Solution Brief

Communications Service Providers
Virtualized Broadband Remote Access Servers

Accelerating Virtual BRAS Data Plane Throughput

Intel® Xeon® Scalable processor-powered Advantech SKY-8000 Servers with Ethernity FPGA-based SmartNIC provide processing power for virtualized broadband remote access servers (vBRAS).

Executive Summary

Communications service providers (CommSPs) are growing more confident in the ability of network functions virtualization (NFV) to deliver carrier-grade voice and data services. This is thanks to the maturing NFV ecosystem and the growing number of virtualized customer premises equipment (CPE) deployments and trials of virtualized core network applications.

Now CommSPs are looking to virtualize very high throughput systems such as broadband remote access servers (BRAS). A BRAS is a dedicated device in a service provider network in which multiple internet traffic sources converge for connection to the access network. The BRAS (also known as a broadband network gateway, or BNG) must terminate subscriber point-to-point protocol over Ethernet (PPPoE) tunnels and routing traffic to and from digital subscriber line access modules (DSLAMs).

Virtualizing the BRAS is challenging because the data plane must be highly scalable to handle widely fluctuating throughput levels and numbers of simultaneous tunnels. It must also support a wide range of network functions from subscriber authentication to routing, service policy control, content filtering, and IP address management.

Advantech and Ethernity, both Intel® Network Builders partners and members of the Intel Network Builders Network Edge Ecosystem, have built a server solution for advanced vBRAS solutions. The solution combines Advantech's Intel® Xeon® Scalable processor-powered SKY Edge Servers with Ethernity's FPGA-based ACE-NIC data processing and acceleration cards and can work with a number of different vBRAS virtual network functions (VNFs).

The Challenge of Virtualizing BRAS

Broadband remote access servers (BRAS) are specialized hardware devices that sit at the edge of a service provider's core network and route traffic to and from subscribers (see Figure 1 for a virtualized BRAS implementation). BRAS serve as the main gateway element with the following tasks:

- Aggregate data from one or more customer premises access devices.
- Provide layer 2 connectivity through either transparent bridging or PPPoE.
- Enforce quality of service (QoS) policies, service level agreements (SLAs), and billing.
- Provide layer 3 connectivity and route IP traffic through a CommSP's backbone network to the internet.

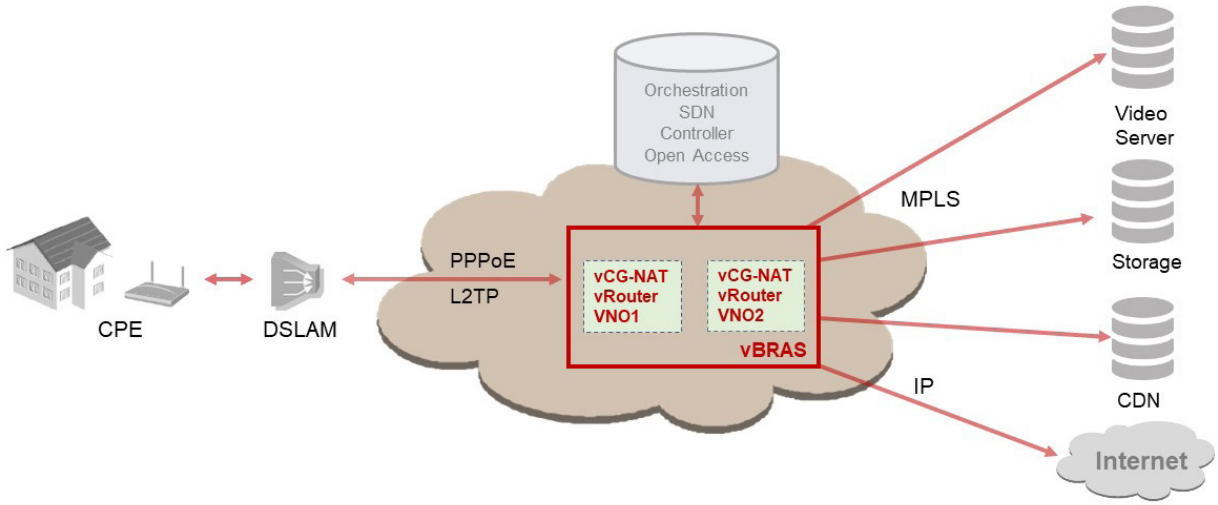

Figure 1. vBRAS functions in a consumer application.[1]

As the main gateway element to the internet, BRAS platforms must support massive throughput and therefore must be scalable enough to support the significant growth in data usage that is expected from ultrabroadband services.

The two elements of the BRAS that are critical to performance are the control plane and the data plane.

- Control plane: Supports signaling, software defined network (SDN) controller functions, connection set up, and routing protocols. As a vBRAS system serves more users, it needs more control plane resources or risks control plane resource starvation.
- Data plane: The data plane is responsible for packet processing and routing east-west to various components within the vBRAS and north-south to and from the Ethernet controller. To match the performance of a dedicated data plane, vBRAS systems depend on fast CPUs, the Data Plane Development Kit (DPDK), and hardware acceleration.

Traditional BRAS has fixed control plane and data plane capacity, which eliminates the flexibility to independently scale each of these elements to match actual network conditions. The fixed control and data plane also requires complex management and maintenance, hinders fast provisioning of services, and restricts optimal resource utilization.

A vBRAS solution, however, delivers a separate, software-based control plane and a data plane that can scale independently. The data plane can also benefit from hardware acceleration to scale for very demanding network deployments.

Advantech has partnered with Ethernity on a vBRAS platform that is software independent and optimized for the data plane demands of a number of vBRAS implementations.

Advantech vBRAS Platform

Hardware

- Compact, high-performance, next-generation 1U and 2U rackmount servers designed for carrier-grade deployment
- Single or dual Intel® Xeon® Scalable processors
- Ethernity's FPGA-based ACE-NIC40 (40 G) or ACE-NIC100 (100 G) data processing and acceleration Smart NICs, utilizing patented Ethernity Flow Processor technology

Software

- vBRAS Control Plane (provided by Ethernity or various software vendors)
- Ethernity Networks HW Adaptation Layer (ENET HAL) – high level APIs to enable upper layer switch/router application layers to seamlessly interact with ENET Flow Processor hardware
- ENET SW acceleration package (ESWAP) and ENET DPDK acceleration
- All-programmable FPGA-based acceleration NIC with H-QoS and CESR data plane

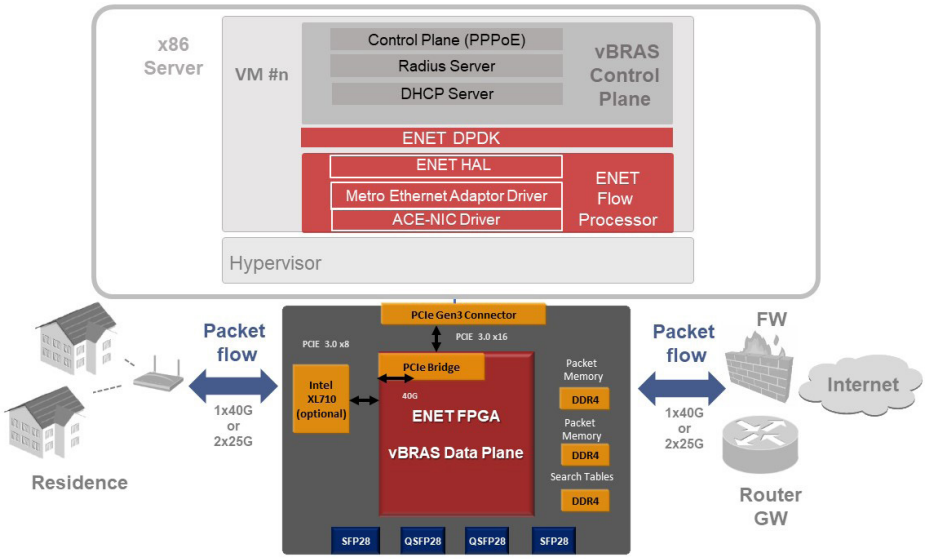

Figure 2. Block diagram of vBRAS solution featuring Advantech SKY-8000 Server and Ethernity's FPGA-based ACE-NIC.

Advantech SKY-8000

The foundation of the Advantech vBRAS solution is the Advantech SKY-8000 series as shown in Figure 2. The SKY-8000 servers are designed to balance the server-class performance of Intel Xeon Scalable processors with maximum I/O and offload density in a short-depth chassis. The server is designed to be deployed in NEBS Level 3 carrier-grade environments and where limited rack depth is available.

Architected around the Intel Xeon Scalable processors, the SKY-8000 series combines outstanding performance with the ruggedness, reliability, and long system lifecycles required by CommSPs.

The primary model for vBRAS applications is the SKY-8101, a 1RU, single-socket server that can scale to 28 cores and supports configurations across the entire range of Intel Xeon Scalable processors. The server supports six DIMM sockets to enable high capacity six-channel configurations providing fast memory access. The SKY-8101 PCIe subsystem offers abundant I/O expansion with slots for three PCIe x8 Gen3 adapters—two full height, full length and one low profile—in addition to onboard NICs and one further PCIe x4 Gen3 slot for Advantech personalization cards.

Figure 3. Front and back views of the Advantech SKY-8101 server.[2]

Remote Evaluation Service

For customers that utilize SKY-8000 (shown in Figure 3) servers in NFV applications, Advantech offers an evaluation framework called the Remote Evaluation Service (RES) that provides an infrastructure where developers can openly collaborate together using Intel architecture-based platforms with a range of processors. This gives the developers the ability to match the system with the application they are working on whether they need several cores from Intel Atom® processors or several hundred cores from Intel Xeon processors.

With RES, developers can get ahead of the curve and begin to test different NFV infrastructures on Advantech platforms destined for deployment at specific network locations: closer to the subscriber in the access network, mobile edge and in customer premises (uCPE), as well as in the network core and in telecom data centers. By testing combined Advantech and Ethernity solutions for vBRAS using RES, service providers can develop and apply new technology sooner to help reduce operating expenses and accelerate next generation product rollouts.

ENET Data Plane Processing

ENET technology increases the efficiency of the CPU by eliminating heavy networking constraints by partially or completely delegating resource-consuming virtual functions to the FPGA. This hardware acceleration means that under similar conditions there are many more available user sessions in the forwarding pool, which results in deterministic results and very low latency. The in-flow data path processing in Ethernity's vBRAS solution provides various mechanisms that are compliant with the requirements for a carrier network and offers numerous options for connectivity to satisfy an operator's specific network application scenarios.

The ENET Flow Processor, when used in a vBRAS/vBNG solution, features carrier grade network address translation (NAT), hierarchical QoS traffic, per flow counters, and fast switchover. The FPGA also supports switching, routing, and tunneling, including virtual extensible LAN (VxLAN), network virtualization using generic routing encapsulation (NVGRE), layer 2 tunneling protocol (L2TP), and point-to-point protocol over Ethernet (PPPoE). ENET technology also offers a comprehensive set of data path acceleration features applicable for multi-access edge computing (MEC), virtual evolved packet core (vEPC), and security with an integrated cryptography engine. The ENET data plane also supports network slicing at any pipeline level with extensive multitenant control and with service partitioning and isolation features, and it can be customized to support emerging protocols and networking functions.

Ethernity Software Solution

The ACE-NIC package comes with a complete, well-tested software solution that includes highly developed drivers, command line interface and user guide, ENET hardware abstraction layer, and third-party software applications.

Furthermore, the solution also includes the ESWAP Toolkit, a software element that enables connectivity to multiple virtual machines to share slices of the ENET flow processor firmware for assisting with delegating various functions to the FPGA. ESWAP uses Ethernity's ENET acceleration middleware to enable communication with the SDN controller through standard interfaces including NETCONF, OpenFlow,* REST API, and Open vSwitch* Database Management Protocol (OVSDB).

Integration with DPDK

DPDK packet processing libraries are widely used by VNFs for efficient data plane implementations. DPDK drivers allow NICs to advertise hardware acceleration capabilities that can benefit processes including flow classification, performance monitoring, counters, H-QoS, and IPSec and other crypto functions. Transparently to the VNF, DPDK applies these features, so that the VNFs gain access to NIC acceleration with no software changes.

The ACE-NIC supports DPDK acceleration, including extensions for the ENET telco-grade feature set that includes traffic management, SLAs, and billing counters. This DPDK integration allows VNFs and NFVI applications—especially services such as vBNG and vEPC that require counters, H-QoS, VG-NAT, PPPoE offload, and other telecom features—to seamlessly complement their software processing with an FPGA that handles computationally intensive features such as traffic shaping and cryptography. Using DPDK as an interface minimizes VNF software changes and provides an open model for hardware acceleration.

Conclusion

The network functions that have traditionally been handled by dedicated BRAS hardware can be decoupled from the hardware by NFV. But the challenge is to maximize throughput without impacting CPU efficiency. Advantech and Ethernity, working with Intel technology, have developed an effective vBRAS solution that offers outstanding performance at the network edge.

About Advantech

Advantech Networks & Communications Group provides an extremely broad range of communications infrastructure platforms, scaling from one to hundreds of Intel® processor cores, consolidating workloads onto a single platform architecture and code base. Its technology stems from x86 design expertise combined with high-performance switching, hardware acceleration and innovative offload techniques. For more information, please visit http://www.advantech.com/nc.

About Ethernity Networks

Ethernity Networks is a technology solutions provider that develops and delivers data processing technology used in high-end carrier Ethernet applications across the telecom, mobile, security, and data center markets. The company's core technology, which is populated on programmable logic, enables delivering data offload functionality at the pace of software development, improves performance and reduces power consumption and latency, therefore facilitating the deployment of virtualization of networking functionality. For more information, please visit http://www.Ethernitynet.com.

About Intel® Network Builders

Intel Network Builders is an ecosystem of infrastructure, software, and technology vendors coming together with communications service providers and end users to accelerate the adoption of solutions based on network functions virtualization (NFV) and software defined networking (SDN) in telecommunications and data center networks. The Network Edge Ecosystem is a new initiative gathering ecosystem partners with a focus on accelerating network edge solutions. As an integral part of the broader Intel Network Builders program, this initiative aims to facilitate partners' access to tested and optimized solutions for network edge and cloud environments. Learn more at http://networkbuilders.intel.com.

[1] Figures 1 and 2 provided by Ethernity.
[2] Figure 3 provided by Advantech.