Unleash Innovation and Restore ARPU Growth with Benu Networks' Virtual Service Edge Platform

Virtual CPE Architecture Moves Service Control to the Provider Edge

EXECUTIVE SUMMARY

Benu Networks' Virtual Service Edge (VSE) platform accelerates the delivery of value added next generation residential and small/mid-size business (SMB) services that take back the customer relationship and restore average revenue per user (ARPU) growth. Leveraging a tiered, software-centric architecture and standards-based network functions virtualization (NFV) technology, Benu Networks' solution moves critical network functions from the customer's site into the service provider's network, creating a fully programmable network layer on a highly virtualized service delivery platform.

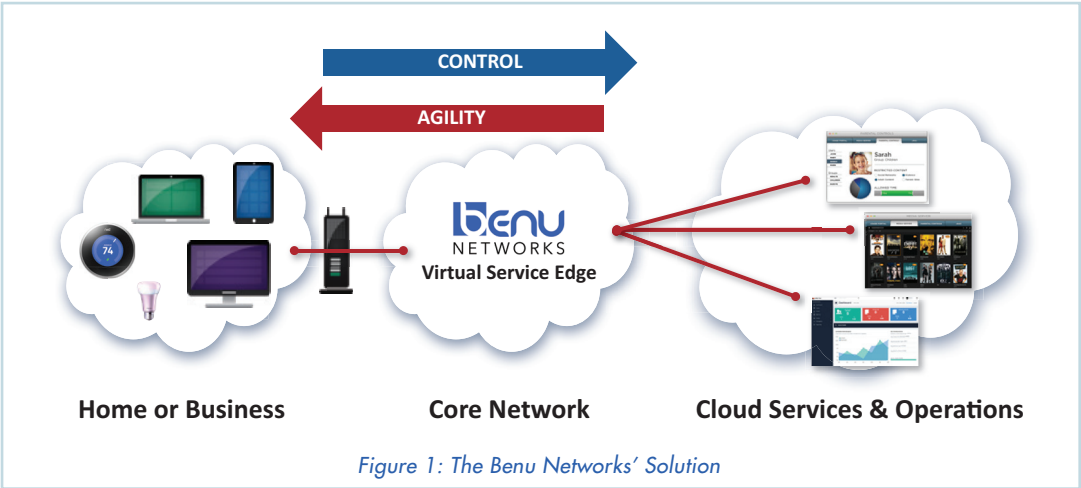

Figure 1: The Benu Networks' Solution

Benu Networks' solution reduces the time, effort, and expense required to introduce value added, high-margin services by moving the IP networking function control from the customer premises equipment (CPE) (e.g. xDSL or cable modem router) into a virtualized platform deployed in the core network. The operator's service delivery control, originally stopped at the CPE/Router, now expands to controlling the end-user device experience and network slicing service delivery to all devices in the home or business.

Benu Networks' Virtual Service Edge platform enables a wide range of differentiated residential and small business services, delivering breakthrough economics, and service agility with carrier-grade reliability and scalability.

INTERNET SERVICE PROVIDER AND CABLE MULTIPLE-SYSTEM OPERATOR CHALLENGES – MARGIN EROSION AND CUSTOMER CHURN

Today's Internet service providers (ISPs) and cable multiple-system operators (MSOs) face a variety of business challenges. Operators are under constant pressure to expand broadband capacity, extend service reach, and increase differentiation. However, legacy broadband access network architectures have evolved in a way that inhibits innovation, hinders service agility, and impairs profitability. Consumed by intelligent, heavy weight broadband gateways, operators are unable to exert control over individual devices or sessions to enable differentiated services.

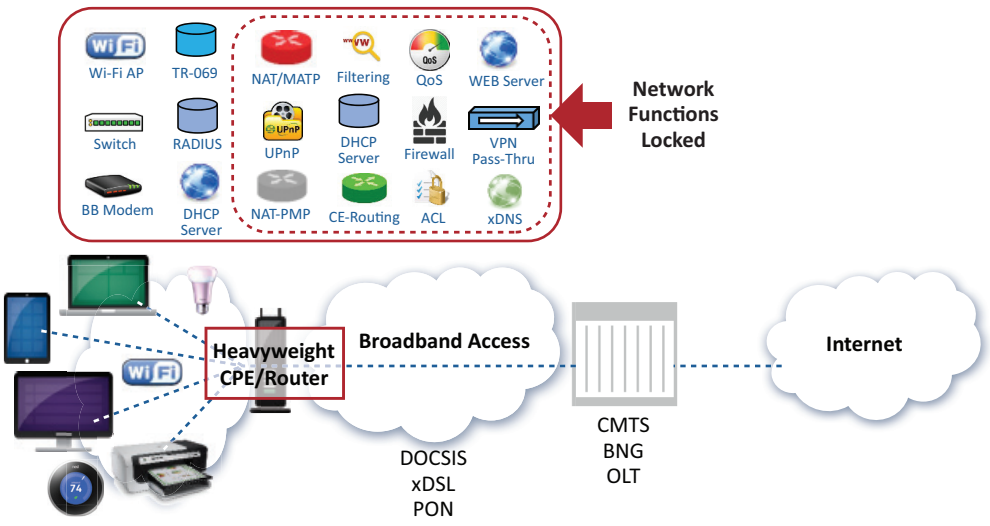

Figure 2: Legacy Network Architecture

In addition, traditional broadband access networks are notoriously difficult and expensive to support because the customer edge router (CER), embedded in the CPE, blocks service control at the device and session level. A service provider's help desk personnel lack visibility beyond the customer gateway into the home or the small business network. Help desk personnel often squander time and money troubleshooting issues that ultimately are not associated with the service provider's equipment or network infrastructure.

From a competitive standpoint, many residential and small business customers are turning to cloud-based services and over-the-top (OTT) providers for core telecommunications services and IT functions. These services move the network intelligence to the cloud, and feature consumer-oriented, easy-to-use interfaces for managing home and business networks in an intuitively simple way. If this continues, ISPs and MSOs risk becoming commodity data providers while OTT providers seize the customer relationship and the revenue streams that go with it – advertising, customer analytics, and premium services. To add insult to injury, OTT content providers (e.g.: Netflix, Amazon, Google, and Apple) are all making money at the expense of the network operators.

Industry analysts project consumer Internet video traffic to grow at a staggering 30% CAGR from 2013 to 2018, to account for 79% of all consumer traffic by 2018. Cable MSOs and fixed line operators must make massive network upgrades to support skyrocketing IP video traffic growth, while the content providers are profiting from their infrastructure investments!

Going forward, ISPs and MSOs must identify new ways to monetize infrastructure investments, win back customer relationships, and rekindle revenue and margin growth. Forward-looking service providers are implementing network-based services – moving advanced network functions from the customer premises into the operator network – to improve service agility, contain costs, and enable differentiated applications.

New virtual Customer Premises Equipment (vCPE) based network architectures let operators efficiently launch new micro-services at the device and session level to drive ARPU growth without investing in new customer premises equipment which is expensive and technically complex. In addition, the vCPE architecture extends help desk visibility all the way to the customer's endpoint, thereby streamlining problem identification, isolation and resolution tasks, improving customer care, and overall subscriber satisfaction.

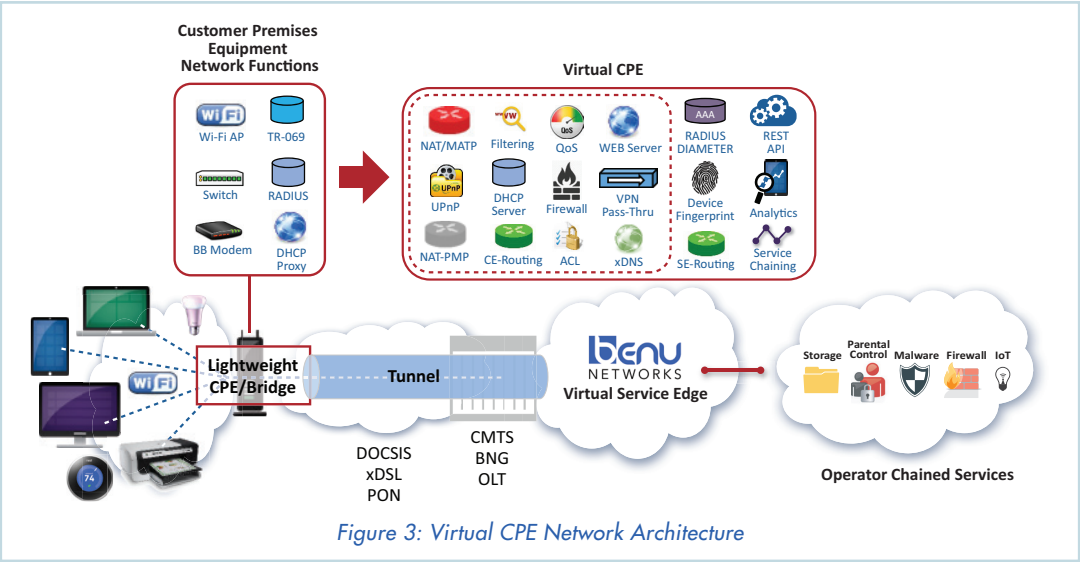

Figure 3: Virtual CPE Network Architecture

INTRODUCING BENU NETWORKS' VIRTUAL SERVICE EDGE PLATFORM

Benu Networks' Virtual Service Edge (VSE) platform helps MSOs and ISPs accelerate the introduction of value added, network-based residential and SMB services that combat OTT threats, curb subscriber churn, and restore margin and revenue growth. Benu Networks' innovative vCPE architectural framework moves key network functions from the customer premises equipment into the service provider's network – creating a highly programmable, fully virtualized, service delivery platform.

The VSE, deployed in the service provider's cloud, is a purpose built, multi-tenant set of network applications that provide the complete suite of CPE network services and business logic. The VSE moves the IP router logic previously locked in a vendor-specific CPE, and makes it open, available, and part of the service provider's native service offering. Conventional customer gateways are re-purposed as lightweight, agile network termination units (NTUs).

With the VSE architecture, service providers can activate a new service for millions of subscribers instantly by simply deploying software in the cloud. The lightweight premise-based equipment requires minimal configuration, or other changes; the services are fully instantiated in the service provider's network. This simple but fundamental architectural transformation has a profound impact on the pace of innovation, and the economics of new services, and the service provider's bottom line.

Benu Networks' Virtual Service Edge Platform (VSE): Residential and Consumer Market Opportunities

The VSE platform lays the foundation for a wide array of network-based, residential market applications including:

- **Internet of Things (IoT) Solutions:** Home monitoring, control, and security applications
- **Consumer IT Applications:** Cloud-based storage, backup, media sharing, and Internet security services
- **Advanced Entertainment Offerings:** Online gaming, music, and TV-to-go services
- **Carrier Wi-Fi Services:** Extended service reach via Wi-Fi HomeSpots and HotSpots
- **Family Broadband Packages:** Family plans with parental controls for regulating and monitoring Internet access based on time-of-day, content, or application
- **Contextual Applications:** Micro-targeted advertising, location-based services, and business intelligence wholesaling using data analytics

Benu Networks' VSE solution lets providers accelerate service velocity by eliminating CPE dependencies which helps to improve the bottom line and accelerate time-to-market by avoiding expensive and time-consuming CPE evaluation, certification, integration, and support efforts. The solution also streamlines customer support by moving business logic from the customer premises equipment to the cloud, this provides the service provider with full visibility all the way to the subscriber's device.

Benu Networks' VSE platform enables a wide range of differentiated services for both residential and SMB markets. Rich instrumentation provides deep visibility into customer traffic to support data analytics, or enable contextual applications such as location-based services and targeted advertising. In addition, the cloud-based framework facilitates user-centric, device-agnostic services that span access networks, so that operators can extend service reach and foster customer loyalty.

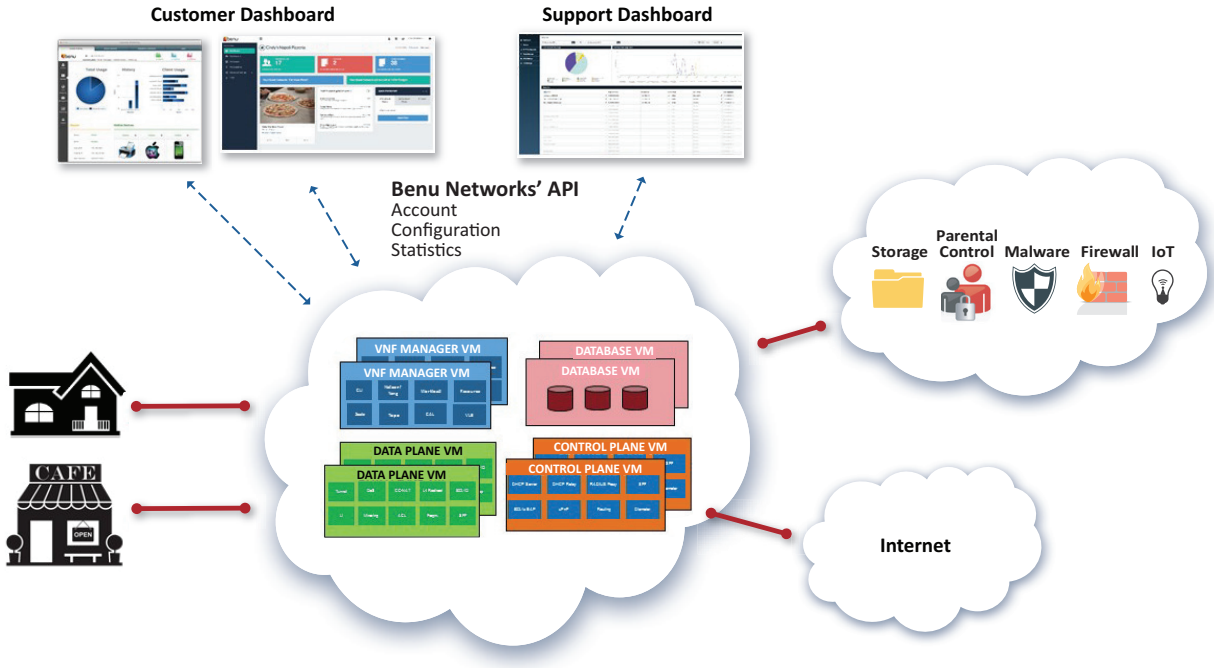

Figure 4: Benu Networks' VSE High Level Architecture

A HIGHLY AGILE AND PROGRAMMABLE SOFTWARE-CENTRIC ARCHITECTURE

Benu Networks' VSE leverages an open, tiered, software-defined architectural model with distinct infrastructure, control, and application layers to achieve superior scalability and agility. The layered architecture streamlines automation and operations by decoupling the network data plane (the networking infrastructure) from the network control plane (the control logic), and by providing abstract, system-wide application programming interfaces (APIs).

Abstract APIs accelerate time-to-market for new services, streamline integration with operations support systems (OSSs) and business support systems (BSSs), and eliminate manually intensive, error-prone configuration management and troubleshooting tasks.

Ordinary web developers, who aren't necessarily well versed in telecommunications, can introduce new cloud-based applications quickly and easily. Distinct services can be "chained" together to spin up or to test market new applications rapidly and cost-effectively.

Front-end portal developers can display real-time customer data using APIs, without special integration to network management systems, and without polling or waiting for data consolidation. Customer care systems can access rich, real-time instrumentation about the network, services, devices, and locations.

Benu Networks' Virtual Service Edge Platform (VSE): SMB Market Opportunities

Benu Networks' VSE enables a wide variety of SMB market applications including:

- **Cloud-Based Network Services:** Firewall, intrusion detection and prevention, bandwidth management and network optimization, user authentication, and authorization services
- **Hosted IT Services:** Cloud-based storage, backup, and file sharing solutions
- **Internet of Things (IoT) Applications:** Facility surveillance, control, and security systems
- **Managed Wi-Fi Services:** Provider installed and operated Wi-Fi networks
- **Carrier Wi-Fi Services:** Extended service reach via public HotSpots and roaming/peering relationships

A HIGHLY FLEXIBLE AND COST-EFFECTIVE NETWORK FUNCTION VIRTUALIZATION IMPLEMENTATION

Benu Networks' VSE leverages standards-based Network Function Virtualization (NFV) technologies for ultimate flexibility and economics. Key network applications and services, such as firewalls, deep packet inspection and filtering, quality-of-service (QoS) marking, device fingerprinting, and data analytics are virtualized and instantiated in software within the service provider's network.

The solution runs on popular hypervisors, such as VMware and KVM, residing on industry-standard x86 servers, leveraging OpenStack and other virtualization technologies. By virtualizing and consolidating a variety of networking functions onto common commodity hardware, service providers can contain CAPEX and OPEX costs, accelerate time-to-market, and eliminate vendor lock-in.

The open, tiered, software-defined architectural model and NFV implementation enables pay-as-you-grow scale-out architectures. Service providers can tightly align upfront capital investments with business demand, to avoid upside-down business models with long payback periods. Physical servers and virtual machines can be added to the network as needed in an incremental fashion to accommodate growth.

Virtual Wi-Fi Network Offerings for SMBs

With Benu Networks' VSE, service providers can segment managed Wi-Fi networks into discrete virtual networks with distinct security and QoS privileges to support multiple tenants or user communities, such as:

- **Private Wi-Fi Networks:** For employees and machine-to-machine traffic
- **Guest Wi-Fi Networks:** For visitors in private business settings
- **Community Wi-Fi Networks:** For guests in public businesses such as cafes, retail stores, medical offices, and hospitality establishments
- **Multi-tenant Wi-Fi Networks:** For property and event management companies

PURPOSE BUILT FOR THE CLOUD

Unlike legacy monolithic edge routers or broadband remote access servers, both of which have been repurposed for NFV deployments, Benu Networks' VSE solution was designed from the ground up for today's on-demand applications and elastic service environments. The deconstructed, software-centric architecture enables high scalability, performance, reliability, and flexibility.

Key features include:

- The network control plane and data plane can be scaled independently for better economics.
- Network functions can be distributed across physical or virtual machines to balance performance.
- Network functions can be migrated across servers or data centers (i.e. using vMotion) to ensure high availability or to enable disaster recovery.
- Centralized management and application programming interfaces enable the entire distributed system to be administered and automated in a cohesive fashion.
- The solution is inherently architected for multi-tenant environments; individual customers can be securely partitioned into distinct virtual instances with discrete administrative interfaces and APIs.

DRIVE ARPU GROWTH AND BOOST CUSTOMER SATISFACTION

Benu Networks' VSE platform delivers breakthrough economics and service agility, this helps MSOs and ISPs gain a competitive advantage with high margin, high value, network-based services. It is the ideal vehicle for rejuvenating business growth in today's ultra competitive business climate.

BENU NETWORKS' VIRTUAL SERVICE EDGE: BUSINESS BENEFITS FOR MSOs AND ISPs

- Rekindle revenue and margin growth with differentiated services; move up the value chain, retake the customer relationship, curb subscriber churn, and combat OTT and MNO threats.
- Streamline customer turn-up and support; eliminate truck rolls, automate provisioning tasks, and simplify remote operations, administration, and maintenance functions.
- Accelerate time-to-market; break dependencies on CPE vendors, expediently tie into existing OSS/BSS systems and practices, and cost-effectively launch new high-margin services quickly.
- Avoid upside-down business models; minimize up-front capital expenditures, enjoy faster investment returns, and test-market new applications and services in the cloud.
- Deliver carrier-grade services; ensure carrier-class reliability, availability, serviceability, and scalability.
- Improve total cost of ownership; minimize CAPEX and OPEX, consolidate network functions onto virtualized commercial off-the-shelf servers, pool resources, and eliminate inefficiencies and overhead.

SUMMARY: BENU NETWORKS' vCPE ARCHITECTURE CAN RESTORE ARPU GROWTH

Looking for innovative ways to combat OTT and MNO threats? Eliminate CPE constraints and unleash innovation with Benu Networks' VSE platform. Advanced network-based services can help you take back the customer relationship to restore revenue and margin growth. Contact Benu Networks today to learn more about the business benefits and functional advantages of Benu Networks' Virtual Service Edge platform.

ABOUT BENU NETWORKS

Benu Networks' carrier-class Virtual Service Edge (VSE) software platform enables the rapid creation and delivery of next generation IP services over a converged infrastructure, and empowers service providers to increase revenue, expand market leadership, and meet the dynamic needs of their business, residential and mobile customers.

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