**ONAP**
OPEN NETWORK AUTOMATION PLATFORM

# Blueprint Overview

ONAP Broadband Service Blueprint Enables CSPs to Create and Manage Broadband Residential Services

**ONAP**

**OVERVIEW:**
- Broadband Forum (BBF) Cloud Central Office concept moves central office to a cloud model using NFV/SDN
- Enables flexibility, scalability, automation, agility for CSPs
- Results in improved customer experience

**CURRENT PROBLEM:**
- Time consuming and inflexible provisioning of broadband services
- No uniform way to orchestrate across locations and technology domains
- Manual post-deployment service changes e.g. when a customer relocates

**SOLUTION:**
- Orchestration of services using ONAP
- Collaboration with BBF and TMForum around standardization
- Post-deployment automation using ONAP

"BBS enables our customers to move their CPE with them and get their services configured at the new location without having to notify us. This blueprint shows how ONAP can contribute to increasing customer satisfaction while reducing operational costs and complexity in IT procedures."

–DAVID PÉREZ CAPARRÓS, LEAD DEVOPS ENGINEER, SWISSCOM

# Overview

Communication Service providers (CSPs) currently must provision and configure a number of physical network functions to provide residential broadband connectivity.

This leads to lengthy provisioning time that is not flexible enough to provide future value-added services. For this reason, the Broadband Forum (BBF) developed the TR-384 Cloud Central Office Reference Architectural Framework in 2018. This framework uses Network Function Virtualization (NFV) and Software Defined Networking (SDN) technologies to provide flexible, agile, and automated central office environments. In addition to this framework, CSPs need the ability to adapt to post-deployment service changes. These have traditionally been manual, time consuming tasks. New concepts such as closed-loop automation can fully address these problems.

# Problem Statement

## To automate the provisioning of a subscriber's High Speed Internet Access (HSIA) service and to adapt to post-deployment changes, three problems need to be solved.

First a CSP needs to be able to orchestrate an end-to-end customer facing service (CFS) across multiple locations (such as central office and core) and access different technologies (such as access and edge). A customer facing service consists of the customer premise equipment (CPE), access connectivity, and an internet profile (created in the core). While the CPE will remain a physical network function (PNF), the other services can be realized through virtual network functions (VNFs). The figure below shows how a CPE is connected to the internet through these various elements.



**CPE**: Customer Premise Equipment
**ONT**: Optical Network Terminal
**RG**: Residential Gateway
**OTO**: Optical Termination Outlet
**FAN**: Fiber Access Network
**OLT**: Optical Line Terminal
**BNG**: Broadband Network Gateway
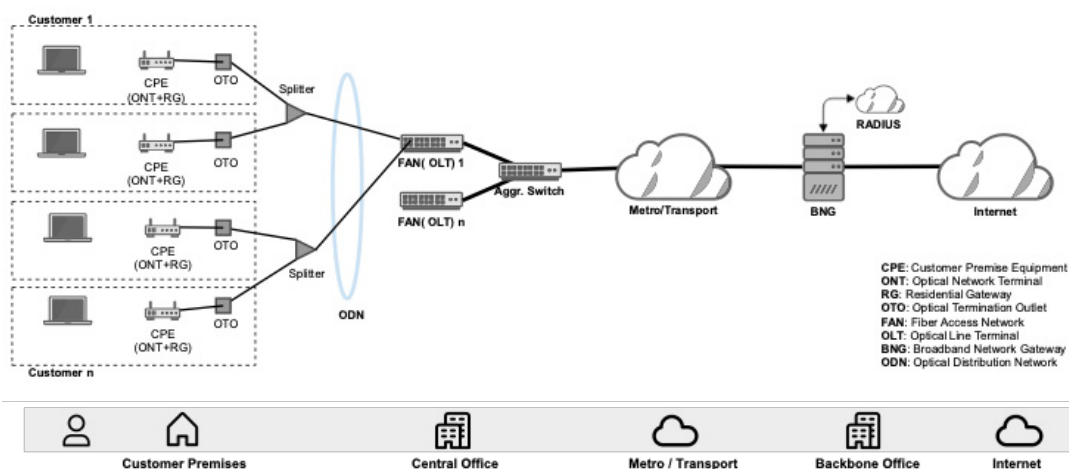**ODN**: Optical Distribution Network

Figure 1: Broadband Service Architecture

Second, a CSP needs automation to address post-deployment changes. These tasks could be handling the relocation of a subscriber to a new address, subscription changes such as bandwidth increases, or the insertion of new value-added services.

Finally, a CSP needs to be able to accomplish the first two goals in a standard, compliant way to prevent vendor lock in. Standards such as the BBF Cloud Central Office, standard TMForum APIs to interact with the orchestrator, and ETSI NFV ISG SOL 001 TOSCA NFV descriptors.

# Solution

Using the Open Network Automation Platform (ONAP) software to orchestrate Broadband Service (BBS), which is based on software defined networking (SDN) and network functions virtualization (NFV), is an ideal solution to the above problem. Specifically, the BBS blueprint set out to accomplish the following:

- Use ONAP to design and provision a multi-gigabit HSIA customer facing service
- Handle post-deployment changes such as a subscriber that relocates, i.e. nomadic Optical Network Terminal (ONT)
- Use open standards from BBF, TMForum, and ETSI NFV ISG

While this blueprint is related to the ONAP vCPE blueprint in that both provide residential connectivity, the goals are quite different. vCPE splits the residential gateway into a much lighter bridged residential gateway and a cloud hosted virtual gateway, and this is different from BBS.

Before looking at the solution in more depth, let us review the objectives of Linux Foundation's ONAP project. ONAP is an open source project that provides a common platform for telecommunications, cable and cloud operators, and their solution providers to rapidly design, implement, and manage differentiated services. ONAP provides orchestration, automation, and end-to-end lifecycle management of network services. It includes all the Management and Orchestration (MANO) layer functionality specified by the ETSI NFV architecture; in addition, it provides a network service design framework and service assurance functionality.

The ONAP project includes a subcommittee to define and test blueprints for specific use cases, to facilitate rapid implementation by users, and to provide guidance to the ONAP developer community in prioritizing features and bug fixes for a use case with immediate user demand.

The BBS blueprint in ONAP provides the establishment of a HSIA service from an ONT to the Internet. This task takes advantage of ONAP's design and deployment services. The HSIA service activation is initiated via ONAP's external APIs; which in turn are triggered by a self-service customer portal. Next, the BBS blueprint aims to show the change of location for ONT devices, i.e. nomadic ONT devices. This occurs when a subscriber relocates. The expectation is that the system will re-register an ONT that moves without any notice. BBS uses ONAP as a global orchestrator that uses southbound 3rd party access SDN manager and controller and a similar edge SDN manager and controller.

The figure below shows an overview of the BBS blueprint. The gray flow shows initial provisioning and the orange flow shows a nomadic ONT re-registration.
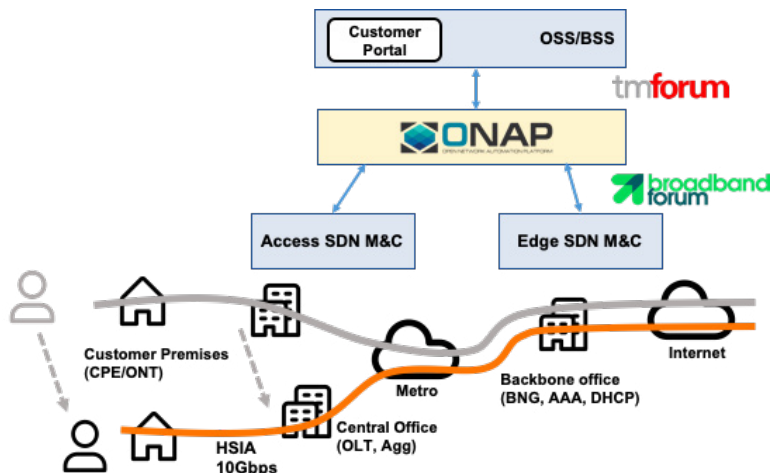


**Figure 2: BBS Overview**

# Implementation Details

In roughly five months, the BBS community members led by Swisscom put together a blueprint that implements the above solution.
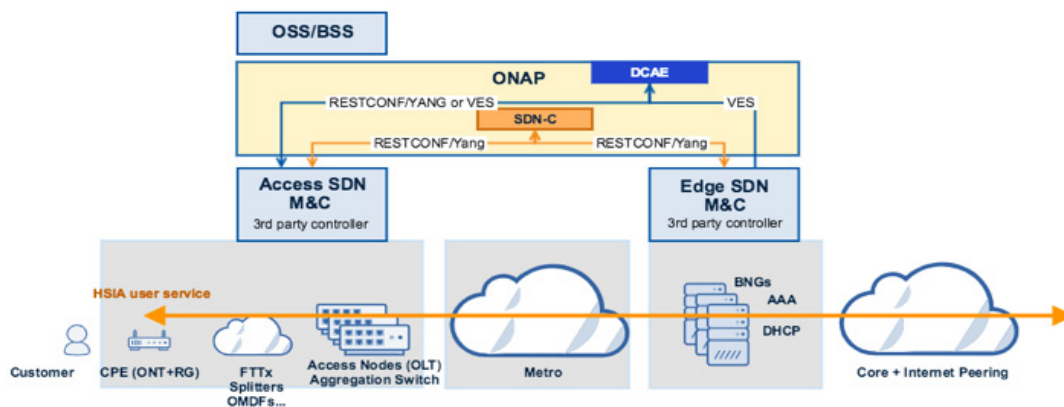


**Figure 3: BBS Implementation**

The team used ONAP Casablanca with some Dublin enhancements. The NFVI chosen was an RDO scenario of the OPNFV Fraser release (OpenStack Pike based). The hardware, hosted in a Swisscom lab, has 12 server nodes (each with Xeon E5-2680, 48 cores, 384 GB memory). The ONT, OLT, and access SDN manager and controller are from Huawei. The edge SDN manager and controller and vBNG and AAA VNFs are from Swisscom. In addition, Nokia and Tech Mahindra assisted with the development of the blueprint.

The HSIA creation and activation phase went through the following design and runtime steps:

**0.** HSIA service model onboarding using ONAP SDC

**1.** Customer orders HSIA service via portal (no human involvement)

**2.** BSS orders instance of HSIA customer facing service (CFS) via ONAP Northbound APIs, specifically TMF 641, TMF 638, and TMF 633

**3.** ONAP creates CFS and waits for CPE

**4.** Customer receives and plugs in CPE

**5.** New CPE is detected and reported

**6.** ONAP orchestrates remaining CFS resources by using the Access and Edge SDN manager and controller
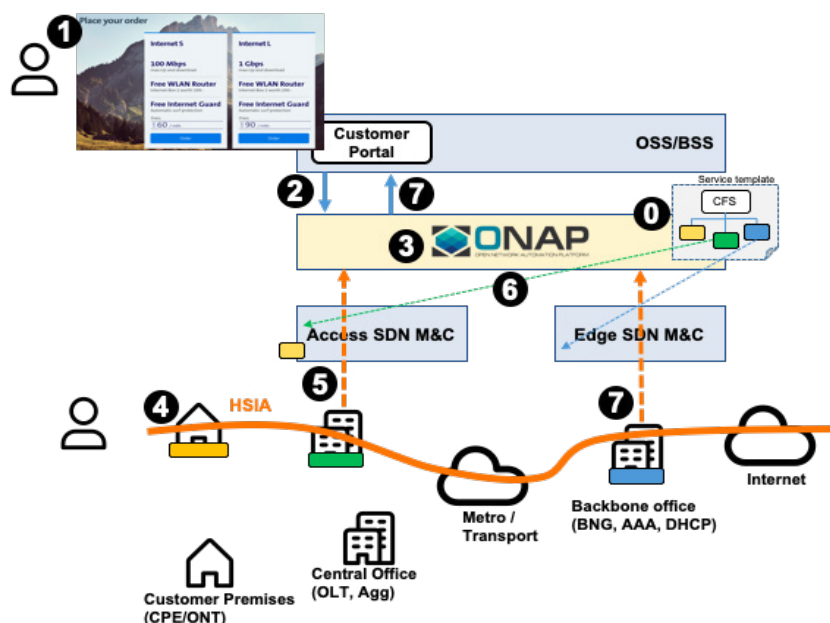
**7.** HSIA service is ready



**Figure 4: HSIA Creation and Activation**

The Nomadic ONT HSIA reconfiguration went through the following design and runtime steps:

**0.** Closed Loop Automation Design

**1.** HSIA service is active in home #A

**2.** Customer moves to new home #B with CPE

**3.** CPE in new location is detected

**4.** ONAP analyzes the event and triggers policy to identify resources to be reconfigured

**5.** ONAP reconfigures the HSIA service
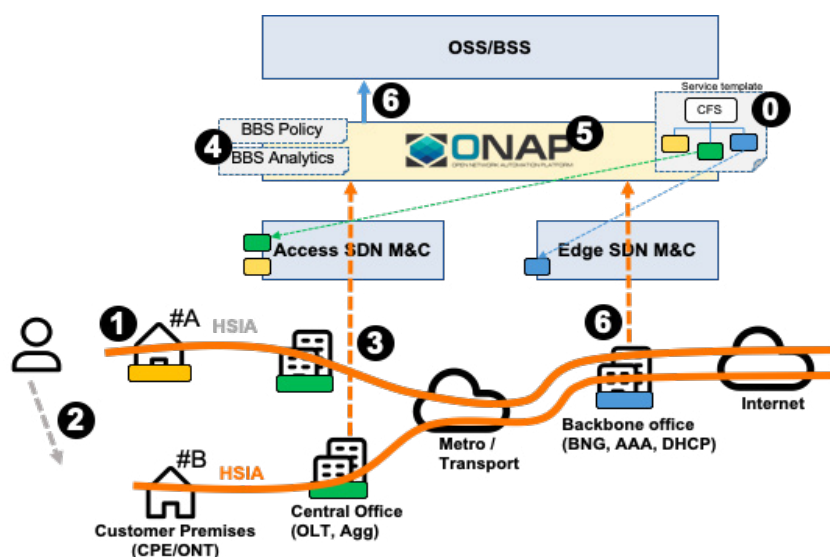
**6**. HSIA service ready in home #B



**Figure 5: HSIA Reconfiguration**

Interestingly, the ONT registration/re-registration makes use of the ONAP PNF integration capability designed originally for the 5G blueprint. This shows how the work done by one blueprint can benefit another.

# Community Contributions

## The BBS blueprint resulted in a number of important community contributions. A partial list is as follows:

- TMForum API alignment (e.g. TMF 638)
- New edge rules schema in A&AI graph database
- New datagraphs (DGs) for interaction with 3rd party SDN manager and controllers
- Enhancements to RESTCONF event collector, VES mapper, and PNF plug-and-play
- New DCAE BBS microservice
- APEX engine policy rules to support the nomadic ONT use case

The blueprint also helped cement a closer relationship with BBF, TMForum, and ETSI NFV ISG.

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# Future Work

The blueprint will continue to do work beyond the Dublin release. Some of the roadmap items are to support subscription plan changes, HSIA service health monitoring, and metro link configuration by using a southbound transport SDN manager and controller. Subscription changes can include items such as bandwidth plan upgrade that will be initiated by ONAP's External APIs and orchestrated using ONAP.
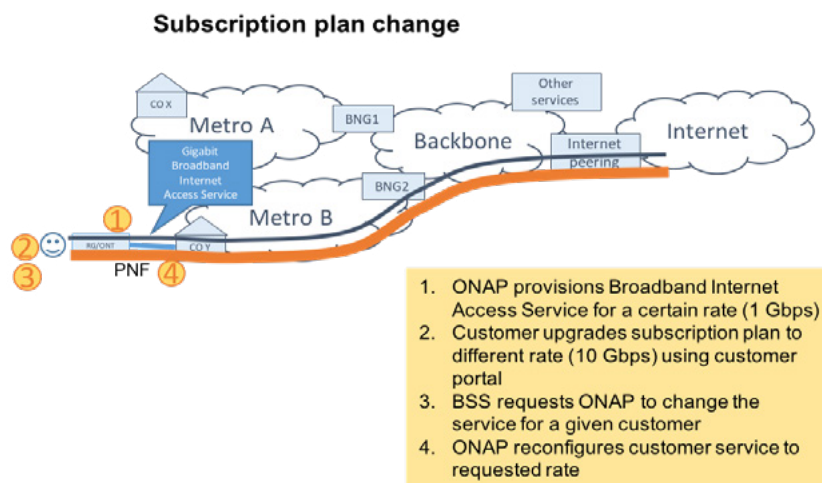


**Figure 6: Future Enhancements in BBS**

# Results

Early results validate the benefit of the BBS blueprint. New services can indeed be deployed in a matter of minutes demonstrating the agility of this service. Five test cases have been run against this blueprint, that include the test suite to onboard the required resources and create and distribute the HSIA service. The blueprint was demonstrated at the Linux Foundation 's Open Networking Summit (ONS) event in San Jose in April 2019.

In summary, the BBS blueprint allows CSPs to take advantage of ONAP to offer broadband services in a more flexible and agile manner. It also enables them to automate subscriber migration and, in the future, changes to the subscription plans, minimizing or eliminating manual intervention. Using this blueprint, CSPs can also provide new services rapidly, on-demand to their residential customers. The BBS blueprint demonstrates how CSPs can take advantage of ONAP to improve operational efficiency, customer satisfaction, and ultimately, increase revenue.

# Resources

BBS wiki page

ONS 2019 BBS demo slides

ONS 2019 BBS presentation slides

BBF TR-384 framework specification