INTEL® NETWORK BUILDERS
SOLUTION BRIEF

RAD* AND INTEL – MAXIMIZING VCPE FLEXIBILITY

Your Network's Edge

Overview

The virtual customer premises equipment (vCPE) is a prime candidate for initial commercial deployment of network functions virtualization (NFV), especially for business services. For service providers, the sweet spot for virtual CPE lies in hardware abstraction and the ability to carry out shorter and more flexible deployment cycles for new services.

While the vCPE model allows networking functionality to be located at the data center or other network locations, the distributed approach to NFV (D-NFV) places virtualized networking functions (VNFs) wherever it makes the most functional and economic sense, be that at the data center, point of presence (PoP), or the customer premises.

As shown in Figure 1, some virtualized functions are placed at the customer edge due to performance, bandwidth efficiency, security, survivability, and quality of experience benefits.

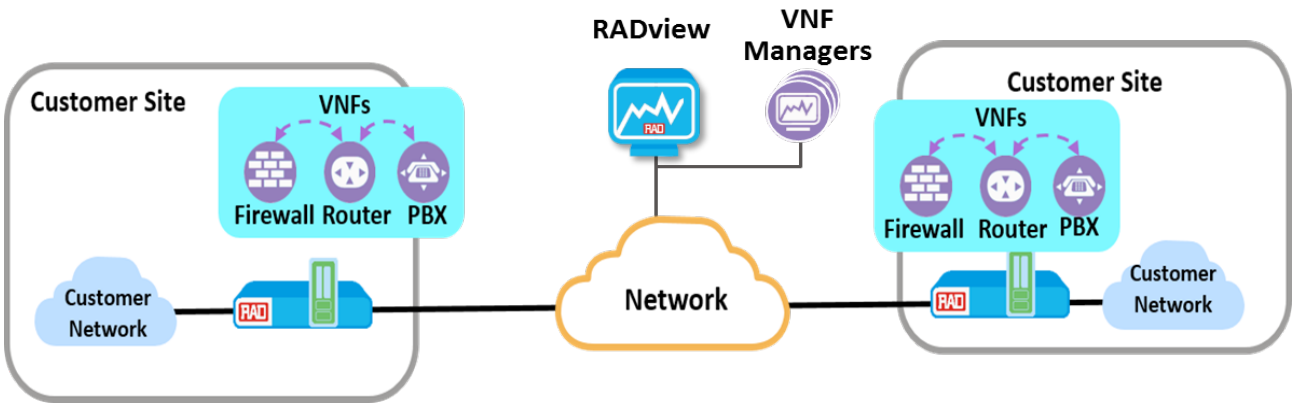


Figure 1. vCPE at the Customer Edge

RAD,* working with Intel® components, technology, and partnerships, has developed a vCPE platform for use at the customer edge. The ETX-2i* combines a network interface device/network termination unit (NID/NTU) with an Intel® x86/Linux*–based server for hosting VNFs.

Challenge

The business vCPE is a virtualized networking appliance at the customer edge that delivers communication services to enterprises, whereby at least some of the networking functionality associated with conventional customer premises equipment is virtualized. Conventional appliance-based CPEs entail slow, expensive deployment processes, which are no longer acceptable in today's market. What once has been a collection of single-purpose, hardware-based devices at each customer location (e.g., a router, load balancer, firewall, etc.) has been transformed, in the vCPE model, into virtualized appliances — running on a single server — that can be dynamically added or dropped as needed.

Some functions are best located near the end user for bandwidth optimization and effectiveness:

- Traffic-monitoring, rate limiting, and diagnostic tools, when run locally, can avoid the latency, ambiguity, and reliability issues associated with running such functions remotely at a data center.
- IP-PBXs are better when run in the customer premises because they would otherwise have to round-trip local calls to a remote network, or might lose local connectivity due to networking or data center problems.
- WAN optimization tools can have reduced effectiveness if implemented in the service provider data center.
- End-to-end quality of service (QoS) processing can immediately allow bandwidth prioritization on the external link when run on the customer premises.
- Finally, security applications, including firewalls and VPNs, reduce transmission of confidential data when they run locally.

This means that adequate virtualization infrastructure must be placed at the customer premises. In addition, all CPE virtualization scenarios include physical service termination equipment at the customer premises, as defined in the European Telecommunications Standards Institute (ETSI) GS NFV 001 (NFV Use Cases) paper.[1] Effective performance of such equipment, especially for high access rates and premium SLAs, is assured with hardware-embedded data forwarding and service demarcation capabilities (e.g., packet forwarding, traffic queuing and prioritization).

Solution

RAD's flexible vCPE solution supports virtualization at the customer edge and in the network for L2/L3 services. It is a complete solution that includes virtualization devices, physical CPE (pCPE) devices, pluggable devices to accelerate server performance, and management and orchestration (MANO) for the network edge, and is enhanced by the RAD D-NFV Alliance, an ecosystem of vendors and international system integrators specializing in new NFV applications. RAD pre-tests and certifies all Alliance partners' applications, which address mission-critical communications needs.

A cornerstone of the solution is the ETX-2i, a D-NFV platform integrated with an advanced L2/L3 NID/NTU. Its NID offers state-of-the-art traffic management, full end-to-end service control and monitoring, service turn-up, and full diagnostics. The key differentiator of the ETX-2i is the optional plug-in D-NFV virtualization card, a module based on Intel® Core™ i7 and Intel® Atom™ processors, which can host multiple VNFs from various vendors. An ETX-2i is shown in Figure 2, including the D-NFV plug-in module.

[1] http://www.etsi.org/deliver/etsi_gs/NFV-SWA/001_099/001/01.01.01_60/gs_NFV-SWA001v010101p.pdf

Figure 2. RAD's ETX-2i vCPE

This hybrid device offers the critical components and options needed in PoP or customer premises equipment. The physical interface includes network interface and termination functions, including:

- Switching
- Service assurance
- Circuit emulation
- Timing, using SyncE and PTP (IEEE 1588-2008)
- Multiple uplink technologies (ETH/DSL/TDM)

The D-NFV plug-in module can be used for standard and value-added services, including:

- Routing
- Diagnostics and testing
- Firewall
- Intrusion detection and prevention
- Antivirus
- Encryption/VPN
- WAN optimization
- IP telephony

RAD's ETX-2i can be used for value-added services characterized by high networking costs and stringent performance requirements (e.g., international business services). It also allows easy migration to NFV services with "pay-as-you-grow" flexibility, as no initial investments in data center upgrades or network-wide orchestration systems are required.

RAD has developed a service-oriented flow treatment (SOFT) feature in order to direct traffic flows between external interfaces and VNFs, taking advantage of the tight integration between the ETX's FPGA-based demarcation entity and the virtualization platform. As shown in Figure 3, information flows can be programmed to be passed through, forwarded to a VNF, mirrored to a VNF, or switched between interfaces to enable handling of user traffic according to specific services/applications. This boosts application performance and allows only relevant traffic to be handled by the virtualized platform, resulting in resource savings and greater capacity to handle additional VNFs.

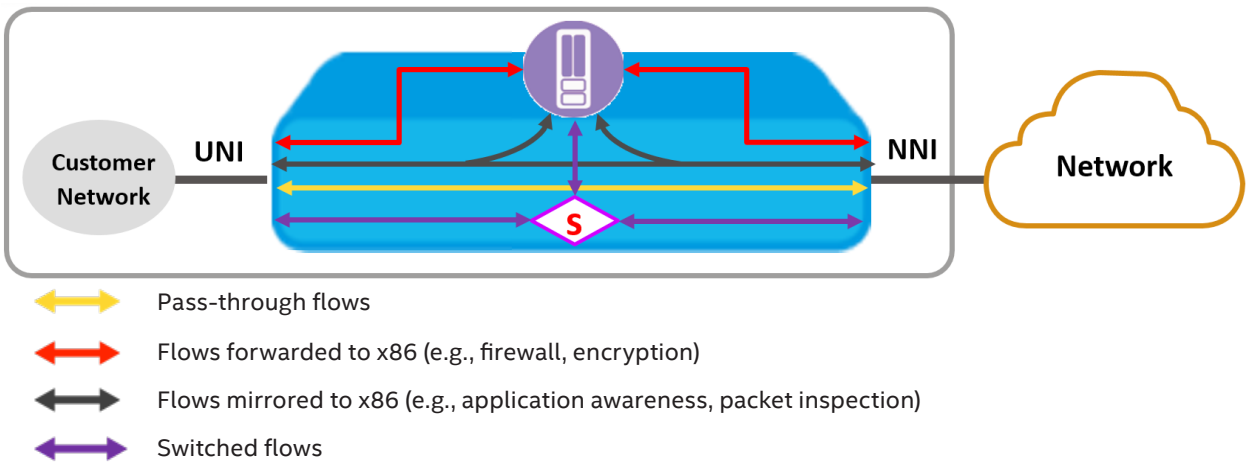


Figure 3. Service-Oriented Flow Treatment

The RADview management and orchestration solution converges the management of both physical and virtualized entities and can be used by customers or service providers for end-to-end operation control of multi-site, multi-customer networks. An open API facilitates automation with higher layer orchestration and OSS/BSS systems.

The ETX-2i has multiple high-speed interfaces and VNF service chaining, making it critical that network traffic be handled at line rate. This requires that the most advanced Intel® supported hardware and techniques be used to optimize traffic flow. RAD uses a number of Intel supported technologies, including:

- **Data Plane Development Kit (DPDK)** – the DPDK software library routes network packets around the Linux OS kernel and vSwitch. Coupled with network drivers and an optimized run-time environment, significant network performance can be achieved compared to a classical virtual environment.
- **Intel® QuickAssist Technology**– offers easy integration for built-in accelerators, employing a hardware-assisted security engine for implementing major security processes. It accelerates and compresses cryptographic workloads by offloading the data to hardware capable of optimizing those functions.
- **Hyperscan** – an optimized pattern-matching library that can be used to detect large numbers of patterns in blocks or streams of data. It is especially useful in security applications such as intrusion prevention (IPS), antivirus (AV), unified threat management (UTM), and deep packet inspection (DPI).

Benefits

RAD's multi-function ETX platform...

- Minimizes time-to-market and time-to-revenue
- Minimizes capital expenditure in data centers prior to vCPE service launch
- Optimizes CPU and FPGA resource usage to maximize speed and application performance using SOFT
- Increases flexibility related to the ability to host VNFs anywhere
- Provides an invest-as-you-grow model, with customer-edge compute resources expanding as more users are connected
- Maintains local policy, security and access control on premises
- Can be used to implement regulatory restrictions

Conclusion

The customer edge is the optimal place for many networking, security, and value-added applications. RAD's D-NFV vCPE technology, combined with the NID/NTU needed to terminate external links, is the perfect platform to host the wide variety of applications that are best located at the network edge.

The economic benefits associated with replacing multiple appliances within one box are immediately apparent. RAD's ETX-2i also provides a convenient means for enterprises to experiment with NFV technology in a setting that leaves them fully in control and provides them with needed experience for scaling these functions into the cloud.

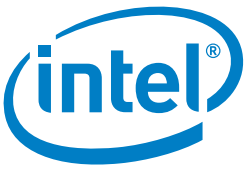
Intel's x86 platform and supported Linux enhancements provide the hardware and software necessary to operate at the speeds required by high-speed networks.

About RAD

RAD is a global telecom access solutions and products vendor. Since 1981, RAD has pioneered innovative technologies that are designed to boost performance and improve the way service providers compete. For mobile, business and wholesale service providers, RAD offers award-winning Service Assured Access solutions, delivering better QoE (Quality of Experience), service agility and complete visibility of network performance to reduce churn, minimize time to revenue and enable greater operational efficiency. Having run Distributed NFV (D-NFV) PoC (Proof of Concept) testing with major carriers since mid-2013, RAD has become the industry leader in virtualization at the customer edge, allowing fast provisioning of value added offerings and low risk, cost effective migration to programmable networks. RAD has an installed base of more than 14 million units, and works closely with Tier 1 operators and service providers around the globe. RAD is a member of the $1.25 billion RAD Group, a world leader in communications solutions.

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.[2] 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.



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[2] Conflict free" and "conflict-free" means "DRC conflict free", which is defined by the U.S. Securities and Exchange Commission rules to mean products that do not contain conflict minerals (tin, tantalum, tungsten and/or gold) that directly or indirectly finance or benefit armed groups in the Democratic Republic of the Congo (DRC) or adjoining countries. We also use the term "conflict-free" in a broader sense to refer to suppliers, supply chains, smelters and refiners whose sources of conflict minerals do not finance conflict in the DRC or adjoining countries.