WHITE PAPER

Communications Service Providers
Network Management and Orchestration

Brain4Net* and Intel Bring Integrated NFV/SDN Technology to Multiprotocol CommSP Networks

Brain4Net's NFV platform solution, leveraging Intel® technologies, combines NFV and SDN to help redefine management of CommSP networks.

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Overview

Software defined networking has great potential to improve data flows on communication service provider (CommSP) networks, and, when combined with network functions virtualization (NFV), help CommSPs to re-architect their networks to improve network throughput and agility, reduce the time required to deploy new services, and dramatically reduce operating and capital costs.

But SDN was not designed for complex, multiprotocol CommSP networks, and this has limited its adoption by CommSPs. Intel® Network Builders ecosystem member Brain4Net has developed its own integrated SDN/NFV solution that solves that problem today, enabling CommSPs to bring the full impact of both of these technologies into their networks.

Challenge

SDN and NFV are two emerging technologies with the ability to dramatically change the network architecture of communications service providers. SDN replaces hop-by-hop packet route decision making with a centralized control plane that calculates the path of data packets through network switches. SDN provides a centrally managed network architecture that delivers a more programmable and agile network that optimizes traffic flows to alleviate congestion. CommSPs leveraging SDN in their services can abstract network functionality in order to dynamically deploy new services very quickly regardless of the underlying networking technology. This is an important function because currently the management systems for CommSPs' metro Ethernet and multiprotocol label switching (MPLS) networks are not automated and require time-consuming and costly service configuration.

NFV allows CommSPs to deploy network services, such as firewall, routing, network address translation (NAT), and other applications running on commercial off-the-shelf Intel® architecture–based servers rather than using purpose-built appliances. NFV leverages data center virtualization enhanced to enable wire speed data plane operations. NFV permanently reduces the capital expense associated with deploying a new service and makes it possible to remotely deploy a new service that can speed the time to revenue for CommSPs.

NFV has been broadly embraced by CommSPs that have been active participants in standards bodies and have initiated a significant number of high-profile trials and proofs of concept. All of this work is leading to imminent NFV service deployments.

In comparison, CommSPs have been much slower to adopt SDN technology, even with the big benefits that it brings to their networks. This is because CommSP networks are more complex, geographically distributed, and heterogeneous than the all-IP networks where SDN has been deployed. Additionally, SDN's impact can

be limited by both the "silo-based" nature of CommSP networks and the lack of interoperability with legacy/traditional networks (e.g., IP/MPLS) that restricts SDN controllers from providing an end-to-end network management.

CommSP transport networks are dominated by MPLS-based switches and a mix of packet-based and circuit-based aggregation networks, including MPLS, Frame Relay, SONET, DS-3, and also IP. MPLS switches are designed to encapsulate all of these data types no matter what the layer two (MAC layer) technology involved. In fact, MPLS switches data at its own layer, the so-called layer 2.5, which has characteristics of layer two and layer three and provides the flexibility to accommodate circuit-switched and packet-switched networks.

With its high-availability features and focus on only the CommSP market, MPLS and other CommSP networking equipment has a much higher capital cost than equipment in the data center. Part of this high cost is due to the fact that every MPLS device has its own ASIC-powered control plane with sophisticated control plane software that facilitates end-to-end routing. With SDN, this can be replaced by an SDN controller that runs on an Intel architecture–based server. Furthermore, this equipment is expected to have a useful life of many years to come, which complicates the SDN rollout for CommSPs.

The developers of SDN have realized this challenge and started work on a new version of SDN that is better suited for CommSP networks. In a presentation in 2012, SDN co-inventor Scott Shenker, professor of computer science at the University of California at Berkeley, claims that he and his collaborators "ignored current systems," including MPLS,[1] when they were developing SDN technology. That's because the design of SDN enabled "simple packet forwarding," which wasn't successful in CommSP networks because "today's data planes are very complicated."[2]

Shenker is spearheading an effort to propose a new standard, dubbed SDNv2, as a way for SDN to deliver more value in a complex CommSP network.

Open Source Dilemma

But SDN faces another deployment challenge because of the open source nature of key technologies such as OpenFlow,* OpenDaylight,* and ONOS.* This software provides some of the key functionality for SDN networks with the development of each technology managed by its own open source consortium.

CommSPs require software that is hardened with unique reliability features in order to put it into production networks. Some of these features are not available in the general releases of SDN software, making it challenging for the operators to embrace the software in their core network.

SDN and NFV together provide synergistic tools for re-architecting service provisioning networks to answer today's market conditions where Internet service providers are challenging CommSPs with lower-cost networks and agile services. Harnessing the power of these technologies for CommSPs is the mission of Boston-based Brain4Net Inc.

Solution

Brain4Net's mission is to redefine management of CommSP networks to better leverage NFV and SDN technology. While there are many NFV platform solutions available for CommSPs, Brain4Net stands out as a unique, fully orchestrated solution that combines NFV and SDN. This allows CommSPs to get the maximum benefit from these technologies.

Through its work with carriers, the Brain4Net team had seen the challenge of applying NFV/SDN technologies across CommSPs metro and IP/MPLS networks. The company's B4N Service Platform* provides a logically centralized but physically distributed approach to managing CommSP metro networks. The solution enables CommSPs to operate their SDN and MPLS networks in parallel until they are able to phase out their MPLS routers in exchange for white-box switches based on SDN-based networking.

Some of the key components of the B4N Service Platform include:

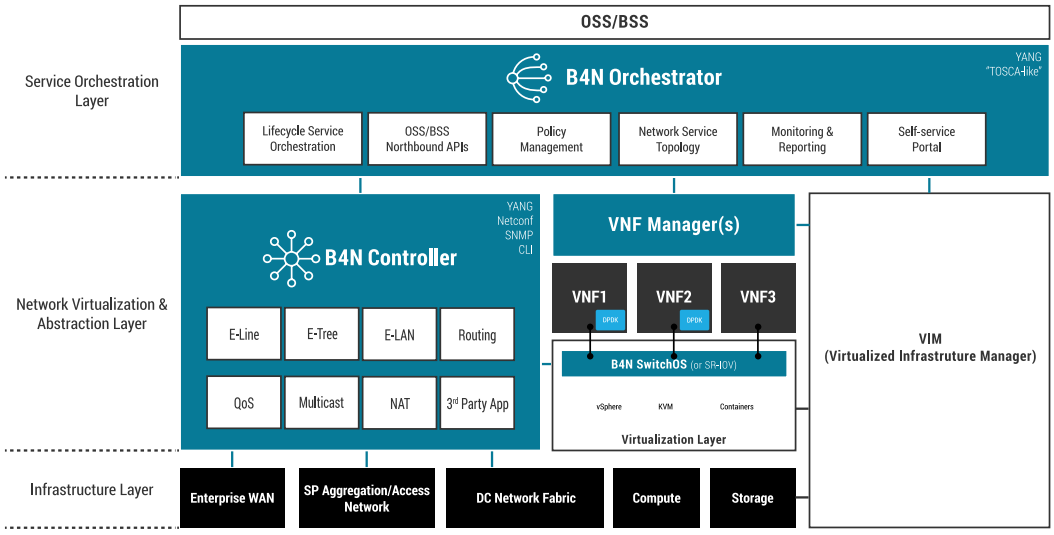

Figure 1. B4N Service Platform Overview

[1] Time for an SDN Sequel? Scott Shenker Preaches SDN Version 2: https://www.sdxcentral.com/articles/news/scott-shenker-preaches-revised-sdn-sdnv2/2014/10/

[2] The Dawn Of Nimble Networking: http://www.cae.cn/cae/html/files/2016-07/05/20160705100641811324023.pdf (PDF download)

B4N SwitchOS*: One of the key platform components is the B4N SwitchOS, multiplatform software that is used to create virtual switches on Intel architecture compute nodes or to enable OpenFlow-based SDN on bare-metal switches.

VNFs that reside on the compute node can leverage the virtual switching functionality to communicate with each other, or with other servers or the Internet via network controllers such as the Intel® Ethernet Controller XL710. The switches can be integrated with OpenFlow SDN controllers or with the company's own B4N Controller.* The B4N SwitchOS leverages the Intel-developed, open source Data Plane Development Kit (DPDK) libraries to deliver high-performance virtual switching.

B4N Controller: The B4N Controller brings SDN functionality into an NFV deployment and also creates a single SDN management domain spanning the entire CommSP network, from telco data center through the aggregation network to the MPLS transport network. The SDN-compliant controller develops and maintains network topologies for each data flow and then performs SDN path computation to provide a path through the network for that packet flow. The B4N Controller creates a unified SDN fabric consisting of OpenFlow-enabled bare-metal switches and vSwitches running in an OpenStack* or VMware* environment. The software allows service chaining of VNFs to facilitate the development of complex services that require a specific data path for added security or other packet processing needs.

Brain4Net can integrate the B4N Controller with a wide range of third-party VNFs and also offers its own VNFs that include network address translation, L3 switching, and others.

One key tool that helps CommSPs migrate customers to SDN is the B4N Routing VNF,* which helps CommSPs to migrate customers to SDN infrastructure without any service degradation and to provide L3 functionality in the SDN domain. CommSPs can use Routing VNF as a part of their network virtualization strategy to replace P/PE routers with a distributed approach.

The B4N Routing VNF is a distributed PE-Router that is designed to help CommSPs automate layer-three VPN (L3VPN) service provisioning. The B4N Routing VNF provides global control plane services, using control plane protocols like ARP, ND, BGP and management plane protocols like CLI, REST, NETCONF, SSH, and Telnet while providing the full stack of routing protocols (MP-BGP, OSPF, ISIS, etc.). Data forwarding in this scenario is provided by bare-metal switches under control of B4N Controller.

B4N Orchestrator*: The unifying element in the solution is the B4N Orchestrator, which manages both the SDN controllers and also the NFV environment. The software communicates with traditional CommSP operational support and billing support systems (OSS/BSS) via APIs developed using REST, NETCONF, or Java. It can also interface with SNMP- or CLI-based network management systems.

The orchestrator can then provide complete service lifecycle management of VNFs and their related components to allow scaling of these applications across multiple servers, if needed, to deliver high-volume services. The orchestrator also provides policy management and service monitoring and reporting that can be communicated to the OSS or NMS. Among the management functions is a self-care portal that lets end customers manage their own services.

Brain4Net is committed to interoperability and has developed its solution to run on an Intel architecture-based server and be open to any third-party VNF. The B4N Orchestrator enables users to quickly and easily integrate its own VNFs as well as third-party VNFs by using ETSI-compatible VNF descriptors. The company has a growing ecosystem that ensures interoperability with all relevant hypervisor and container software and also with virtualized infrastructure management solutions.

vE-CPE Use Case

An important use case for the Brain4Net solution is virtual enterprise customer premises equipment, also known as vE-CPE or virtual branch. According to the 2016 NFV Strategies Service Provider Survey conducted by IHS Group,[3] nearly 90% of surveyed CommSPs named vE-CPE as their most important NFV use case for revenue generation. The B4N Platform Software solution offers a unique advantage for business vCPE applications.

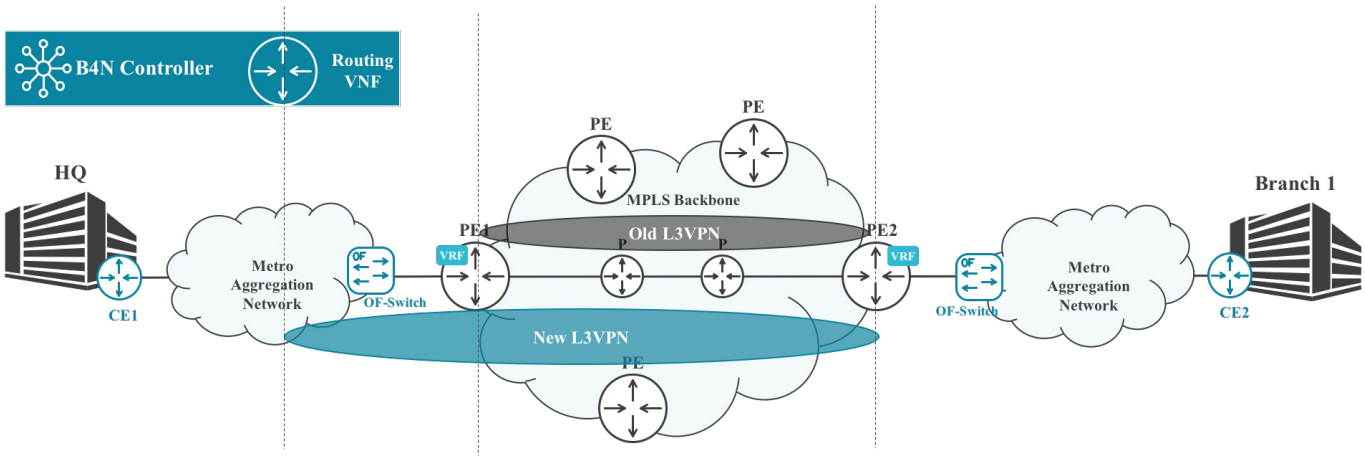

Figure 2. L3VPN in SDN Network

[3] RESEARCH NOTE - Most Service Providers Will Deploy NFV by 2017; https://technology.ihs.com/582741/research-note-most-service-providers-will-deploy-nfv-by-2017

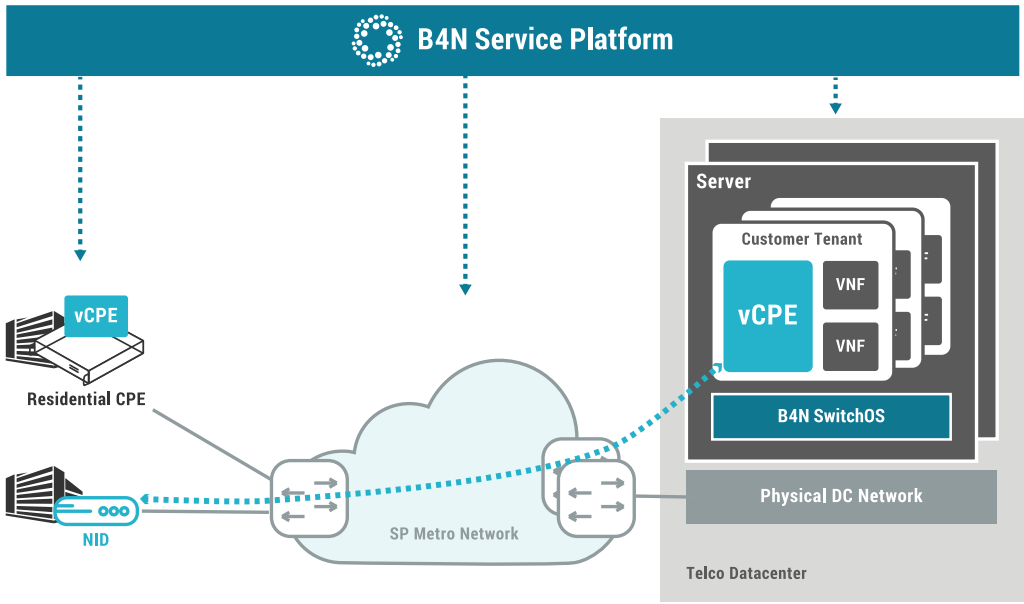

Figure 3. Brain4Net vE-CPE Use Case

The Brain4Net solution creates a unified SDN switching fabric using the B4N Controller to manage OpenFlow switches in a metro network and B4N SwitchOS virtual switches on the NFV server, which can be on the customer premises or in the cloud. This vE-CPE network is tied into the broader CommSP metro and access network with the B4N Orchestrator, which uses the SDN switching fabric to deliver customer traffic from access network to NFV servers in the telco data center.

Some of the features of the vE-CPE include:

Any Service Location: The B4N vE-CPE can be scaled to provide the best fit solution, regardless of whether it's serving a point of presence or a residential location.

Unified Network Fabric: The B4N Service Platform integrates physical networks with virtual networks, which enables the CommSP to provide the connectivity between vE-CPE in the cloud and customer network interface devices (NIDs), creating an end-to-end SDN fabric spreading from an access network to the egress ports of telco data center.

Virtualization Options: B4N Service Platform supports both VMware and OpenStack virtualized infrastructure managers (VIMs) for a vE-CPE solution that can be implemented on existing infrastructure.

Lifecycle Service Orchestration: The B4N Service Platform provides lifecycle service orchestration (LSO) and resource management that can be flexibly deployed in the cloud, at the point of presence, or embedded at the customer site.

Integration with Third-Party Systems: B4N vE-CPE solution supports RESTful API to OSS/BSS systems and third-party orchestrators.

Powered by Intel® Technologies

Intel technologies play a key role in the performance of the Brain4Net software, starting with the software being optimized for servers that are powered by Intel® Xeon® processor E5 v3 or Intel Xeon processor E5 v4. Intel Xeon processors E5 support workloads for cloud, high-performance computing, networking, and storage and have become Intel's leading CPU for SDN and NFV implementations.

In order to maximize packet throughput on Intel architecture–based servers, Brain4Net has developed its platform software using the Data Plane Development Kit (DPDK), an open source set of libraries and drivers for fast packet performance. Through poll-mode drivers, ring buffers, and huge page memory functionality, Brain4Net has achieved excellent performance in its SwitchOS, NFV, and other key parts of its platform software.

The Brain4Net Service Platform also leverages Intel® QuickAssist Technology, a hardware acceleration capability that provides fast processing of encryption and security workloads. In SDN and NFV applications, Intel QuickAssist Technology delivers greater flexibility and agility when compared to fixed-function compute environments.

Conclusion

With SDN and NFV remaking their networks, CommSPs are in a better position to offer new services to customers and generate new revenues. Through its work with Intel technologies and the Intel Network Builders program, Brain4Net has developed its Brain4Net Platform Software, which provides a synergistic NFV/SDN solution that allows CommSPs to benefit from these technologies today.

About Brain4Net Inc.

Brain4Net Inc. is an innovative SDN/NFV solution provider for enterprises and service providers. The Brain4Net Platform provides a comprehensive network orchestration and control solution for multivendor network infrastructure. The firm's approach helps organizations bring agility to the network, improve network service chaining, and reduce both capital and operational expenditures for network infrastructure deployment and operations. For more information about Brain4Net Inc.: https://brain4net.com.

About Intel

Intel (NASDAQ: INTC) is a world leader in computing innovation. The company designs and builds the essential technologies that serve as the foundation for the world's computing devices. As a leader in corporate responsibility and sustainability, Intel also manufactures the world's first commercially available "conflict-free" microprocessors.[4] Additional information about Intel is available at newsroom.intel.com and blogs.intel.com and about Intel's conflict-free efforts at conflictfree.intel.com.

Abbreviations

ASIC	Application-Specific Integrated Circuit
ARP	Address Resolution Protocol
BGP	Border Gateway Protocol
CLI	Command Line Interface
IS-IS	Intermediate System to Intermediate System
MAC	Media Access Control
MP-BGP	Multiprotocol Extensions for Border Gateway Protocol
ND	Neighbor Discovery
NETCONF	Network Configuration Protocol
NID	Network Interface Device
OSPF	Open Shortest Path First
REST	Representational State Transfer
SSH	Secure Shell

[4] "Conflict-free" refers to products, suppliers, supply chains, smelters, and refiners that, based on our due diligence, do not contain or source tantalum, tin, tungsten or gold (referred to as "conflict minerals" by the U.S. Securities and Exchange Commission) that directly or indirectly finance or benefit armed groups in the Democratic Republic of the Congo or adjoining countries.