



VIRTUAL BROADBAND NETWORK GATEWAY EVOLUTION

SDN-enabled virtualized access solution (SDvAS)

Broadband network gateway evolution

The broadband network gateway (BNG) is a subscriber aware system that provides subscriber management, session management, and service edge functionality for the offered services. Traditionally, the BNG is implemented as a “centralized service edge” that provides services such as high-speed internet (HSI), video on demand (VoD), IPTV (multicast), VoIP, and business VPNs.

With the need to offer services requiring low latencies, such as AR and VR, gaming, etc., emerging architectures involve a distributed service edge closer to the subscribers. This also changes the system profile of the BNG from a typical chassis-based system to a distributed and disaggregated function using off-the-shelf white box switches and servers.

The BNG functionality could be implemented in white box switches that aggregate the optical line terminals (OLTs), distributed in the OLTs and the aggregating white box switches, or as virtual network functions (VNFs) in compute nodes. These options can be chosen based on the deployment requirements, considering the scale of the subscriber sessions and per-subscriber throughputs.



Disaggregated architecture solutions

The Capgemini Engineering SDvAS Virtual BNG (vBNG) solution provides a disaggregated architecture with separated control and forwarding planes. The BNG control plane can be run as a scalable VNF on a compute node that could be associated with multiple BNG forwarding planes on white box switches, OLTs, or on other compute nodes. The BNG control plane VNFs can be spawned based on policies that include dynamic monitoring of subscriber sessions.

The Virtual BNG provides standard BNG functions in a scalable manner – subscriber and session management functionalities with IPoE and PPPoE access modes. Functions such as edge routing or carrier grade NAT (CGNAT) can be provided by additional VNFs or appliances, or integrated as a vRouter enhanced with BNG and CGNAT functions.

As a virtualized solution, it brings in the advantages associated with NFV deployments, including the ability to be managed by an NFV MANO with life cycle management, and support high availability and load balancing across a set of virtual instances. vBNG also provides for elastic scaling based on relevant triggers, for example, subscriber sessions or throughput.



Capgemini Engineering SDvAS vBNG deployment models

The vBNG enables flexible deployment models across varying use cases.

Compute node based: Capgemini Engineering vBNG with Ethernity SmartNIC

With the control plane and forwarding plane as VNFs; the forwarding plane can be software based – Capgemini Engineering Fast Path Accelerator (FPA) based on Intel DPDK – or accelerated with hardware-based offloading using SmartNIC solutions. Capgemini Engineering vBNG supports Ethernity Networks' ACE-NIC SmartNIC for the vBNG data plane. Ethernity ACE-NIC Smart NICs are FPGA based, and support line rate packet processing on multiple 10GE or 25GE interfaces per SmartNIC, with a highly scalable number of sessions. With the SmartNIC based approach, the compute node CPU is freed up to handle more control plane functions and other smart application processing.

The Capgemini Engineering vBNG with the Ethernity SmartNIC provides a feature rich, highly scalable, and cost-competitive BNG realization. Compute nodes typically support four to six NICs with PCIe Gen3 or Gen4. Capgemini Engineering's vBNG with Ethernity SmartNICs supporting two to four 25GE interfaces, can realize the BNG with per compute node throughput of 300 to 600 Gbps. Each SmartNIC enables support for up to 256K subscriber sessions with PPPoE or IPoE, along with per-subscriber hierarchical QoS, and per-subscriber counters and statistics. The SmartNIC is configured for a full-offload of the BNG data plane, enabling the compute node x86 CPU availability for the BNG control plane and other smart edge applications.

Switch based: Capgemini Engineering vBNG on white box switches

With the forwarding plane on the white box ToR switch aggregating OLTs, or distributed in the leaf-spine fabric; the control plane runs either in the local CPU or VNF based

on compute nodes. White box switches based on Broadcom StrataXGS Tomahawk, or StrataDNX Qumran or Jericho, are supported for the BNG functions.

In this model, the Ethernet switches aggregating the OLTs are enhanced with the Capgemini Engineering vBNG functionality. This vBNG can be enabled on white box platforms with Broadcom Tomahawk or the Qumran or Jericho switches.

Distributed BNG: Capgemini Engineering vBNG on white box switches and OLTs

Distributed BNG with functions spread between access nodes (OLT) and an aggregator white box ToR switch or leaf-spine switch fabric. In this model, the BNG functionality can be enabled on white box switches based on Broadcom StrataXGS Tomahawk, or StrataDNX Qumran or Jericho. Specific BNG functions can be distributed to the OLT access nodes to enable higher scaling.

Capgemini Engineering BNG supports the ability to distribute specific per-subscriber functions to the access node (OLT) to achieve further scaling. In this approach, the BNG running on the white box switches also provides a chassis-like view of the whole OLT-BNG system.

This approach enables efficient aggregation of a large number of XGS-PON OLT systems and overlays the aggregation switches with BNG specific packet processing.

Capgemini Engineering SDvAS vBNG features

Virtualization functions

- Orchestrated from MANO for life cycle management, VNF parameters setting using descriptors
- Scalable 32K subscribers per VNF instance
- Elastic scale out design to support 256K subscribers on a compute node

Subscriber management

- Subscriber identification and IP address assignment
- Authentication through RADIUS
- Dynamic policy management
- Compliance to TR-101, TR-146 standards
- Support for PPPoE and IPoE

Redundancy and load balancing with MC-LAG

QoS

- Per-subscriber policing, classification, queueing
- Hierarchical scheduling (four levels)
- Video, voice, and HSI services

IPv6

- TR-178 - IPv6 capabilities
- Subscriber management
- IP address assignment using DHCPv6

Routing and CGNAT

- Static routing, OSPF, BGP, VRRP
- Multicast routing using PIM-SM, PIM-SSM

Support DPDK based forwarding, SmartNIC, or white box switches

About Capgemini Engineering

Capgemini Engineering combines, under one brand, a unique set of strengths from across the Capgemini Group: the world leading engineering and R&D services of Altran – acquired by Capgemini in 2020 – and Capgemini’s digital manufacturing expertise. With broad industry knowledge and cutting-edge technologies in digital and software, Capgemini Engineering supports the convergence of the physical and digital worlds. Combined with the capabilities of the rest of the Group, it helps clients to accelerate their journey towards Intelligent Industry. Capgemini Engineering has more than 52,000 engineer and scientist team members in over 30 countries across sectors including aeronautics, automotive, railways, communications, energy, life sciences, semiconductors, software & internet, space & defence, and consumer products.

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