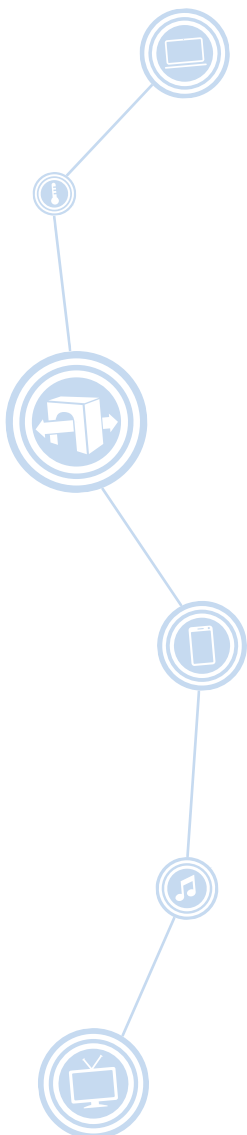# Head in the Cloud, Feet on the Ground –

Virtualization of the Broadband Home Gateway

**Intel® Connected Home Division, Intel® Network Platform Group
January 2016**

Virtualization of the Broadband Home Gateway is an architecture evolution that will dramatically improve operating efficiency and customer satisfaction for service providers. Virtualization brings the promise of open networking, improved day-to-day network maintenance and simplified deployment of advanced services to millions of residential subscribers, even when these subscribers use home-gateway systems from different makers.

Residential broadband services have advanced significantly in the last two decades. We have progressed from a single-user broadband modem, through Voice over IP (VoIP) services and multi-user home routers and on to support for wireless services and today's emerging requirements for Community Wi-Fi and Smart Home applications. Despite all these changes, the

access network architecture remains the same: processing and controlling home traffic is entirely implemented on residential systems. Adding such advanced services as Secured Networking, Mobility over Community Wi-Fi, and Home Automation – will further accelerate the growing complexity of the "Connected Home Logic" and the challenges associated with legacy network architecture.

At the same time, broadband technology has improved 10,000%, from 60-70Mbps DOCSIS2.0[1] in 2005 to 6-7Gbps DOCSIS3.1 in 2016[2]. This makes it possible to configure network architectures to split processing between the residence and Central Office. And as the network operator's Central Office evolves into a Data Center operation (Place of Percent) – it now is conceivable to virtualize the network

**Intel® PUMA™ Software Development Kit
Incremental Gateway features added Year-over-Year**
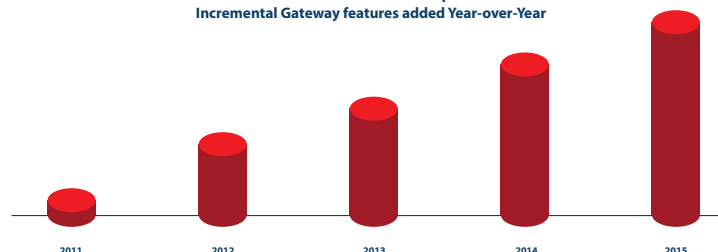
Over the last five years several hundreds of new Gateway features were implemented by Intel® on the Puma™ Software Development Kit
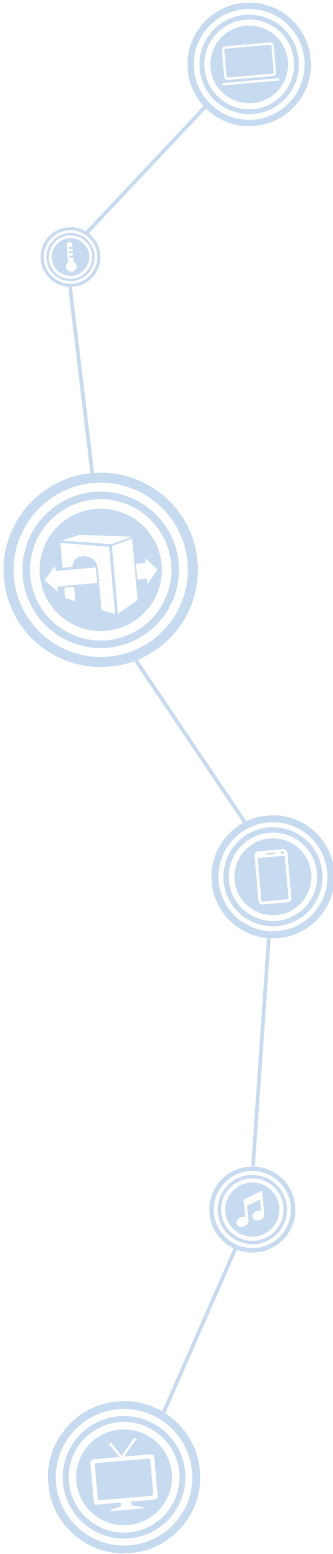
functions of the Home Gateway based on principles of Software Defined Networking (SDN) and Network Function Virtualization (NFV). We have a convincing evolutionary path to the Virtual Home Gateway.

In 2016 we can expect Virtual CPEs (vCPE) deployed in Enterprise networks and the Virtual Home Gateway will be seriously considered by Service Providers. In some cases, virtualization principals have been trialed with equipment manufactures. It's not difficult to imagine the value: ease of SW maintenance, ease of service-chaining with very little dependency on capabilities of the residential resources, and improved mobility as part of Community WIFI infrastructure.

Successful implementation of vCPE in the challenging residential environment

calls for proper attention to "Doing it properly." Open networking while preserving subscriber privacy, intelligent "hair-pinning" of application resources over wide-areas using constrained uplink resources, preserving performance under elastic service chaining, and service resiliency: these are some of the implementation challenges in the path of making Virtual Home Gateways ready for mass deployment.

Recognizing both the advantages and the implementation challenges of Virtual Home Gateways, Intel's Connected Home Division and Network Platform Group are developing an End-to-End reference implementation of an open network solution for residential deployments including a Virtual CPE (vCPE) component in the Cloud and a Physical CPE component (pCPE) in the residence.
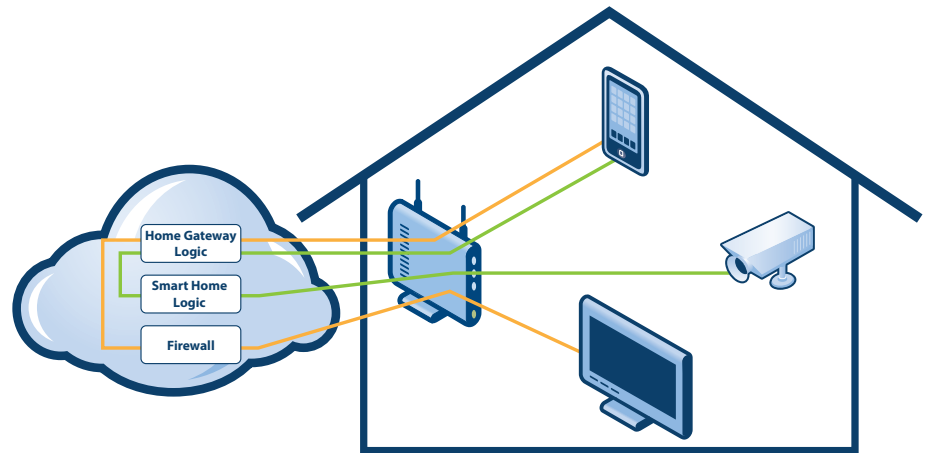
Cloud Hair-pinning of in-home traffic: per-session granularity is used for efficient utilization of uplink resources. Virtualization of the home gateway brings the promise of open networking to improve deployment of services independently from capabilities of the residential resources.

Virtual Home Gateway

Notes:

(1) http://www.cablelabs.com/wp-content/uploads/specdocs/CM-SP-RFIv2.0-C02-090422.pdf
(2) http://www.cablelabs.com/wp-content/uploads/specdocs/CM-SP-PHYv3.1-I08-151210.pdf