Stream, are developed under the Non-PS Assigned category.

2.3. Access Architecture (AA) Project Stream

Project Stream Page: Access Architecture (AA) Project Stream

Project Stream Leads: Jonathan Newton, Vodafone

Mission:

3. Work Area Overview

3.1. Mission Statement:

The Access and Transport Architecture (ATA) Work Area (WA) defines and specifies the architecture and equipment requirements for access, routing and transport network infrastructure. ATA produces industry-agreed specifications for applications such as mobile transport infrastructure (fronthaul and backhaul), data center interconnect, broadband Internet access, etc. as well as specifications for managing, testing, and maintaining these networks and their applications. This work typically takes the form of architecture, equipment requirements, test & implementation guidance, and education materials.

Work Area Directors:

The project stream mission is to advance access broadband network architecture in traditional and new areas to ensure quality connectivity leading to quality user experience. Identify and document the key functionalities and relationships between entities to facilitate the transition of networks to encompass new practices such as virtualization while documenting the key functionalities that need to be brought forward to enable a seamless evolution path.A critical element of the work is the long term support of existing and new physical and statically management network elements alongside agile and virtualized functions in what effectively will be a stable hybrid network. This enables seamless migration based on market acceptance on new technologies, protection of existing infrastructure investment and normal spread of deployment in different territories.The project stream will focus on:

1. New, distributed access network architectures, including some or all of which is virtualized.
2. Defining the access (e.g., AN, BNG) function, interfaces and interactions of the equipment within these new architectures
3. Defining the equipment requirements needed to support the new architectures
4. Migration from existing access networks to those deployed leveraging the new architectures, functions and equipment
5. Maintenance of existing access architecture, functions and equipment requirements

Business Impact:

The work creates the necessary foundation for all of the broadband network. It underpins new value-added services and application delivery for fixed access networks, for home and business that can now be deployed at the pace of each market. Co-existence of physical and virtualized solutions and from static and dynamic services will create a broadband network mitigating the risks to existing revenue and enabling market-paced migration. Drive evolution of the network to improve scale, resiliency, reliability and security.

Scope:

Specifically the project stream covers the following areas:

- Overall broadband access network architecture from RG through BNG.
- Conventional Broadband Network Gateway (BNG) - definition, architecture, function definition and requirements.
- Disaggregated Broadband Network Gateway - definition, architecture, function definition and requirements.
- Conventional Access Node (AN)- definition, architecture, function definition and requirements.

Projects

Project Name and Page Link	Project Overview
	Overview

- David Sinicrope (GM), Ericsson

3.2. Business Impact:

A critical element of the work is the long term support of existing network elements alongside virtualized software based network functions, resulting in a stable network that may be evolved over time. This enables seamless migration of new networking technologies based on their market acceptance, at the same time protecting existing infrastructure investment, and deployment into new different territories. ATA specifications underpin the network infrastructure, value-added services and application delivery for fixed and mobile access networks, and allow deployment at the pace of each relevant market. Co-existence of physical and virtualized solutions for static and dynamic services create a network infrastructure mitigating the risks to existing revenue at the same time it leverages new networking technology according to market demand.

3.3. Scope:

Multi-Service Disaggregated BNG with CUPS

The Architecture and Transport Architecture (ATA) Working Area (WA) has a rich history in defining various BNG architectures and requirements, from classic functions such as L2TP LAC to more recent functions such as Network Enhanced Residential Gateway (NERG) and Public Wi-Fi access in MS-BNG. The MS-Disaggregated BNG (DBNG) is an on-going project at ATA. TR-459 serve as a foundation document in defining the the architecture and requirements for a DBNG. Standardizing interfaces and protocols will ensure interoperability between various types of control planes and user planes deployments. One of the key objective TR-459 is to ensure the DBNG provides the same broadband service offerings as a classic MS-BNG. Compared to a classic MS-BNG, the MS-DBNG have several key advantages such as independent user plane and control plane scaling, independent control and user plane life cycle management, and centralized control plane for configuration. The separation of the control plane and user plane enables more efficient use of resources and simplifies operations. In addition, BBF is a forum that allows synergy amon gst various work area and creates a unified vision for the broadband industry. An example of this is WT-459 the protocol selected for the State Control Interface (SCI) named, Packet Forwarding Control Protocol (PFCP). PFCP, a protocol defined by 3GPP in TS 29.244 for control and user plane separation (CU PS) communication, is used for 4G and 5G 3GPP architecture. In WT-458, CUPS for fixed mobile convergence, BBF again selected PFCP for the SCI. This is one of many examples of how BBF is providing a platform for all stakeholders to collaborate and create synergy across different Working Areas with a unified vision for Broadband.The DBNG project continue to define and study new architecture and new requirement of interest to service providers and vendors. DBNG YANG modeling, DBNG CG-NAT, and DBNG User Plane traffic steering are just some of the current working projects related to DBNG. New DBNG topics are encouraged to be brought to the ATA group through contributions, the following **link** provide the most up-to-date topics.

Project Deliverables

Title	Number	Description	Resources	Editors

ATA maintains the primary architectures for the work of Broadband Forum. The architectures, requirements and other deliverables reflect the control, management, and data plane aspects of the access, transport and routed networks used to provide operator, enterprise and “over-the-top” Internet based connectivity services.
The deliverables of the work area are designed to leverage and integrate new industry technologies while protecting investment of current deployments. These deliverables provide the industry with a collective and consistent methodology to drive product development and service deployment.

3.4. Email List:

ATA Work Area (WA): ata@broadband-forum.org

- used for ATA meeting notification, agendas, discussion, etc.

Join or Leave BBF Groups and Email Lists

- Go to your JIRA profile page to see all of your current BBF group memberships.

3.5. ATA Calls, Minutes, Agendas

Each Project has its own agenda and set of minutes.

See the ATA Calendar for details on conference calls and meetings.

3.6. See Also:

Multi-Service Disaggregated BNG with CUPS. Reference Architecture, Deployment Models, interface, and Protocol Specifications	WT-459 issue 2	This is an issue 2 of TR-459, renamed to "Multi-Service Disaggregated BNG with CUPS. Reference Architecture, Deployment Models, interface, and Protocol Specifications". This is to further differentiate from WT-487. This Working Text further clarify call flows, requirements, and PFCP IEs updates for TR-459.	Baseline Working Text (WT) draft CONTRIB-22737.	Kenneth Wan Nagaraj S Turaiyur
IPTV Multicast for the Disaggregated BNG	TR-459.3	This document defines the architecture and requirements to support IP Multicast for a disaggregated BNG defined in TR-459.	CONTRIB-22628	Nagaraj S Turaiyur
CGN Functionality for Disaggregated BNG Project	TR-459.2	This document defines the architecture and requirements to support CG-NAT for a MS-DBNG defined in TR-459.	Baseline Working Text (WT) draft CONTRIB-21341	Kenneth Wan

	Control and User Plane Separation for a Disaggregated BNG	TR-459	This document defines the architecture, the requirements, and the protocol for a control and user plane separation of a disaggregated BNG.	TR-459	Kenneth Wan
YANG Modules for Broadband Network Gateways	**Project Overview** Purpose: BNGs and virtual BNGs are generally configured with SSH/telnet/SNMP protocols today. Current evolution of BNG function is requiring much more flexibility in terms of programmability thus requiring the BNGs and vBNGs to interface with SDN Controllers and/or new Element Managers. In order to achieve BNG and vBNG programmability, availability of BNG /vBNG YANG models is required.IETF has already created some YANG data modules that can be reused for being applied to BNG /vBNGs, some examples are: • RFC8344 “A YANG Data Model for IP Management” • RFC8022 “A YANG Data Model for Routing Management” • RFC8347 “A YANG Data Model for the Virtual Router Redundancy Protocol (VRRP)” • RFC8349 “A YANG Data Model for Routing Management (NMDA Version)” • RFC8345 “A YANG Data Model for Network Topologies” • RFC7317 “A YANG Data Model for System Management” • RFC8294 “Common YANG Data Types for the Routing Area” • Draft RFC “A YANG Data Model for Routing Policy Management” However the above mentioned data models are not sufficient for configuring and managing a BNG/vBNG, in particular among the others data models for the subscriber management are missed as it is indeed one of functionalities of a BNG actually. Motivation: This project has been created in order to close a gap we currently have with respect to Access Node where projects on YANG data Models already exist since years, while none has been created for BNG/vBNG. Scope: The scope of this project is to define and develop the set of YANG data modules needed for configuration and monitoring (FCAPS) of BNGs/vBNGs as follows: • Identification of Existing applicable YANG models in IETF or other SDO • Development of YANG models to cover BNG functionalities that are not sufficiently covered by existing YANG models			

This project can be managed as other projects in Common YANG PS (for example TR-383), that is it can be an ongoing project. When one or more YANG modules are ready for publication they will go through SB and FB in the same way as any other WT and it will be published, and then work on the next Amendment will immediately begin. The new BBF's YANG DMs and those published by IETF for BNG/vBNG are expected to be cross referenced in future TR-413 Issue 2.

Project Deliverables

Title	Number	Description	Resources	Editors
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Subscriber Session Steering

Project Overview

Purpose:

As Broadband Networks become more dynamic with SDN control and Cloud Central office, it is now possible to programmatically control which User Plane (UP) function each individual subscriber should be connected to. This creates many advantages for an operator to offer different service propositions to different customers.At the same time, User Plane functions (such as the BNG) are becoming increasingly disaggregated and cloud native, with centralised control plane and subscriber state and the ability to scale out (add additional UP processing functions) to manage short term or long term changes in load. There is a need for a standardised approach for a disaggregated service function ,such as a disaggregated BNG (dBNG), to be able to be able to identify to which UP instance newly authenticating subscribers should be connected, or to request that existing subscribers should be redistributed or moved between UP instances. In other words, we need to define an architecture and interfaces such that the access network can offer an ingress load-balancing capability towards cloud-native user plane functions

Motivation:

Network Operators will not be able to effectively deploy disaggregated service functions such as the dBNG without a standardized approach to balance and move subscribers between UP instances. Service Providers increasingly desire to differentiate the services that are offered to individual customers (eg low latency / by revenue / for high throughput). This project will enable increasing differentiation by steering subscribers to a suitable UP function. This could include UP that are deployed to offer different SLA (i.e edge services). It may also include use cases where a subscriber-specific User Plane is created on demand, to which the subscriber session is then dynamically connected.Network Operators need new tools to be able to manage and upgrade networks as the industry moved to sdn /nfv. Session Steering will enable software deployment approaches in line with the cloud paradigm (such as automated incremental upgrades with canary testing on a small number of subscribers), as well as additional network resilience.Our industry is under increasing pressure to reduce power usage. The ability to dynamically move active subscribers between functions without service impact will allow hardware / software to be temporarily removed from service at certain times of the day.

Scope:

This project will create a WT that defines an architecture for Subscriber Session Steering, using the dBNG as an exemplary function.

The following are in scope for inclusion in the project:Phase 1:

- Identification & definition of the opportunities and use cases for session steering.

Phase 2:

- How to identify the UP instances that can serve a subscribers requirements
- How to balance newly authenticating subscribers amongst the available UP instances that can meet their requirements.
- How to request that a subscriber or group of subscribers is moved from one UP instance to a different UP instance (without customer impact if at all possible).
- How a change in subscriber policy can trigger a change in the placement of a subscriber.
- Requirements on the SDN controller to support session steering
- Requirements for the Service Function (eg dBNG) to support session steering
- Identification of the protocols and interfaces that will be used

Note: the term 'Subscriber Session' is used within the context of this NPIF as per the definition in TR-146. It is recognized that there may be use cases for steering with a different context of session (IP session or even IP Flow), but this is currently out of scope.

Project Deliverables

Title	Number	Description	Resources	Editors
Subscriber Session Steering	WT-474		Baseline Working Text (WT) draft CONTRIB-22389.	Jonathan Newton

DBNG For Wired Access

Project Overview

Purpose:

This projects focuses on control/user plane separation of BNG in the case of wired access (e.g. PON, xDSL, etc). It will start with use case details, including deployment scenarios and operational aspects, then move to architectural framework and finally move to protocol considerationsThis project profiles DBNG aspects specific to MS-BNG aggregating subscribers over wired access networks, including fixed access(e.g. PPPoE, IPoE, L2TP, etc.), CGN, multicast, resilience, etc.It will define use case, architecture, requirements and CUPS protocol for wired access.

Motivation:

Continue to promote BNG enhancements that allow more flexibility in terms of deployment models and multi-vendor interoperability between disaggregated components.Key business impact: benefits of network disaggregation applied to fixed subscriber management; additional deployment models to adapt to wide areas of operators requirements**Scope:**This project profiles DBNG aspects specific to MS-BNG aggregating subscribers over wireline access networks. The scope of this new project addresses a subset of the fixed access use cases found in TR-459 and potential additional fixed use cases.This project excludes any use cases that includes wireless access (4G /5G, Wi-Fi,…), hybrid access and wireless-wireline convergence. Such use cases are addressed by TR-459 cases in addition to the wireline baseline.The project is phased with checkpoints in-between phases, to ensure clear transitions between stage 1/ 2/ 3 aspects.

Phase 1: Scope and DBNG for wired access Use Cases

- Detailed scope/ non-scope for the document
- List and Describe use cases with wireline access
- Identify service-level aspects (e.g. high speed internet, voice, IPTV,…) and key enablers (e.g. HQoS, multicast, etc)
- Include deployment scenarios (e.g. distribution) and operational aspects
- Identify any candidate architectural extensions meeting use cases requirements and deployment scenarios
- Include interoperability aspects
- Identify adjacent BBF projects if applicable (eg. Traffic steering)
- Refer to TR-459: deltas, including additional use cases, should be clearly highlighted, if any

----------Phase 2: Architectural Aspects for DBNG in fixed access & Requirements for nodes and interfaces/protocols between CP and UP

- DBNG functional architecture – refer to TR-459 section 4.3, but limited to wireline access models and relevant functional blocks. Includes external interfaces (e.g., B interface)
- Define interfaces between CP and UP – Expecting Mi, SCi, CPRi to still be relevant; refer to TR-459, identify subsets and deltas in case of wired-only access.
- Call flows – protocol independent presentation

- Define general, protocol-independent requirements for each interface type
- Specify common call flow principles to define points and conditions in the flow that result in subscriber/node level UP programming and status reporting
- Specify common protocol requirements with regards to per node, per subscriber state programming and reporting, status / event-based updates, security, reliability, resilience, etc.
- For the requirements that have already been defined in TR-459, this project will not try to redefine them, instead, references to those requirements will be added.

----------Phase 3: Protocol specific aspects

- Protocol analysis:
  - candidates and evaluation of protocol fit with requirements - goal is multi-vendor interoperability
  - PFCP evaluation – required subset to cover wireline only; analysis of flaws and deficiencies, if any
- Alternative protocol option(s)
- Depending on analysis results, create annexes in the same document describing use of specific protocol in the context of DBNG for wired access, possible protocol enhancements, specific attributes / extensions for BBF, etc.
- For now, the project does not make assumptions if one, two or more protocols can be applicable to support DBNG fixed-only.
- This annex/these annexes is/are the only content which is protocol specific.

Between each phase, consensus is required to agree to progress to the next phase. The goal is to proceed in a top-down fashion, encouraging the group to focus contributions relevant for the active phase, getting to a stable content before moving to the next level of detail.This project is expected to leverage the protocol-independent areas of TR-459 (e.g. architecture, functional decomposition,…) for what is relevant for fixed only. As much as possible, consistency with protocol independent aspects of TR-459 should prevail.It is understood that following issues/revisions of TR-459 will continue in parallel to this new project (eg. CGNAT and multicast support). This does not preclude this new project to cover these use cases.Upon completion of this working text, some Marketing Document can be generated to advertise BBF recommendations

Project Deliverables

Title	Number	Description	Resources	Editors
DBNG for Wired Access	WT-487	*This project profiles DBNG aspects specific to MS-BNG aggregating subscribers over wired access networks, including fixed access(e.g. PPPoE, IPoE, L2TP, etc.), CGN, multicast, resilience, etc.*This project will include use case, reference architecture, requirements, interfaces, and protocol specifications for Wired Access DBNG.	Baseline Working Text (WT) draft CONTRIB-22693	Mengmeng Li

WiFi Authentication	

Project Overview

Public Wi-Fi user authentication and data local forwarding technical requirements

Purpose:

This project aims to define the network architecture and technical requirements for Wi-Fi users to be uniformly authenticated by AC and local forwarding of user data, so that Wi-Fi devices developed by device manufacturers can meet the requirements of Wi-Fi networking and operation requirements. This project is to focus on the requirements and use case aligned and complementary to TR-321.

Motivation:

Further promote the development of Wi-Fi networking technology. The implementation of this project can realize the networking technology of Wi-Fi users focusing on AC authentication and management and local forwarding of user data. A variety of AC devices can be used for networking, including traditional dedicated AC and NFV based virtual AC (vAC) , etc. AC can also be deployed in the cloud. This networking mode can meet the new requirements of operators.

Scope:

Based on the TR-321 architecture 3, the project contents including the following three aspects shall be carried out

1.Define networking scenarios.

1The AC is deployed on the network cloud, and the AP connects to the AC through the Internet by a gateway device.

2The AC is deployed on the edge of the metropolitan area network or on the access network side, and APs access the AC through dedicated lines.

2.Propose user cases and formulate operation processes,

1) User address allocation operation process.

2) User association process.

3) User online operation process.

4) User offline operation process.

3.Put forward equipment technical requirements.

Project Deliverables

Title	Number	Description	Resources	Editors
Public Wi-Fi user authentication and data local forwarding technical requirements	WT-497	This project defines the networking architecture, user authentication and nodal requirements for Wi-Fi users to be uniformly authenticated by AC and local forwarding of user data.	Baseline Working Text (WT) draft CONTRIB-23456	Gao Bo Lei Zhou

2.4. Mobile Transport and Routing (MT&R) Project Stream

Project Stream Page: Mobile Transport and Routing (MT&R) Project Stream

Project Stream Leads: David Sinicrope (GM), Ericsson

Mission:

To produce industry agreed specifications of the routing and transport network infrastructure and solutions for the transport of traffic in mobile networks, including 2G, 3G, LTE and 5G mobile networks. This work typically being in the form of architecture, equipment requirements, interoperability and conformance test plans, implementation guidance and education materials.

Business Impact:

This work accelerates industry adoption of new routing and transport technology and deployment of new services and infrastructure in mobile networks. The work includes the introduction of and migration to SDN and virtualization of the mobile transport network infrastructure where commercially viable.

Scope:

Control, management and data plane for the IP layer down to the physical layers, including time and synchronization, OAM, routing, resiliency, scalability, security, virtualization of the mobile transport infrastructure, and enablement of software driven networking.

Project Name and Page Link	Project Overview
5G Transport Project	**Project Overview** This project will deliver documentation that gives the architecture, and equipment requirements for providing a transport network suitable to supporting 5G mobile RAN and Core network traffic.

Project Deliverables

Title	Number	Description	Resources	Editor (s)
5G Transport Architecture and Requirements	TR-521		**CONTRIB-20551** - Getting issue details... STATUS	Ron Insler , RAD
5G Transport Tutorial	MR-521.2		**CONTRIB-21956** - Getting issue details... STATUS	David Sinicrope , Ericsson
5G Transport White paper	MR-521.1		**CONTRIB-21980** - Getting issue details... STATUS	Joel Halpern , Ericsson
MPLS in Mobile Backahul	TR-221		**MSTRFILES-49** - Getting issue details... STATUS	
MPLS in Mobile Backhaul Amendment 1 - adds support for enhanced services and small cells	TR-221 Amd 1		**CONTRIB-11531** - Getting issue details... STATUS	Balazs Varga, Ericsson
	TR-221 Amd 2			Yuanlong Jiang ,

	2nd amendment to TR-221 MPLS in Mobile Backhaul Networks - adds architecture and requirements for			**CONTRIB-15842** - Getting issue details... STATUS	Huawei	

	• *time and phase synchronization* • *resilience* • *BGP based signaling* *and other changes.*				

MMBI LTE Tutorial	MR-234		**CONTRIB-8748** - Getting issue details... STATUS **CONTRIB-8294** - Getting issue details... STATUS **MSTRFILES-7** - Getting issue details... STATUS **MSTRFILES-69** - Getting issue details... STATUS	David Sinicrope , Ericsson
MMBI White Paper on Use of MPLS in LTE	MR-238		**CONTRIB-8162** - Getting issue details... STATUS **CONTRIB-8306** - Getting issue details... STATUS	
Energy Efficient Mobile Backhaul	TR-293		**CONTRIB-11026** - Getting issue details... STATUS	Konstantinos Samdanis

<table>
<tr>
<td>Mobile – Transport Network Slice instance Management Interfaces (MTNSi)</td>
<td>
Project Overview

This project delivers documentation that gives the referece architecture, functions and requirements of MMI interfaces for providing an IETF Network Slice required in context of 5G network slice.

Project Deliverables
<table>
<tr><th>Title</th><th>Number</th><th>Description</th><th>Resources</th><th>Editor (s)</th></tr>
<tr>
<td>Mobile – transport network slice instance Management Interfaces</td>
<td>TR-522</td>
<td>This document defines the reference architecture for MMI interface, fuctional requirements, attributes and parameters for network slice enablement, and data model for MMI.</td>
<td>CONTRIB-21582 - Getting issue details... STATUS</td>
<td>Xueyan Song , ZTE

Reza Rokui , Nokia</td>
</tr>
<tr>
<td>Mobile – transport network slice instance Management Interfaces -</td>
<td>MD-522</td>
<td>This document explains the motivation of the reference architecture for MMI interface work and its relationship to other industry work.</td>
<td>CONTRIB-23069 - Getting issue details... STATUS</td>
<td>Xueyan Song , ZTE</td>
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2.5. Performance, Experience, and Application Testing (PEAT) Project Stream

Project Stream Page: Performance, Experience, and Application Testing (PEAT) Project Stream

Project Stream Leads: Gregory Mirsky , Ericsson

Mission:

The project stream mission is to advance testing in traditional and new areas to ensure quality connectivity leading to quality user experience.

The project stream will focus mainly in two areas:

1. Enhanced packet layer performance testing e.g.,bandwidth/capacity, min/average/max latency measurements and jitter, loss, etc and
2. Testing that goes beyond traditional packet layer performance to test and analyze the application and service layer quality

Both are needed to provide insight into quality of experience and application outcomes such that the network, while essential, becomes an invisible part of the customer experience.

Business Impact:

Provide the information needed to analyze a network's detailed performance allowing service providers to offer not only higher capacity connectivity services, but also higher quality connectivity services.

This in turn enables and accelerates industry adoption and deployment of new services and infrastructure.

Scope:

Specifically the project stream covers the following areas of connectivity quality testing:

- Application Layer Testing supports specification of test traffic, and associated measurements, that exhibits the complexity resulting from multiple types of applications and subscribers aggregated in a common network.
- CE to IP Edge testing extends Broadband Forum's OAM framework with architectural and nodal requirements to enable Customer Equipment to IP Edge service assurance of broadband subscribers, both for business and residential connections.
- IP Layer Capacity Metrics and Measurements harmonizes the Industry around a specific set of Capacity metrics and measurement method with clear benefits of multi-dimensional performance assessment at existing and new Gigabit-rate access speeds.
- Quality Experience Delivered is a method of systems performance analysis that decomposes a round trip time into constituent components enabling the networks performance to be analyzed and traced to sources causing performance degradation (packet loss/delay), be they structural (architecture/design), network dimensioning (link speeds etc.) or network load/scheduling related.

Project Name and Page Link	**Project Overview**

<table>
<tr>
<td>Application Layer Testing Project</td>
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Project Overview

To define how test traffic is specified and generated at the application layer. It supports specification of test traffic, as well as associated metrics and measurement methods, that reflects the complexity resulting from multiple types of applications and subscribers aggregated in a common network.

Project Deliverables
<table>
<tr><th>Title</th><th>Number</th><th>Description</th><th>Resources</th><th>Editor (s)</th></tr>
<tr><td>Application-Layer Test Traffic Architecture and Requirements</td><td>WT-421</td><td></td><td>Click Here</td><td>Ken Ko, ADTRAN

Daniel Moss, UNH IOL</td></tr>
<tr><td>Application-Layer Testing Implementer's Guide</td><td>WT-422</td><td></td><td>Click Here</td><td></td></tr>
<tr><td>Data Models for Application-Layer Test Traffic</td><td>WT-424</td><td></td><td>Click Here</td><td>Martin Casey, Calix

Jason Walls, QA Cafe</td></tr>
<tr><td>Application Layer Testing: The Key to Optimizing Quality of Experience</td><td>MR-433</td><td></td><td></td><td>Ken Ko, ADTRAN</td></tr>
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<tr>
<td>Performance Measurement from CE to IP Edge Project</td>
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Project Overview

This project will extend Broadband Forum’s OAM framework with architectural and nodal requirements to enable Customer Equipment to IP Edge service assurance of broadband subscribers, both for business and residential connections.

The main business drivers for this work are:

• Define standardized mechanisms for performance measurement (e.g. delay, jitter, loss) between network side of the RG/CPE and access side of the BNG/PE
• Give service providers insight on how their access network is performing
• Ability to use existing but not currently deployed tools
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The BBF is in a unique position to give service providers the tools they need in this subject matter, defining a solution that allows measurement and exposure of RG/CPE to BNG/PE network performance and addresses the current gap.

Project Deliverables

Title	Number	Description	Resources	Editor (s)
Performance Measurement from Customer Equipment to IP Edge	WT-390	This specification extends Broadband Forum's OAM framework with architectural and nodal requirements to enable Customer Equipment to IP Edge service assurance of broadband subscribers, both for business and residential connections.		Guiu Fabregas , Nokia
Performance Measurement from Customer Equipment to IP Edge	WT-390i2	This specification extends Broadband Forum's OAM framework with architectural and nodal requirements to enable Customer Equipment to IP Edge service assurance of broadband subscribers, both for business and residential connections. - Using STAMP		Gregory Mirsky , Ericsson

Broadband Quality Experience Delivered (Broadband QED) Project

Project Overview

This project will deliver documentation that gives a comprehensive overview of Quality Attenuation and its applicability to broadband networks. It will cover the theory, measurement technique, use-cases and benefits of the approach.

Project Deliverables

Title	Number	Description	Resources	Editor (s)
Broadband Quality Experience Delivered (Broadband QED)		Broad-ranging study document	**CONTRIB-21189** - Getting issue details... STATUS	Peter Thompson , PNSol Bruno Cornaglia, Vodafone
Motivation for Quality Broadband (QED & Quality Attenuation)	MD-452.1	First MD in the series for MD452, describing the motivation for QED	**CONTRIB-21664** - Getting issue details... STATUS	Jonathan Newton , Vodafone
Quality Attenuation Architecture and Requirements	TR-452.1	First TR for the revised NPIF - in Final Ballot	**CONTRIB-22003** - Getting issue details... STATUS **CONTRIB-22012** - Getting issue details... STATUS **CONTRIB-22119** - Getting issue details... STATUS Outstanding issues	Peter Thompson , PNSol Rudy Hernandez , Spirent

Quality Attenuation Measurements using TWAMP	WT-452.2	Second WT for the revised NPIF	**CONTRIB-22056** - Getting issue details... STATUS **CONTRIB-22800** - Getting issue details... STATUS **CONTRIB-22825** - Getting issue details... STATUS	Peter Thompson , PNSol
Quality Attenuation Conformance Testing	WT-452.3	Third WT for the revised NPIF	**CONTRIB-22147** - Getting issue details... STATUS	Peter Thompson , PNSol
proposed text for MD on QED for creation of application SLA	MD-452.2	Proposes a draft for an MR in the MR-452.x series to cover the use of DeltaQ in managing customer SLA.	**CONTRIB-22309** - Getting issue details... STATUS **CONTRIB-22673** - Getting issue details... STATUS **CONTRIB-22674** - Getting issue details... STATUS	Jonathan Newton , Vodafone
Presentation on QED	MD-452.3	Slides for a presentation or webinar on QED	**CONTRIB-22457** - Getting issue details... STATUS	Peter Thompson PNSol

	Text for MR on QED Uses in Lab Evaluation & Network Design	MD-452.4	draft Marketing Document on use of Quality Attenuation in NW design & lab evaluation phases	**CONTRIB-22449** - Getting issue details... STATUS	Gavin Young , Vodafone Peter Thompson , PNSol
IP-Layer Capacity Metric, Related Metrics, and Measurement Methods Project	**Project Overview** Standardize the IP-Layer Capacity Metric and Measurements with the benefit of BBF membership's unique expertise and perspectives. Ideally, to harmonize the Industry around a specific Capacity metric and method with clear benefits of multi-dimensional performance assessment at existing and new Gigabit-rate access speeds. **Project Deliverables**				

Title	Number	Description	Resources	Editor (s)
Maximum IP-Layer Capacity Metric, Related Metrics, and Measurements	WT-471		Click Here	Al Morton, AT&T
Maximum IP-Layer Capacity Metric and Measurement	MD-471.1		Click Here	Al Morton, AT&T

2.6. Cloud Interconnect (CI) Project Stream

Project Stream Page: Cloud Interconnect (CI) Project Stream

Project Stream Leads: David Sinicrope (GM), Ericsson (acting)

Mission:

This project addresses architectures, requirements and use cases for providing interconnection between Cloud data centers.

Business Impact:

Carrier Ethernet provides extensions to Ethernet enabling telecommunications network providers to provide Ethernet services to customers for multi service use, including cloud data center interconnection. Service providers are deploying Carrier Ethernet services around the globe, in large part, because Carrier Ethernet has compelling capabilities such as standardized service definitions as well as improved scalability, reliability, QoS, and manageability.

Carrier Ethernet services are being used in Broadband access networks, enterprise networks and backhaul networks. This deliverables for this project provides technical architecture and equipment requirements implementing the specified Ethernet services using various technologies, e.g., with an MPLS EVPN network. By specifying a common technical architecture, common equipment requirements and common set of feature options, this project promotes multi-vendor interoperability of cloud interconnect services, networks and equipment. e.g,. EVPN for support of MEF Carrier Ethernet services.

Scope:

Currently the project focuses on data center interconnect via Ethernet and Ethernet Services and their implementation using BGP MPLS based Ethernet VPNs (EVPN) in IP/MPLS network. While at the current time this involves networks providing Carrier Ethernet connectivity, other interconnection technologies are not excluded.

WT-224 and WT-178 provide architecture and nodal requirements to support broadband multi-service networks and MEF carrier Ethernet services. They use VPWS and VPLS in IP/MPLS networks and provides how service parameters are supported in MPLS network.

New Ethernet service applications require capabilities such as: multi-homing with all-active forwarding; load balancing; policy based control, and control plane MAC learning. WT-224 and WT-178 based solutions do not provide these features; solutions based on BGP MPLS EVPNs do.

This project also considers, the work underway in the IETF, specify how Ethernet Provider Backbone Bridging [802.1ah] can be combined with EVPN.

Through its deliverables, (i.e., TRs, MRs, Tutorials), this project will specify how to *implement* the Ethernet service layer to provide cloud interconnect connectivity. It will not specify the service layer itself. Ethernet Control and OAM protocols will be transparently transported, except for cases where Layer 2 control protocol processing is required by the service definition.

For example:

- Support for attachment circuits providing user-to-network interface complying with Metro Ethernet Forum (MEF UNI).
- Support for Ethernet attachment circuits for multi-service broadband access and aggregation (i.e., TR-101/WT-178).
- Support for service level OAM and performance monitoring
- Frame Relay and ATM are out of scope

In order to support Carrier Ethernet services for cloud interconnect across multiple networks the project will addresses multiple autonomous systems and the preservation of end-to-end capabilities (e.g., OAM, QoS and protection etc).

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<tr><td>Ethernet Services Using BGP MPLS Based Ethernet VPNs (EVPN)</td><td>
Project Overview

The project covers the support of following Ethernet services:

1. Ethernet services in Multi-service Broadband Network Architecture (TR-145)
2. Carrier Ethernet Services (MEF CE 2.0)

• Support MEF carrier Ethernet services
  ◦ E-Line, E-LAN, E-Tree and E-Access
  ◦ Support of service attributes for all services and service profiles (e.g., mobile transport front/backhaul for 5G)
  ◦ Control, OAM, QoS, reliability and scalability
  ◦ Multi-homing and load balancing
  ◦ Support Carrier Ethernet services across multiple network domains

It is intended to apply the same understanding as has been used for WT-224 and WT-178 and to profile IETF and MEF standards.

This project specifically addresses the support of Ethernet services using BGP MPLS Based Ethernet VPNs (EVPN).

For more information, please see the New Project Information Form (NPIF) for the EVPN project.

Project Deliverables
<table>
<tr><th>Title</th><th>Number</th><th>Description</th><th>Resources</th><th>Editor (s)</th></tr>
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White Paper - Ethernet Virtual Private Networks for Integrated, Scalable Layer 2 and Layer 3 VPN Services	MR-350i2			Eric Gray , Ericsson
White Paper - Ethernet Virtual Private Networks for Integrated, Scalable Layer 2 and Layer 3 VPN Services	MR-350			

	Ethernet Services using BGP MPLS Based Ethernet VPNS (EVPN)	TR-350i2			Eric Gray , Ericsson
	Tutorial on Ethernet Services using BGP MPLS Based Ethernet VPNS (EVPN)	MR-367			
MPLS in Carrier Ethernet Networks (VPLS and VPWS)	**Project Overview** Provide architecture and nodal requirements to support broadband multi-service networks and MEF carrier Ethernet services. Use VPWS and VPLS in IP/MPLS networks and provides how service parameters are supported in MPLS network. The project covers the support of following Ethernet services: 1. Ethernet services in Multi-service Broadband Network Architecture (TR-145) 2. Carrier Ethernet Services (MEF CE 2.0)				

- Support MEF carrier Ethernet services
  - E-Line, E-LAN, E-Tree* and E-Access (*Note that E-Tree cannot be fully supported as defined using VPLS or VPWS)
  - Support of service attributes for all services and service profiles (e.g., mobile transport front/backhaul for 5G)
  - Control, OAM, QoS, reliability and scalability
  - Multi-homing and load balancing
  - Support Carrier Ethernet services across multiple network domains

It is intended to apply the same understanding as has been used for WT-224 and WT-178 and to profile IETF and MEF standards.

This project specifically addresses the support of MPLS in Carrier Ethernet Networks.

Project Deliverables

Title	Number	Description	Resources	Editor (s)
Technical Specification for MPLS in Carrier Ethernet Networks	TR-224			Scott Mansfield , Ericsson Rao Cherukuri, Distinguished Fellow, Juniper
Seamless MPLS for efficient broadband services delivery - Tutorial	MR-325			

2.7. Packet Optical Evolution (POE) Project Stream

Project Page: Packet Optical Evolution (POE) Project Stream

Project Stream Leads: David Sinicrope (GM), Ericsson (acting)

Mission:

To produce industry agreed specifications of the routing and transport network infrastructure and solutions for the integration of packet and optical technologies, including DWDM, Ethernet, MPLS and IP. This work typically being in the form of architecture, equipment requirements, interoperability and conformance test plans, implementation guidance and education materials.

Business Impact:

This work accelerates industry adoption of new routing and transport technology and deployment of new services and infrastructure in optical and packet infrastructure networks. The work includes the introduction of and migration to SDN and virtualization of the packet optical transport network infrastructure where commercially viable.

Scope

This work leverages the optical and packet technologies defined in other organizations such as ITU-T SG15, OIF, IETF, IEEE and brings them together for integrated packet optical solutions, architecture and equipment requirements.

FlexE in IP /MPLS networks

Project Overview

Study usage of Flex Ethernet (OIF) in MPLS networks. A first application may be 5G networks.

Project Deliverables

Title	Number	Description	Resources	Editor (s)
FlexE in IP /MPLS networks Study	OD-462 (was SD-FlexEMPLS45G)		**CONTRIB-20370** - Getting issue details... STATUS	Dean Cheng , Huawei

Achieving Packet Network Optimization using DWDM Interfaces	**Project Overview** Integration of optical transceivers and IP routing equipment. (e.g., IP over DWDM) **Project Deliverables**

Title	Number	Description	Resources	Editor (s)
Achieving Packet Network Optimization using DWDM Interfaces	TR-319 Base			Manuel Paul , DT
Achieving Packet Network Optimization using DWDM Interfaces – Physically Integrated Model	TR-319 Part A			Diane Patton, Cisco
Achieving Packet Network Optimization using DWDM Interfaces – Physically Separated Model	TR-319 Part B			Paul Doolan, Coriant