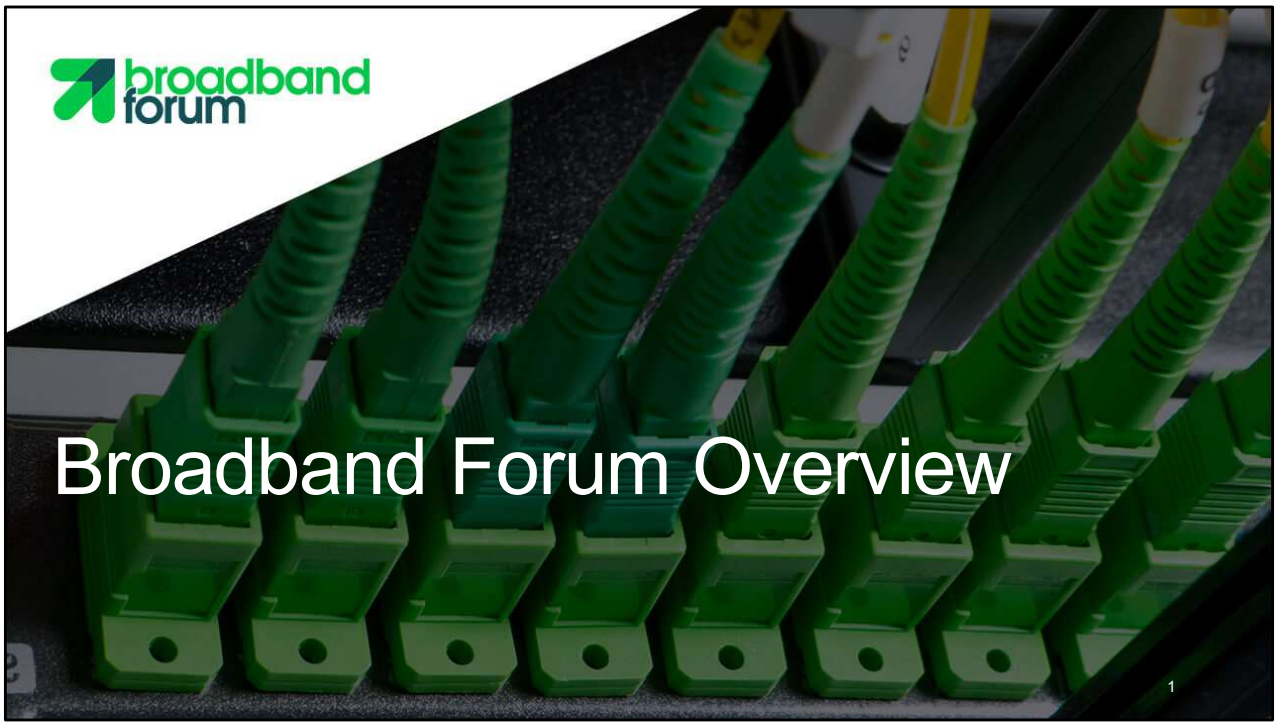
broadband forum
Broadband Forum Overview
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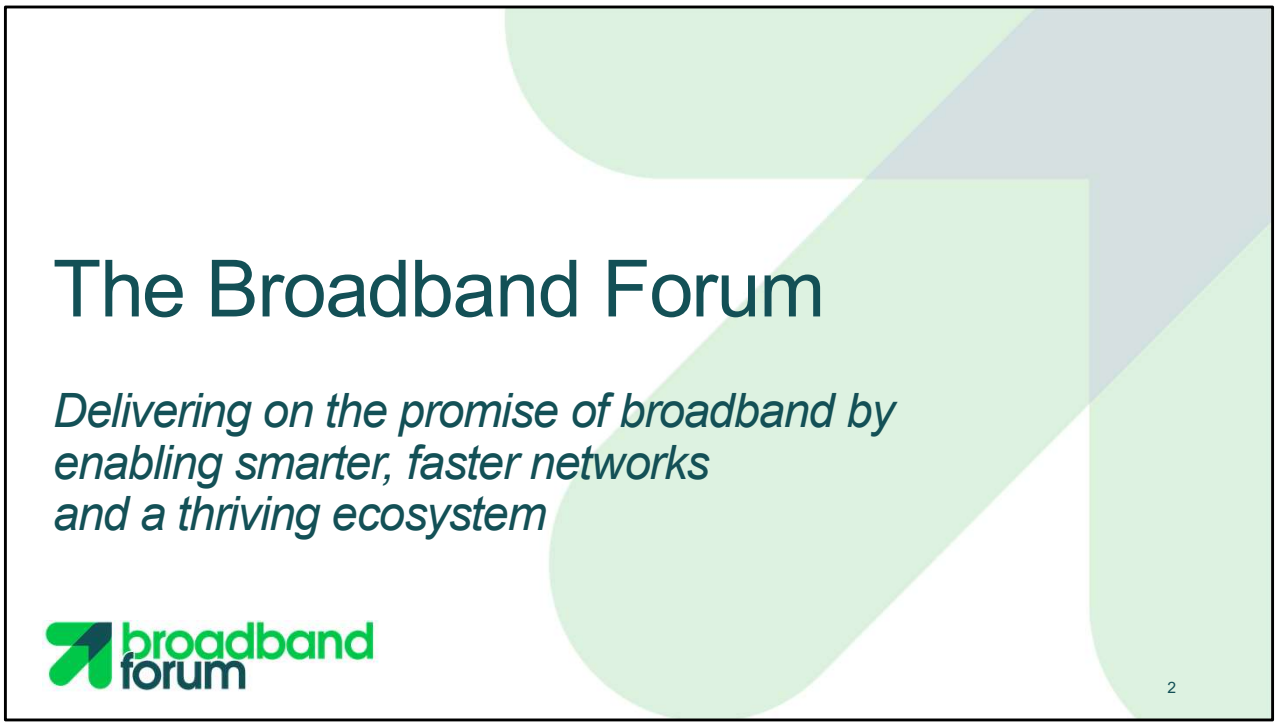
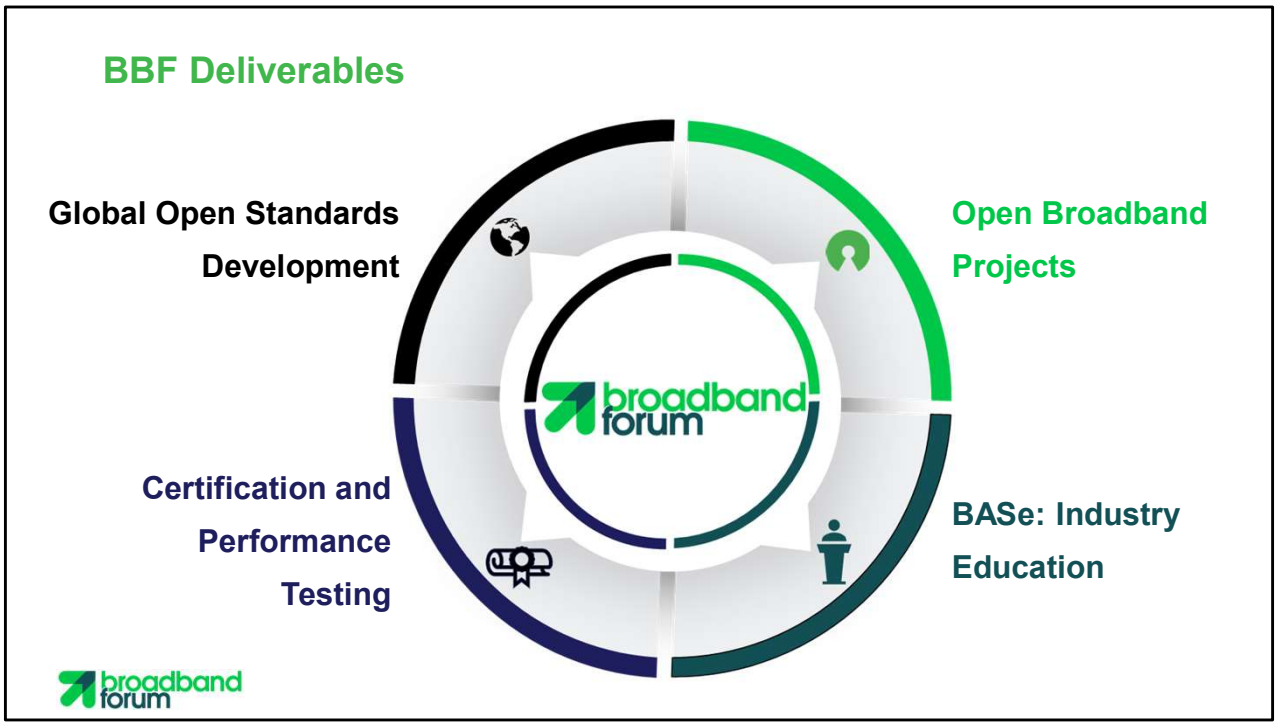


For those of you who aren't familiar with the Forum, we've been working with this industry since its infancy to enable smarter and faster networks. Our members define the specs and other materials needed to deploy broadband networks and services, and to provide value for the end users who rely on them so much these days.



The Broadband Forum has four main types of deliverables.

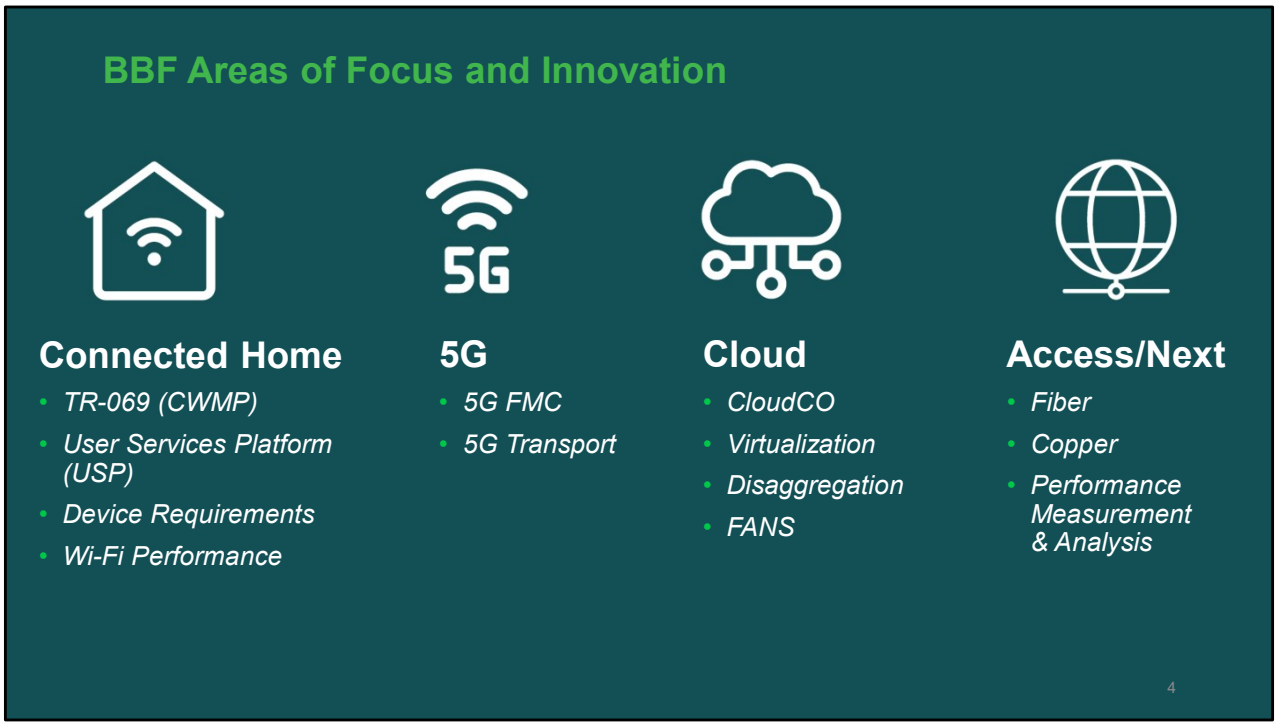
First, our traditional mainstay has been standards development. Our technical reports define the architectures, requirements, and data models necessary for products to interoperate with each other with the features needed by service providers and end users. Our standards are open and freely available online, and we supplement them with market reports describing how they are used and why.

Second, we work with test labs around the world to provide certification and performance testing. These programs assure service providers that a product conforms to the requirements, that they can be deployed, and that they will interoperate with products from other vendors. For vendors, these programs provide a way to test a product once, and then use the results to assure all of your customers that you meet their requirements.

Our third deliverable comes in the form of Open Broadband projects . These projects implement selected specifications as open-source software designs providing proof of concept, guidance for implementers, and verification of the associated specs. What we found by doing Open Broadband projects hand in hand with our open standards

development, is that the whole is greater than the sum of the parts. By definition, the specifications inform the Open Broadband projects, but the reverse is true as well. These projects feed valuable information back into our standards work, which helps define the improvements and additional features needed in that arena.

Our 4th deliverable is our BASe program, or Broadband Acceleration Seminars. About five years ago we started offering BASe events as a means of educating the industry, and to give member companies a chance to let folks know what new work they were doing. BASe started with just a few events a year and has grown to where in 2021 we held a total of 20 events with over 70 speakers participating.



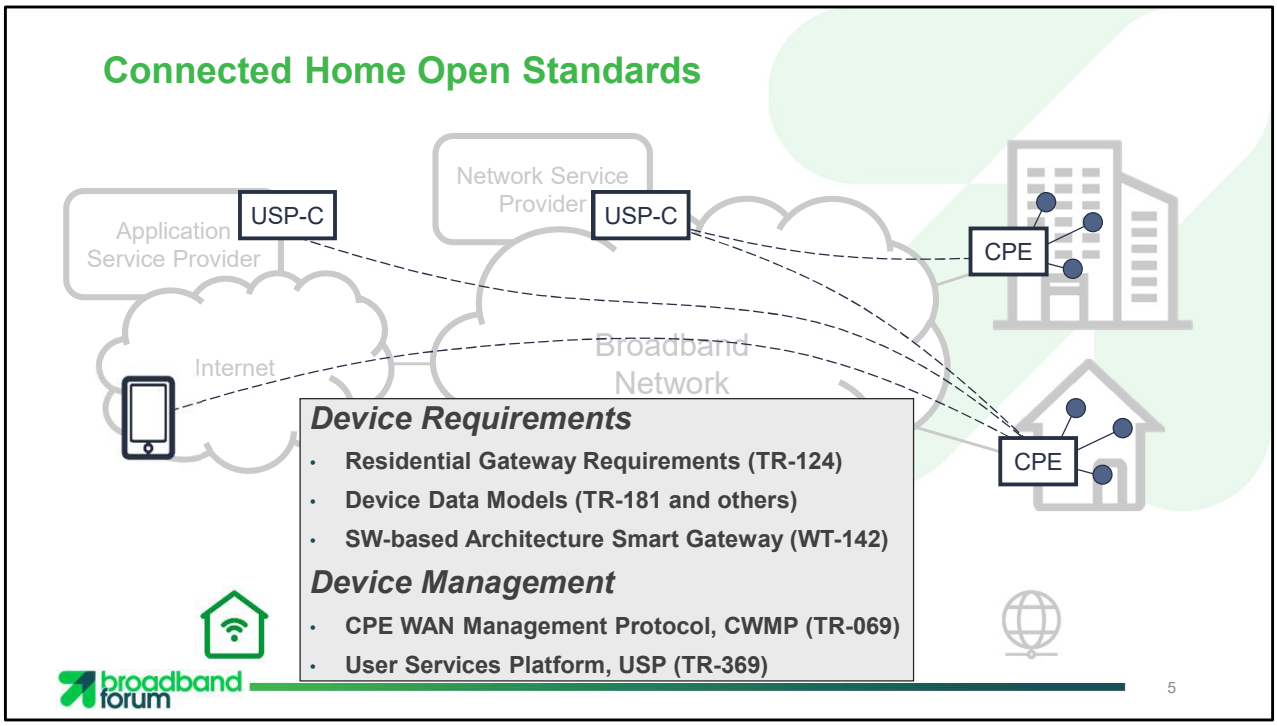
BBF's technical work is organized into four focus areas.

The first is Connected Home. This involves the delivery, management, and performance of the services that go into and across today's increasingly complex end user networks. We all know that service providers are held accountable for performance all the way to the end device. Well, this work helps them deliver that performance.

The second focus area is 5G. We've been coordinating with 3GPP for several years now, to enable the fixed/mobile convergence that the industry has been looking forward to for quite some time.

Our third area is Cloud. Here we're defining how operators can transform their networks, get the efficiency and flexibility of cloud-based deployments, and also preserve interoperability. You may have seen a recent press release from a major service provider who announced a test of a disaggregated, multi-vendor cloud-based system. That test was based on our Cloud specifications, which is a great validation of the work we've been doing in this area.

Finally, we come to Access/Next which has long been a core strength for us. Here, in addition to fiber and copper access, we've been focusing on how to measure and analyze performance to provide actionable results for operators, and to maximize value for end users.

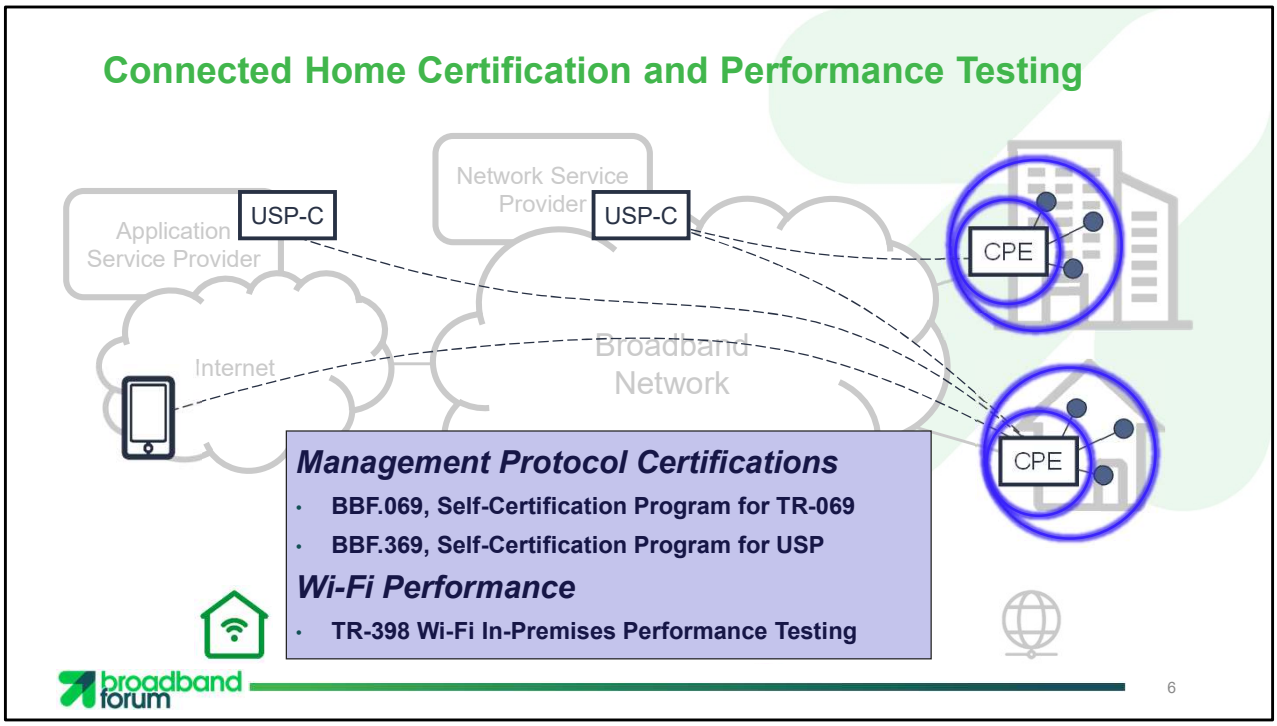


In Connected Home, we've been defining residential gateway requirements for home services for a long time, and we've published a lot of iterations of the associated standards. The requirements themselves are defined in TR-124 and the associated data models are distributed in several documents. We're also working on specifications for smart gateways using software-based architectures.

We've also been defining for a long time how to manage residential gateways. CWMP, better known as TR-069, is one of the most widely used Broadband Forum specifications ever, with over a billion devices running the protocol around the world.

More recently we've introduced User Services Platform, or USP. USP builds on TR-069 with a more comprehensive and flexible protocol. It lets you manage all the devices in today's more complex home networks, with the USB controller in the network managing USP agents embedded in devices throughout the house. USP also allows multiple controllers to manage devices, with permissions specific to the needs of each controller. For instance, an Application Service Provider can control just the parameters they need on their devices. Or, end users can have a controller app on their smartphone, to manage their devices from within the home or from anywhere in the Internet.

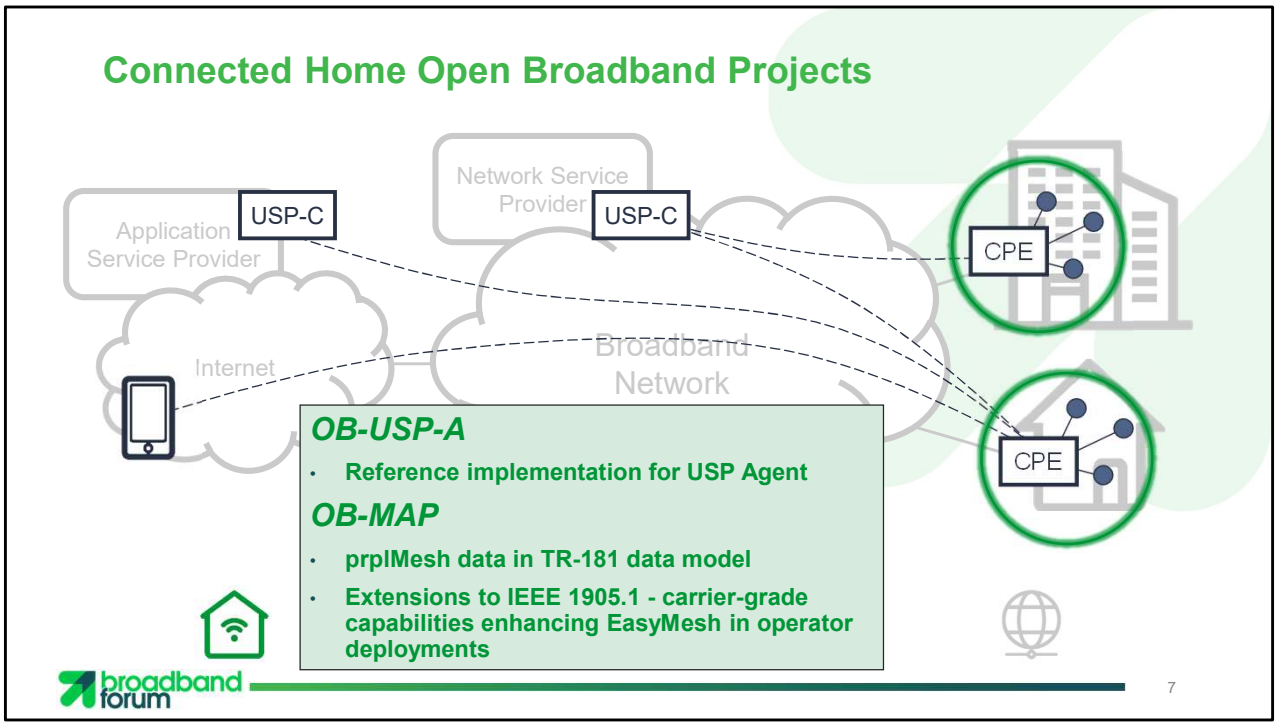
Finally, USP is flexible enough to be deployed in both home and business environments.



We support certification programs for both TR-069 and USP. These are self certification programs which are very popular and convenient, because vendors can test their own devices in house and then submit the results to the appropriate lab for the certification stamp.

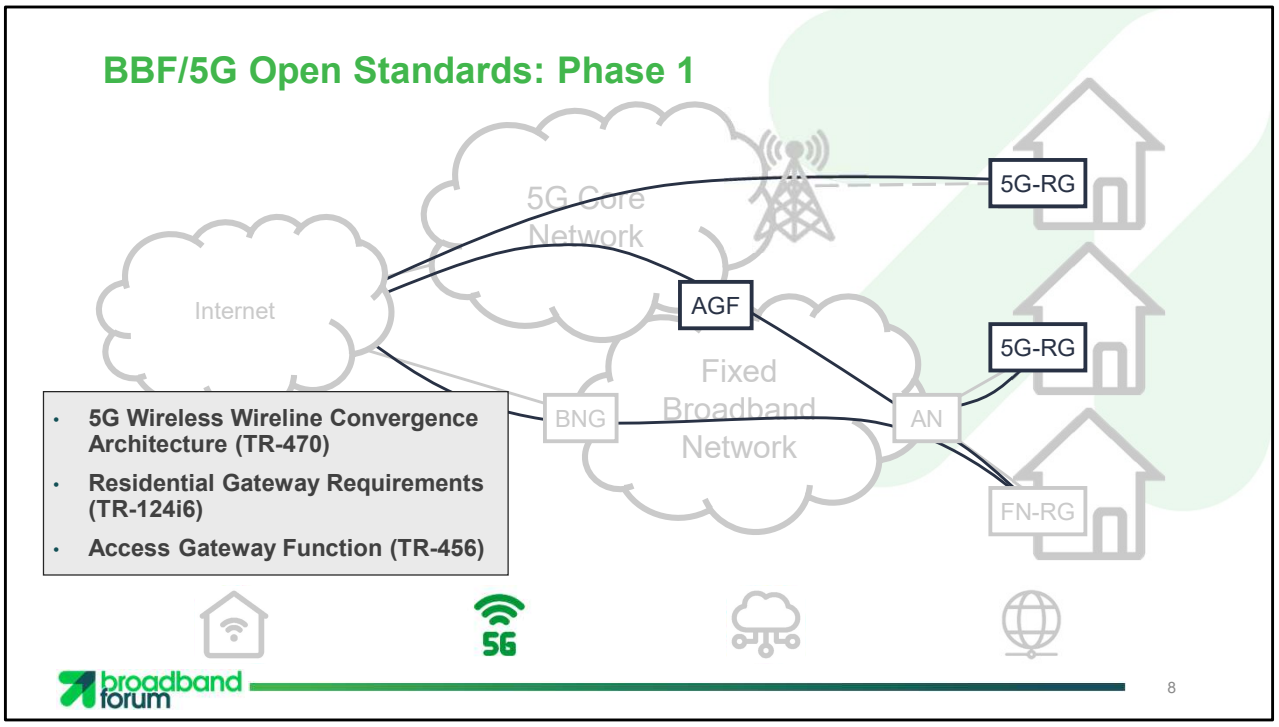
For TR-069, CPEs can be self-certified. For USP, certification extends to USP agents on any device in the end user's network.

We recently introduced TR-398, a new performance testing program for Wi-Fi access points in the home. Using RGs that pass TR-398 helps Service Providers deploy reliable managed Wi-Fi services, with fewer trouble tickets in the home network.



OB-USP-A is creating a software reference implementation for the USP agent. This reference implementation can be used to validate vendors' designs, or it can form a framework for a vendor's full featured product implementation.

The OB-MAP project is working in cooperation with the prpl Foundation to add prplmesh data into our device data models. They are also defining extensions to IEEE 1905.1, including carrier grade capabilities that enhance EasyMesh in managed Wi-Fi as a component of broadband services.



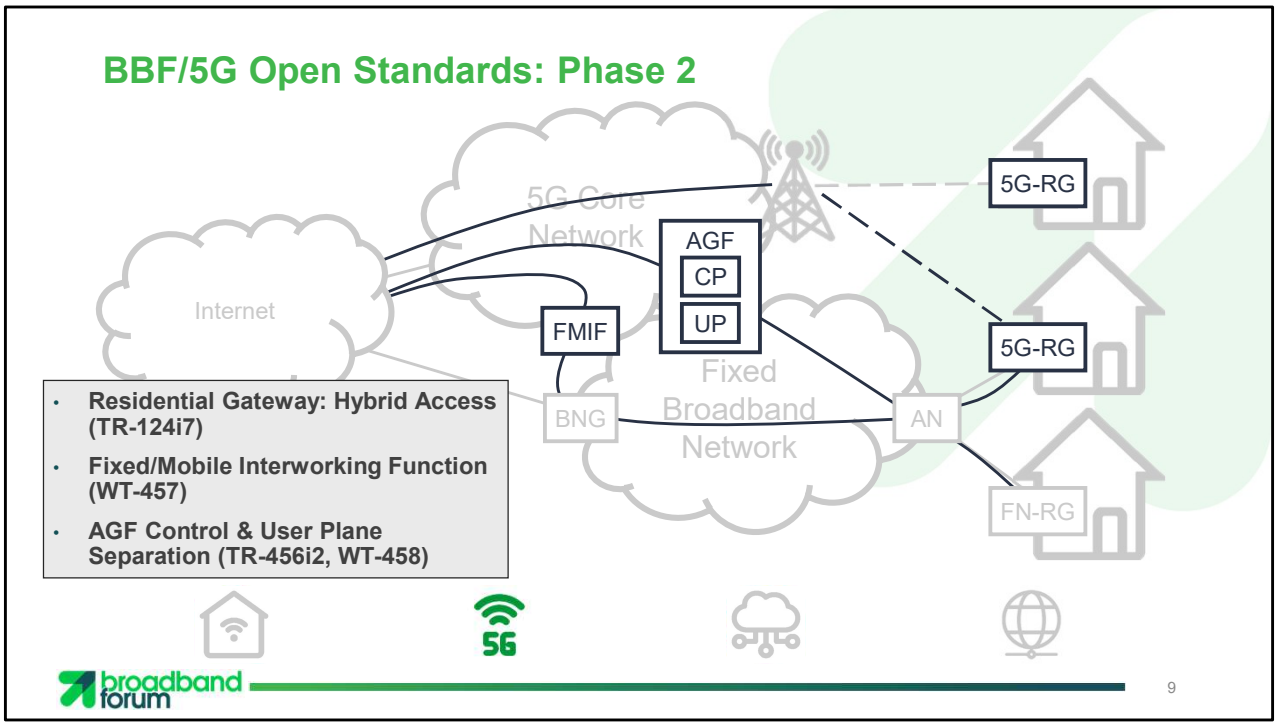
A few years ago at the request of about a dozen operators, Broadband Forum and 3GPP held a joint workshop to discuss how we could make convergence between wireline and wireless networks a reality. 3GPP was fully occupied at the time with getting 5G standards out, so we agreed that Broadband Forum would do most of the convergence work, and that we'd coordinate with them on any items that might need attention in the mobile network. That mode of operation has worked very well, we've released the first set of convergence specifications, and are now working on Phase 2.

If you look at the current state for wired and wireless networks, you see 2 independent paths from the user to the internet. Wireless users - including fixed wireless users - go through the mobile core network, and fixed users go through the fixed broadband network, from the residential gateway on out through the broadband network gateway. That's the baseline in our convergence architecture, which defines several alternatives for using a common core network.

To get to that common core you need to do a couple of things. First, we've defined requirements that apply to 5G access in Residential Gateways. That's an update to TR-124, requirements for Residential Gateways.

Second, we've defined an Access Gateway Function that sits between the fixed access network and the mobile core. The AGF works in a couple of modes. To support legacy Residential Gateways, it translates between the protocols used in the 5G core and the protocols used in the fixed network. But when it's working with RGs that support the new 5G access requirements, the AGF will tunnel those 5G protocols all the way out to and through the RG, bringing the same set of features available in mobile services out to devices that are connecting through the wired broadband access. Now it doesn't matter to end users how they're accessing their service on their mobile devices - whether it's through the cellular network or through the wired network, they're getting the same service.

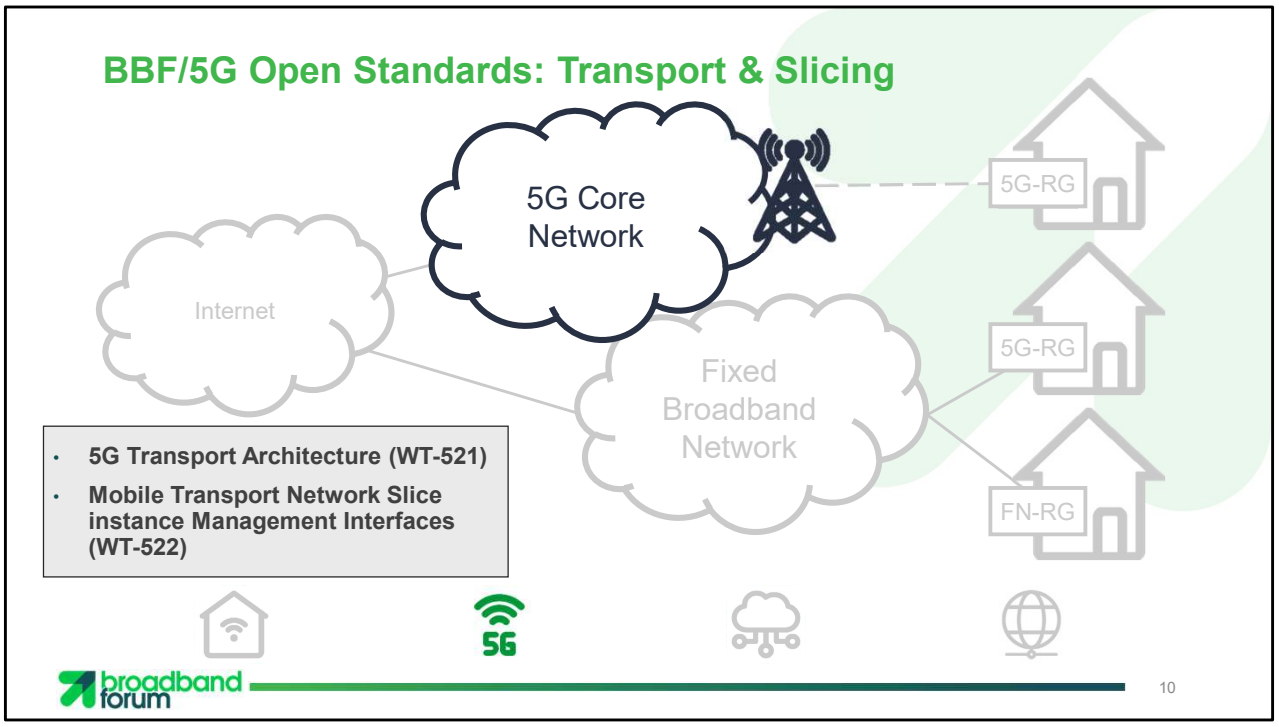
A couple of architectural notes. First, we're still using the legacy Access Nodes that are already deployed in the fixed network. It was important that we be able to do this without having to update those nodes. Second, you see that the BNG is no longer used in this scenario to terminate wired services – they're being terminated in the 5G core network. So when you do this, you can start capping your use of BNGs in the fixed network.



For Phase 2 of BBF's 5G work, the first item of business is hybrid access. We've added 5G access requirements to the residential gateway, so it can be used either for fixed wireless access or wired access in 5G convergence. Why not both? This has resiliency applications, and it also provides additional bandwidth for certain scenarios.

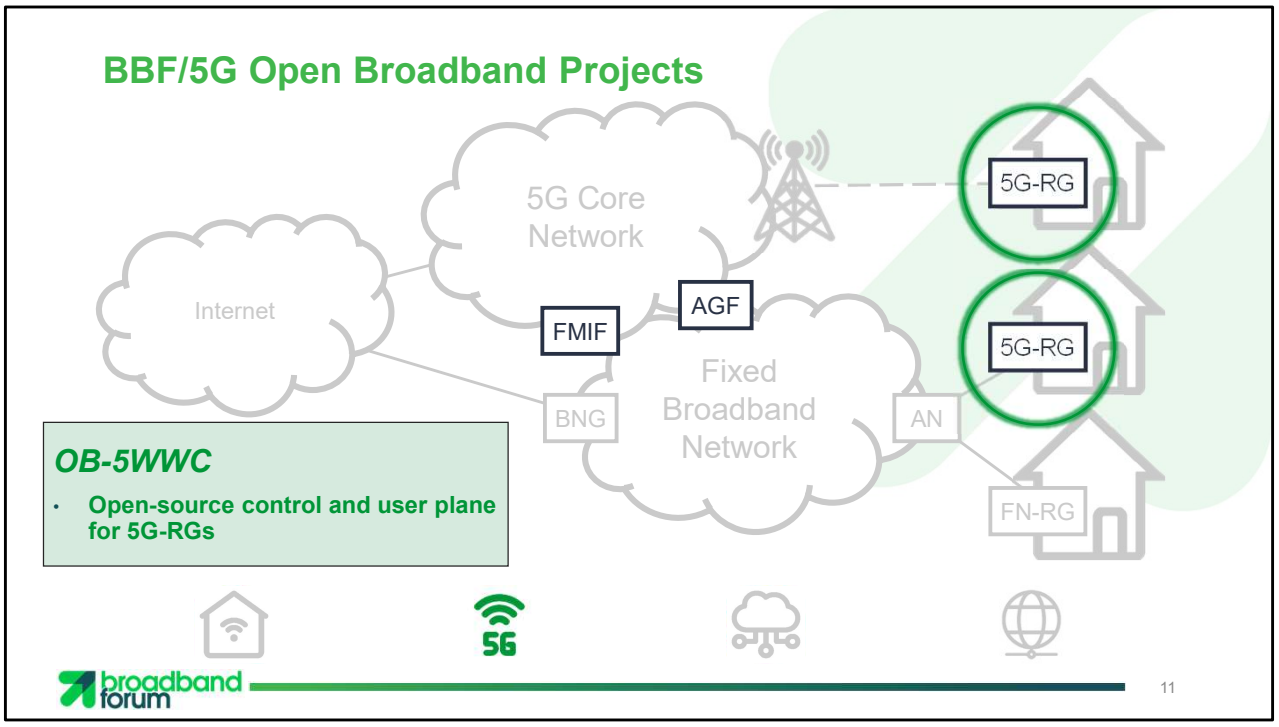
Next - we defined the AGF in phase one. Some service providers want a different path that still terminates fixed services in the BNG. We're providing that with a function called the FMIF, or the Fixed/Mobile Interworking Function, that you see here. This lets service providers offer a subset of features on their fixed networks while minimizing the changes they need to make in their architecture.

We're also using phase two to define disaggregation of the AGF. Separating the control plane from the user plane via disaggregation allows a lot of flexibility in how that AGF is deployed, especially in a virtualized environment.

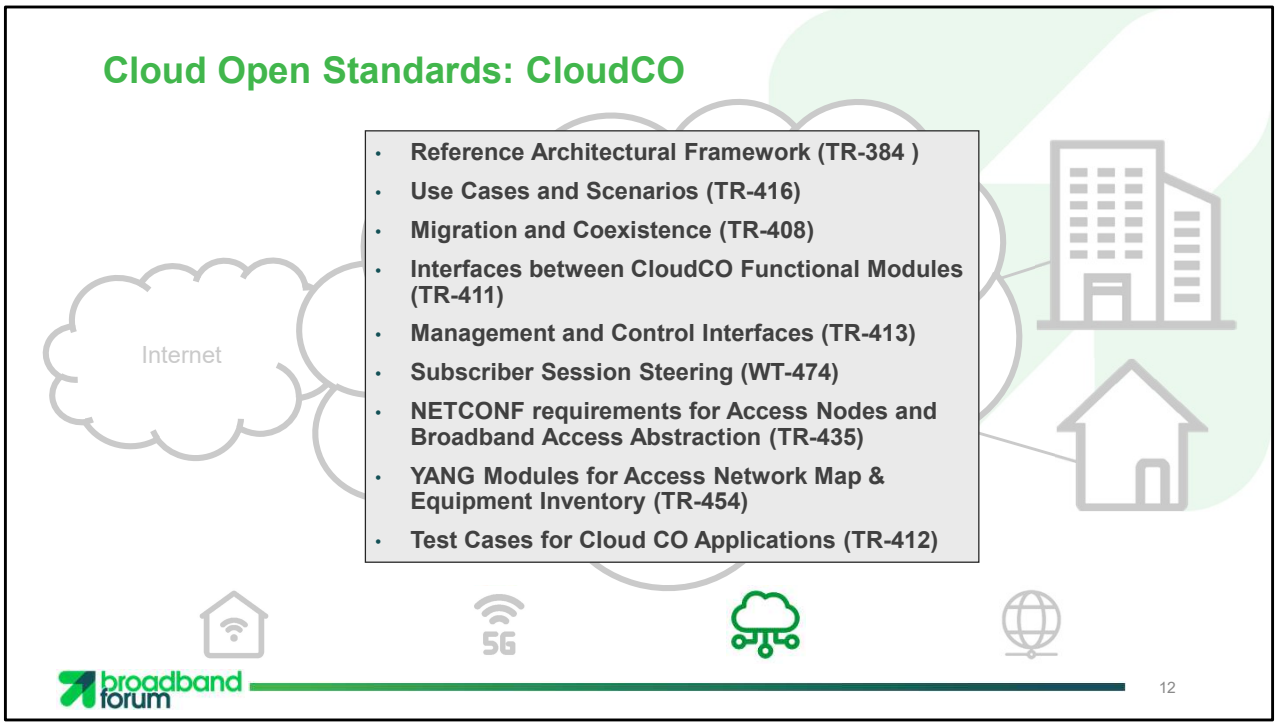


BBF has 5G work beyond convergence. We also have a history of supporting backhaul, and also fronthaul, transport in mobile networks. We're continuing that with our 5G transport architecture in WT-521.

Additionally, we're defining the management interfaces that you need to support 5G network slices in WT-522.



On the Open Broadband front, the OB-5WWC project is creating an open-source reference design for the 5G-enabled residential gateway.

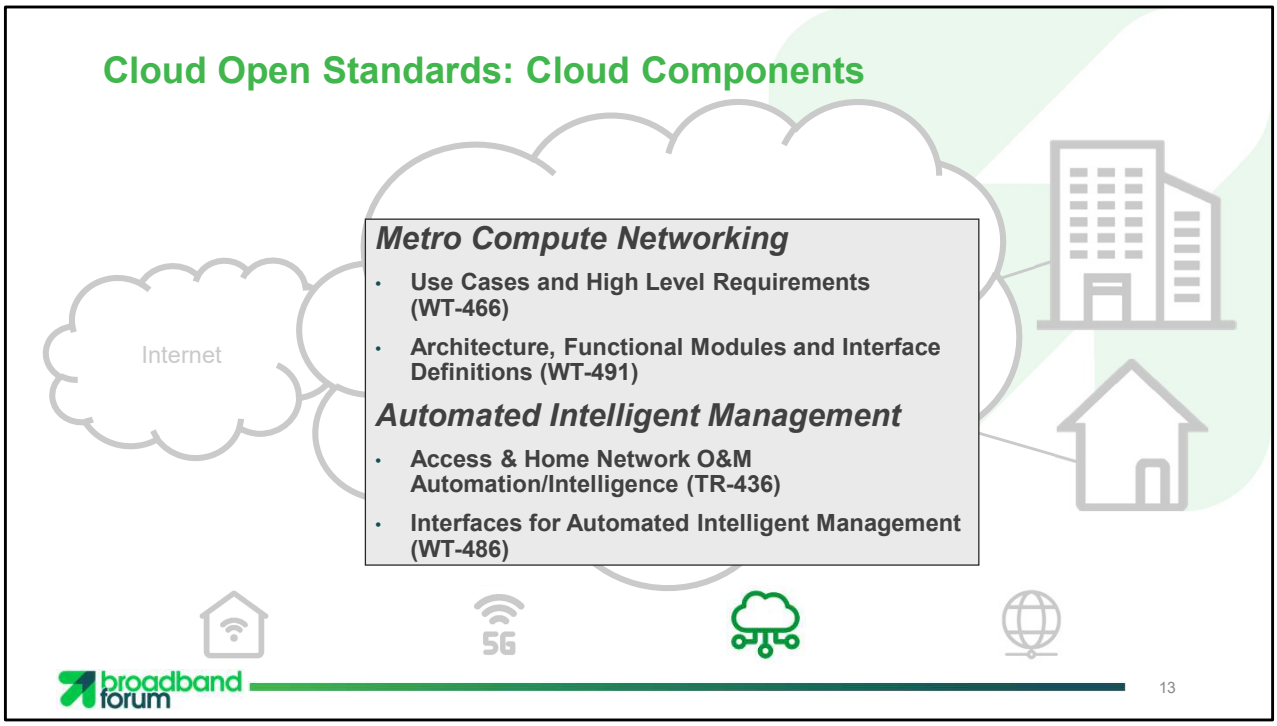


Broadband Forum started working on cloud-based specifications in 2015. One of the first projects that we tackled was to create a reference architectural framework called the CloudCO architecture. TR-384 defines that framework and it provides an overview of the architecture.

Since that document came out, we've created more specifications supplementing CloudCO with detail in different areas. These include:

- Use Cases
- Migration and Coexistence
- Functional Interfaces
- Management and Control Interfaces
- Subscriber Session Steering
- NETCONF requirements
- YANG Modules
- Test Cases

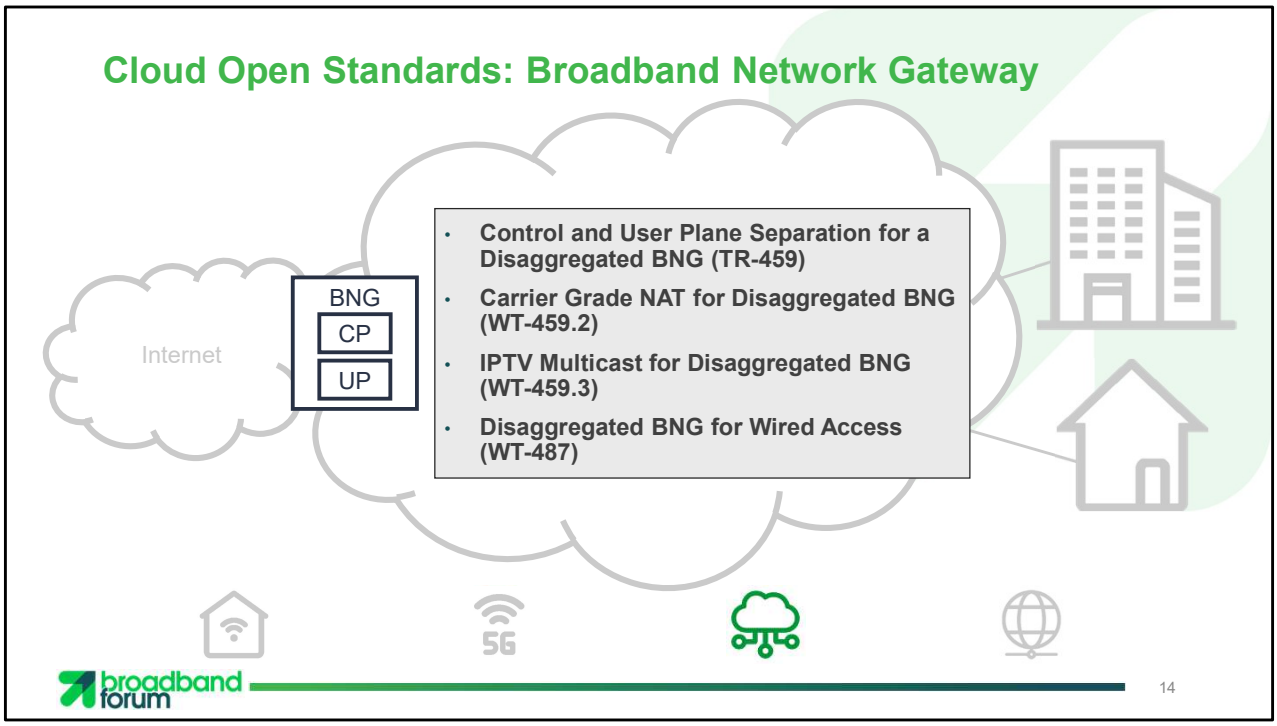
Taken together, these documents provide a solid basis for virtualizing the Central Office which is consistent with other work done in the industry, including the ETSI NFV ISG and several industry Open-Source projects.



BBF is also progressing Cloud work under the category of Cloud Components. This includes:

- Metro Compute Networking, which considers how to integrate Edge Computing into the multi-service broadband network and the associated virtualization architectures; and

- Automated Intelligent Management, which uses cloud-based automation and AI to improve efficiency for service providers' O&M processes. This should reduce the OpEx required to manage access and home networks.

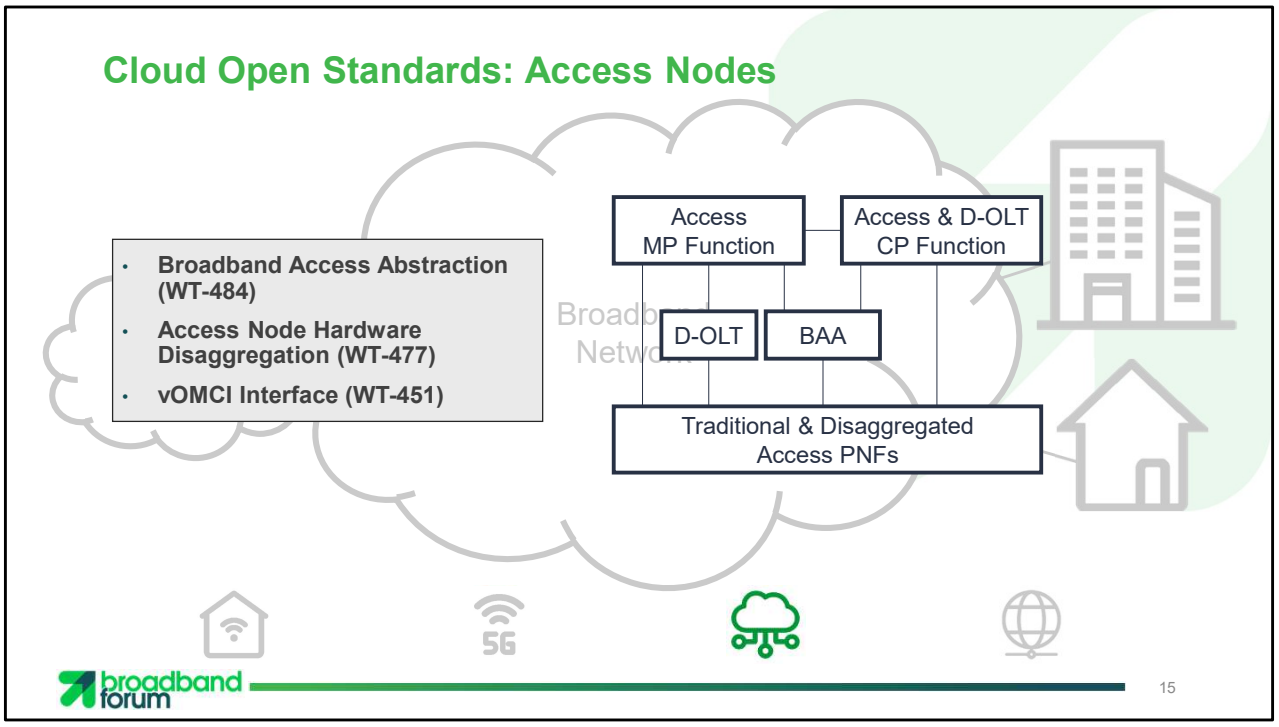


Quite a few nodes in the broadband network can benefit from disaggregation. As we virtualize the network, many of the functions that used to be implemented as dedicated boxes are being virtualized and disaggregated.

One of the first nodes we tackled is the Broadband Network Gateway. The BNG is a prime candidate for disaggregation because of the criticality of its control plane, and because of the wide range of loads it can carry in its user plane. By separating these two planes and implementing them independently, you get a lot of flexibility in how you can deploy this function:

- You can scale the user plane capacity based on your network's needs, independently of having to scale the control plane.
- You can deploy a distributed user plane, putting smaller boxes out at the network edge, closer to your end users. This lets you add volume where it's needed, and it improves performance for end users by placing the network edge closer to them. At the same time, you can centralize your control plane and have a single, consistent set of policies across your network.
- You can use independent resiliency mechanisms in your user and control planes.
- You can use different vendors for each plane.

We have several follow-on projects related to the disaggregated BNG that address specific features, including CG-NAT; IPTV multicast; and a simplified variation for wired networks.

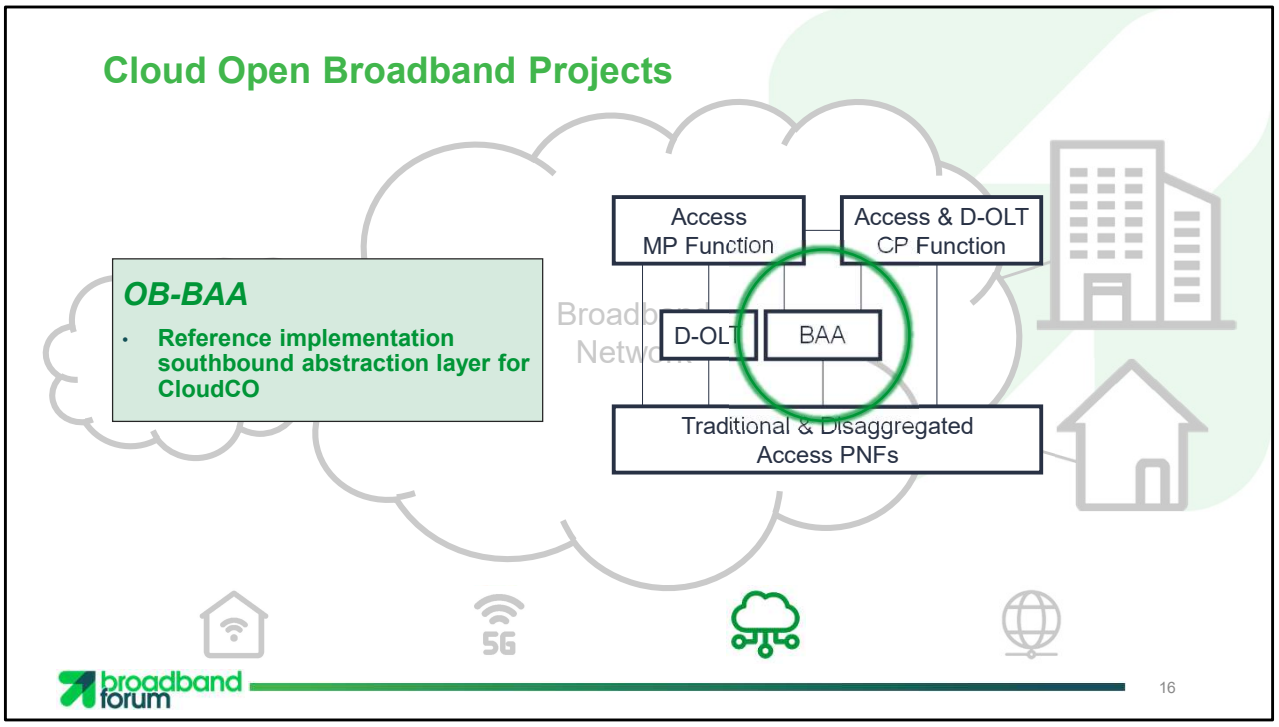


We've also done a lot of work on disaggregation and virtualization of the Access Node.

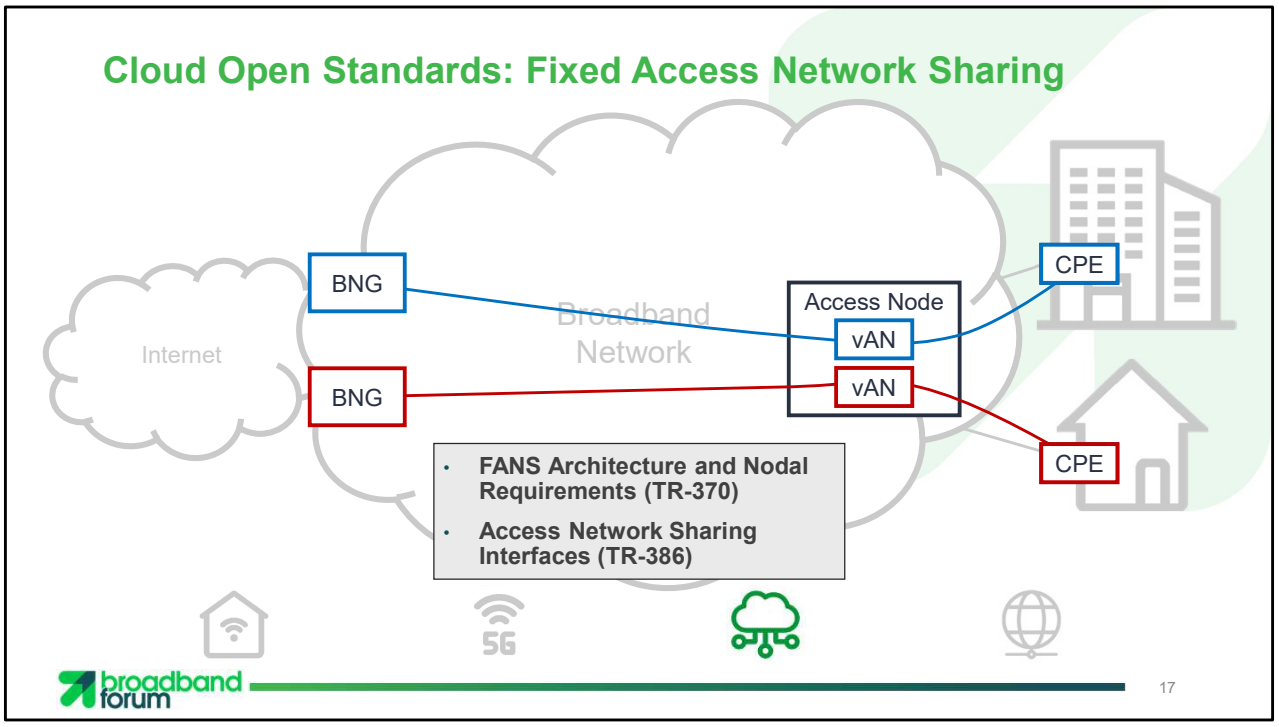
One of the first projects we tackled was the Broadband Access Abstraction, which allows you to mix traditional, disaggregated, and whitebox Access Nodes, all with their own control and management interfaces, and apply an abstraction layer between them and the network that lets you manage them using a common northbound interface.

We're also specifying control and user plane separation in the Access Node, similar to the other nodes we've talked about, with many of the same advantages.

Finally, we have a project that's virtualizing the OMCI management channel for PON networks. This facilitates interoperability with ONUs, since the network side OMCI interface can be deployed to interoperate with each different type of ONU regardless of which physical OLT the user plane is flowing through.

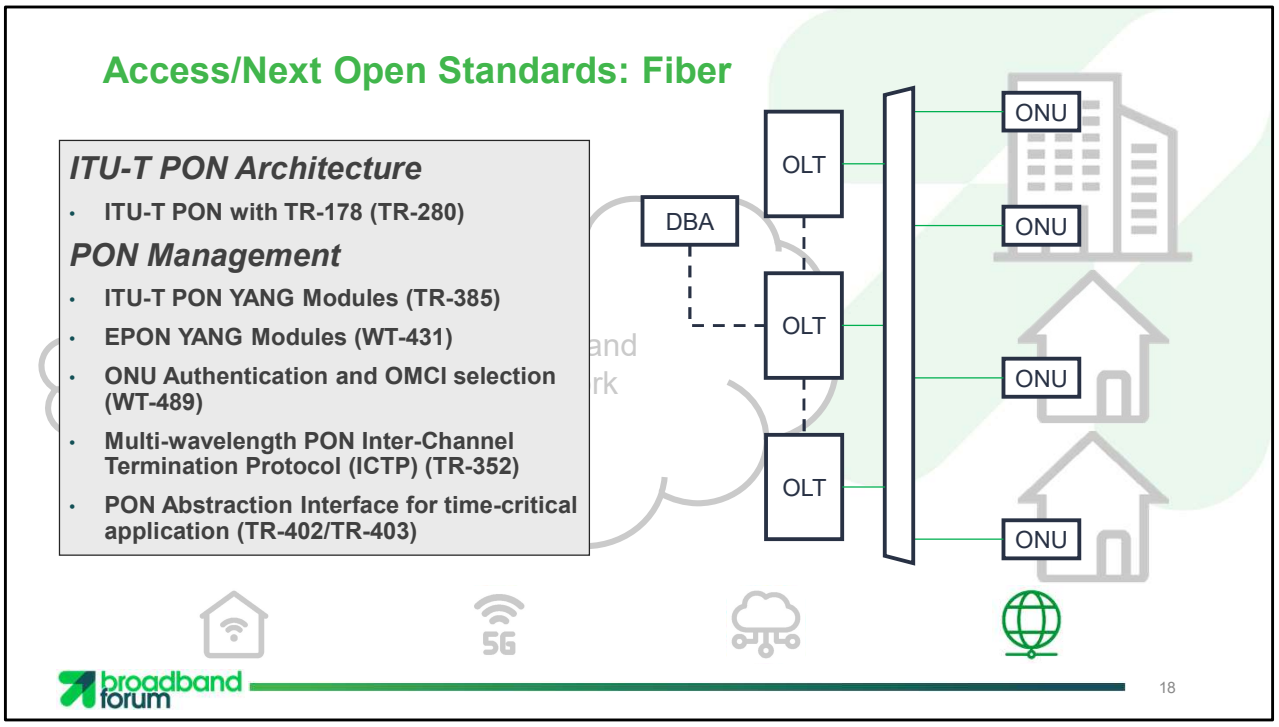


The OB-BAA project has been creating and enhancing a reference implementation for the Broadband Access Abstraction since it was initiated as the first Open Broadband project tackled by the Forum. This project has had lots of participation and has been adding features for several years, most recently implementing virtualized OMCI.



One final topic within Cloud is Fixed Access Network Sharing, or FANS. Some regulators have required incumbent broadband operators to open their networks at the physical layer to multiple service providers. The way we facilitate that is by specifying multiple virtual instances of the Access Node. Each virtual instance can be managed and configured by a different network operator. The virtual networks are isolated so that each operator only sees, and controls, their own part of the network.

We've had two projects supporting FANS - one defining the architecture and requirements, and a second specifying the required interfaces.



Our final focus area is Access/Next. Most of our access specifications concern either fiber- or copper-based access.

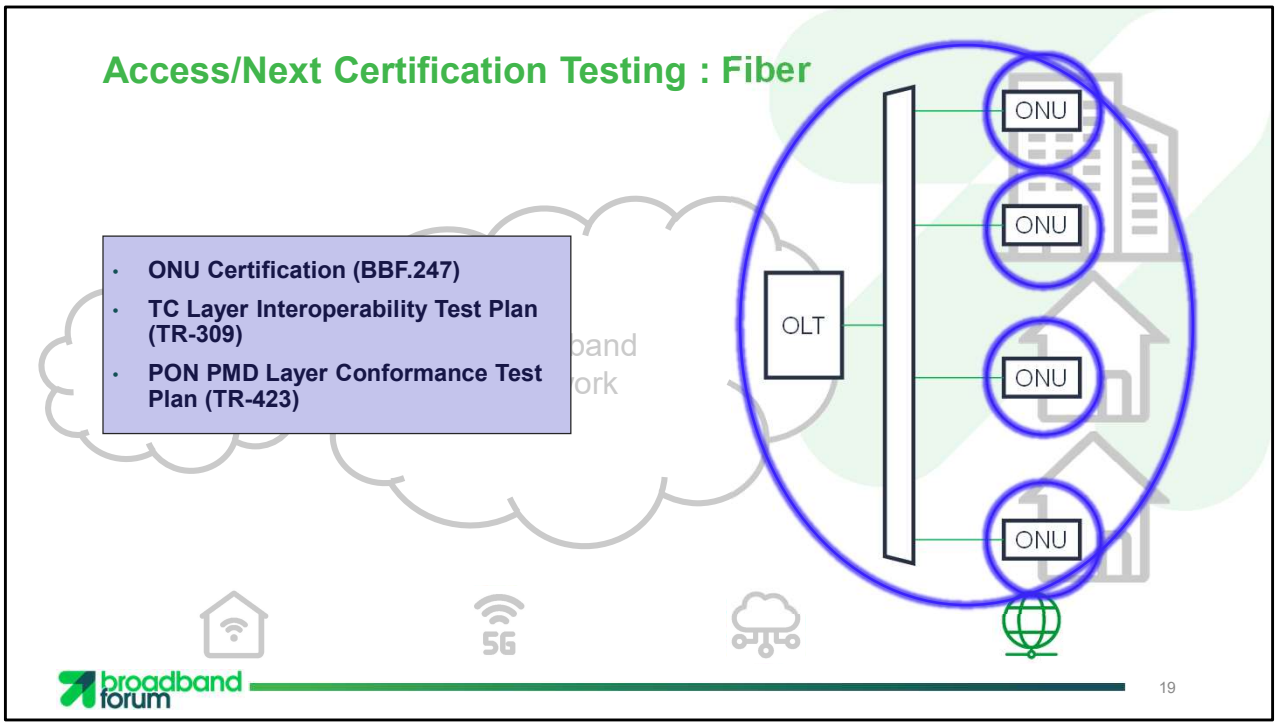
We've been defining the PON system requirements for working within Broadband Forum architectures for a long time. The most recent iteration of that work has been TR-280.

More recently our focus has been on specific aspects of PON management. We've defined the YANG modules needed by PON, both for ITU-T based GPON and newer generations like XGS-PON, and for IEEE based EPON. We're also working on virtualizing OMCI, the PON management channel, as well as the authentication and selection processes associated with that virtualization.

We've also specified ICTP, an Inter-Channel Termination Protocol used to communicate between OLTs on the same PON network. The primary application for this is NG-PON2, but it also has applications for resiliency in XGS-PON and other deployments.

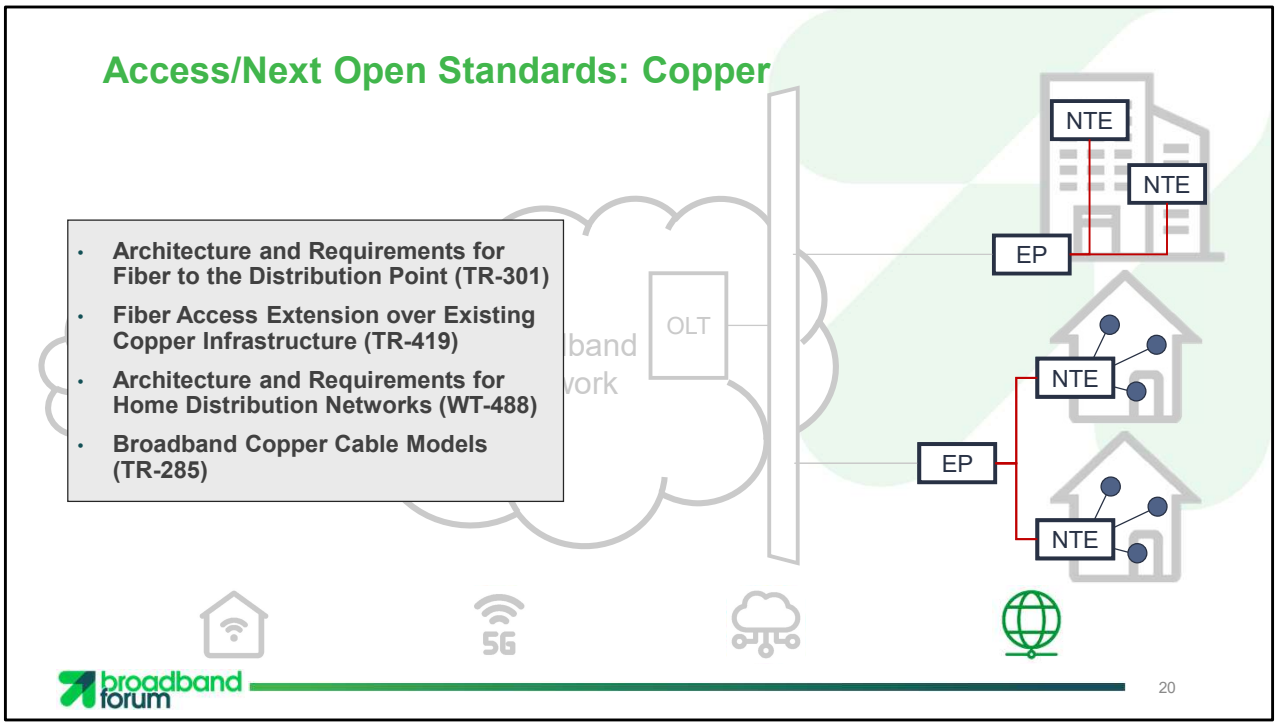
Since most PON systems are time multiplexed, latency can sometimes be an issue for

critical applications. To deal with that, we specified a PON Abstraction Interface that allows an external element to control time-critical functions like Dynamic Bandwidth Allocation. This lets those time critical functions be updated as the network requirements evolve, or even synchronize with other network elements to minimize end-to-end delay.



The first certification Broadband Forum ever did was BBF.247, for GPON ONUs. We introduced that program back in 2011, and today we list 117 ONU models that have been certified to GPON, XG-PON, and XGS-PON requirements.

We also specify test plans that service providers can use to test for interoperability between the OLT and the ONU. These test plans cover the physical layer and at the TC layer.

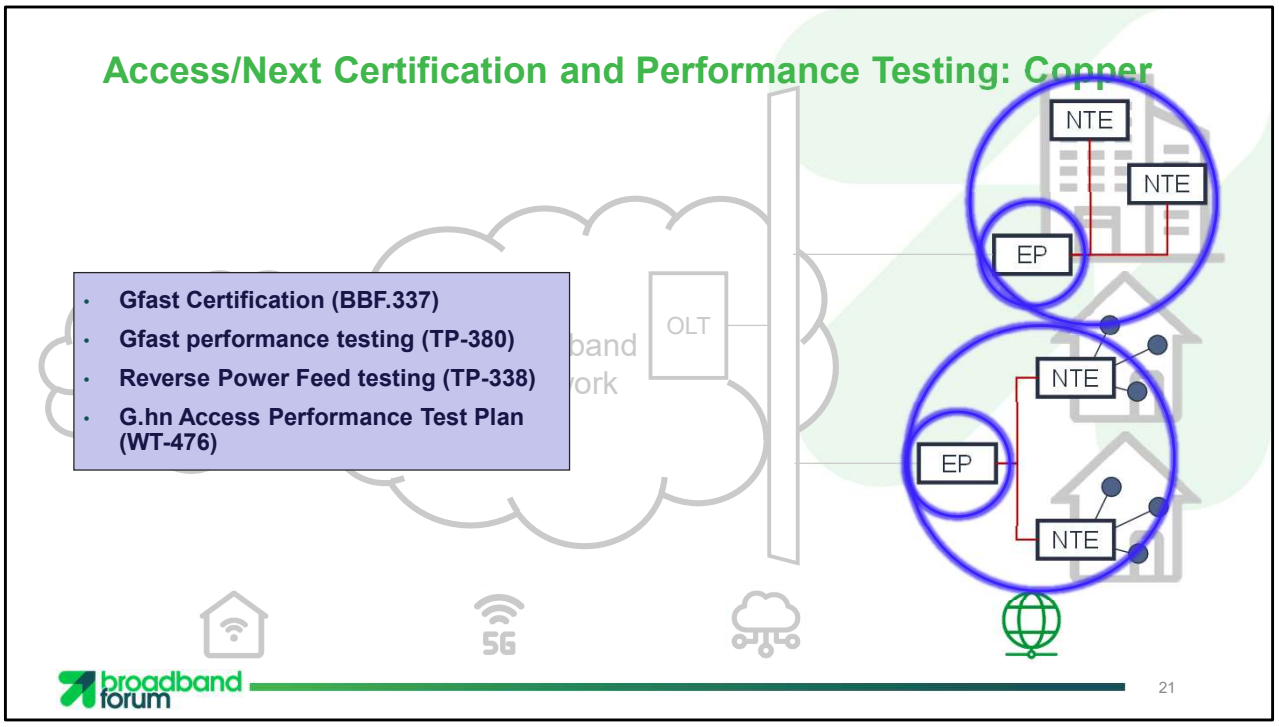


The Broadband Forum has a long history with copper-based access, starting with ADSL and then VDSL. Our more recent work Involves transmission at higher frequency ranges and speeds.

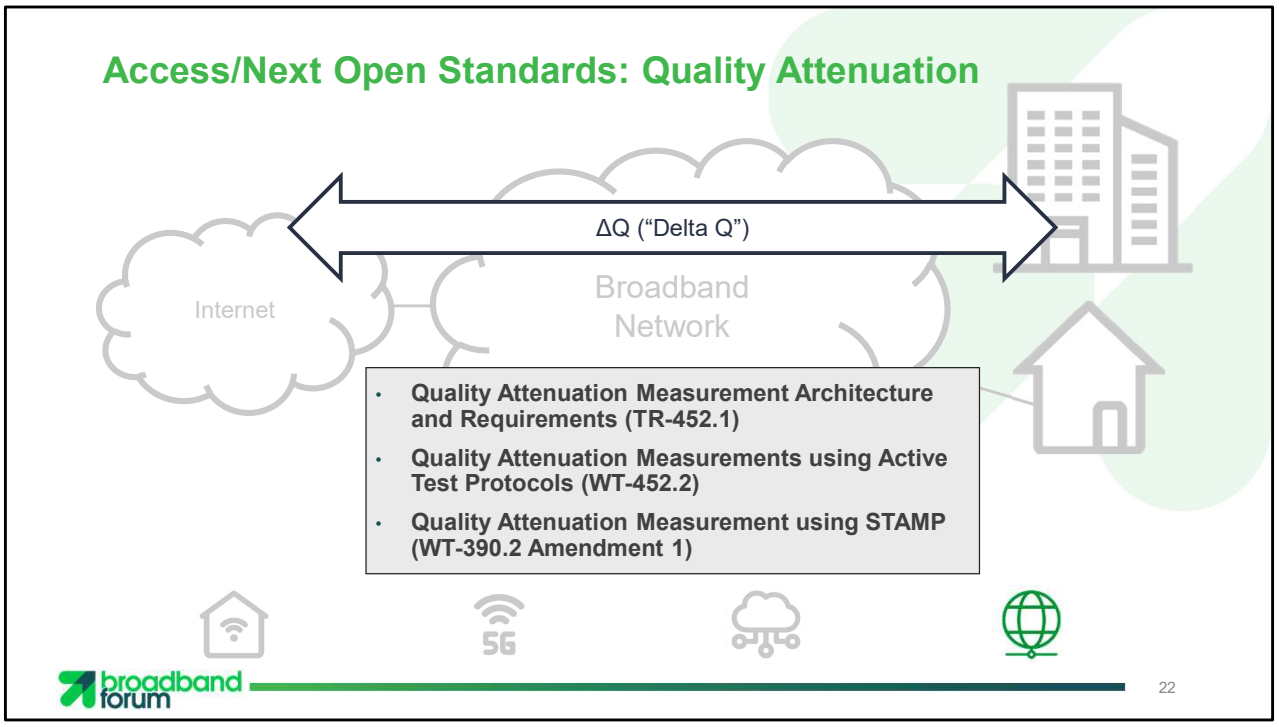
We first specified how to deploy Gfast with our Fiber To The Distribution Point architecture in TR-301. While that's been through several iterations, we've also generalized it with TR-419, which specifies a set of architectures to extend fiber networks over copper loops or coax. These include point to point and multipoint extensions originating from neighborhood distribution points, basements, or other locations.

Another area where we're taking advantage of wiring that already exists is within the home. WT 488 is specifying an architecture and requirements for home distribution networks that may run over multiple types of media, including copper, coax, or Wi-Fi.

Our copper experts also specify cable transmission models. As the frequencies over which we transmit get higher, this has become an increasingly important component of the work.

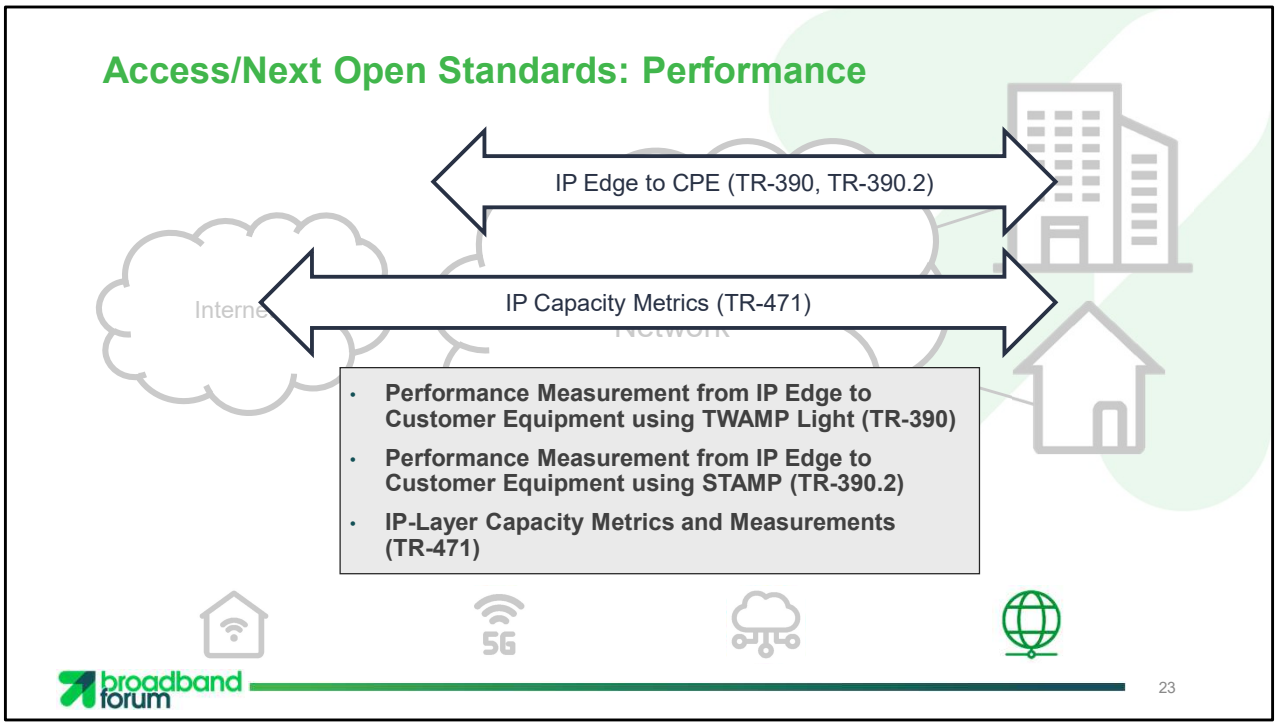


BBF has a full suite of certification and performance test programs for copper transmission . BBF.337 has gone through several iterations certifying Gfast functionality, and its companion TP-380 specifies performance testing. We also have tests for the Reverse Power Feeding, which is frequently used to power nodes out at the distribution point. Finally, we're developing a plan to test performance for GHNA access technology.



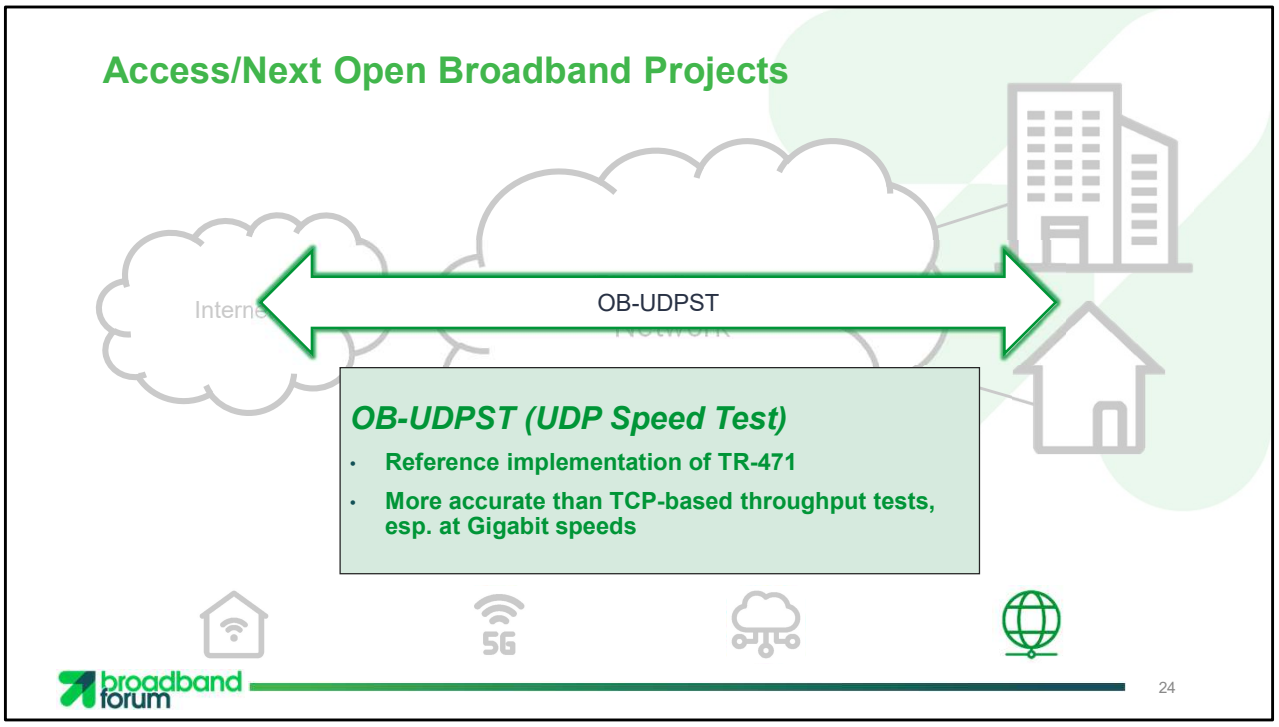
One more technical area involves the measurement and analysis of broadband performance. It's becoming increasingly apparent that as typical broadband rates get into the gigabit range and as applications get more complex, traditional TCP throughput testing is not enough to predict the quality experienced by end users. We're addressing this with a multi-pronged approach.

One prong involves a comprehensive technique for analyzing and specifying broadband quality called Quality Attenuation, or Delta Q. Quality Attenuation treats quality as a quantifiable parameter that represents the amount of attenuation applied by the network. You can get the metrics you need using existing protocols. Quality attenuation has been adopted by at least one major service provider, and we’re looking forward to seeing its use increase in the industry.



In another prong we specify how to measure performance from the IP edge out to the CPE. This is the traditional span of broadband services, and it continues to be a mainstay for many service providers.

Yet another prong has been measuring IP layer capacity using UDP instead of the traditional TCP throughput. UDP has several advantages over TCP, especially at Gigabit rates where TCP tends to underestimate the capacity of the connection.



UDP capacity measurement brings us to our last Open Broadband project, which is a reference implementation of a UDP based speedtest. Like all of our Open Broadband projects the releases for this project are available on GitHub.

Thank you

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http://www.broadband-forum.org/

Interested in getting more involved?
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Rhonda Heier at: rheier@broadband-forum.org