Enabling High Density CPE Virtualization

Customer Premises Equipment (CPE) delivering Internet services to the home is becoming more and more complex. Current network access architectures rely on a Layer 3 gateway located in home premises that implements an increasing number of network functionalities such as NAT, DHCP, IGMP, routing, PPP termination and more. Additional devices are also required to provide value-added services such as IPTV, remote monitoring and more.

High-speed fiber access brings another level of complexity as Optical Network Termination is a Layer 2 only device that relies on a separate gateway. The installation of all these different devices at home increases installation and operational support costs for the Service Provider.
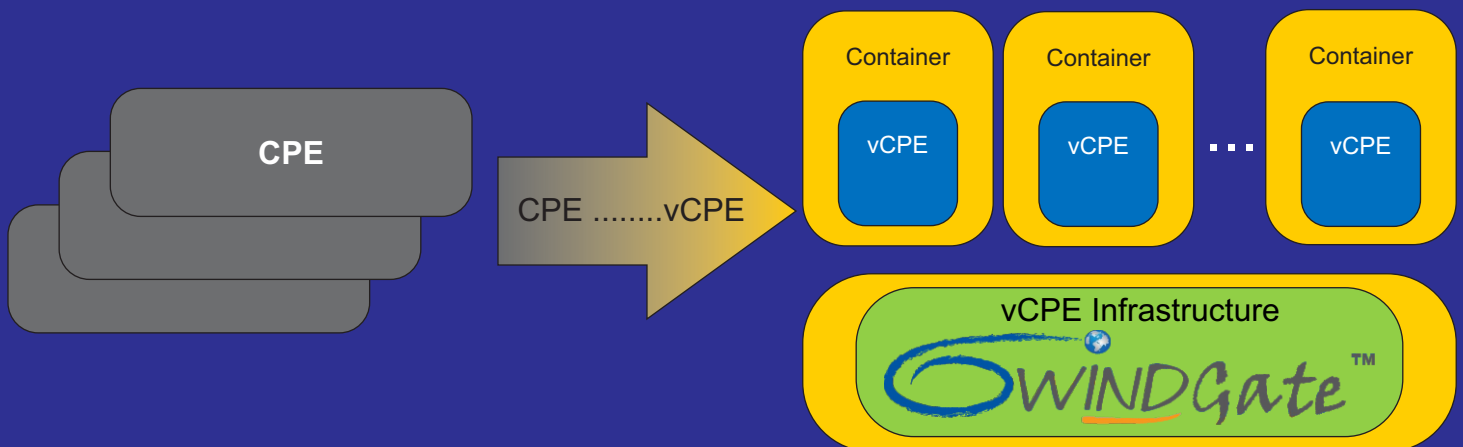
The introduction of high performance access technologies combined with a cloud-based approach aimed at virtualizing access functions in the Service Provider's core infrastructure as promoted in the ETSI NFV (Network Functions Virtualization) standardization group advocates for a new partitioning of the networking functions and services available in CPE.

Instead of deploying all access functions and services in physical equipment at home, virtual CPE (vCPE) moves network access functions and applications in central servers running the CPE functions in virtualized architectures. Only Layer 2 functions are required at customer premises including access, switching, and wired and wireless local networks. vCPE significantly reduces the price of equipment, decreases operational costs for the Service Provider and shortens the delivery time for the introduction of new and differentiated services.

However, vCPE architectures bring some specific performance challenges to the server that has to aggregate the traffic from a large number of CPEs. The 6WINDGate software solution for vCPE solves networking performance bottlenecks and maximizes the number of vCPE instances on a server to enable cost-effective vCPE architectures.

Since the first shipment of its 6WINDGate packet processing software in 2007, 6WIND has been selected by many network vendors to unlock hidden infrastructure performance for commercial off-the-shelf (COTS) and server hardware.

6WINDGate Enables Thousands Of vCPE Instances On A Single Server

CPE

CPE ....vCPE

Container — vCPE
Container — vCPE
... Container — vCPE

vCPE Infrastructure
6WINDGate™

Packet Processing Software * Outpace The Competition

vCPE Relies on High Performance Networking Software

Virtualizing CPE functions in centralized servers makes economic sense only if a large number of vCPE instances can be instantiated on a single server, thus reducing the price per vCPE. Typically, it's expected to run thousands of vCPEs on a server.

Running each vCPE in a Virtual Machine (VM) cannot work because the number of VMs on a server is limited to a few dozen. This solution can only be considered for virtualizing high-end enterprise CPEs (refer to 6WIND's Solution Brief: Powering The New Generation of Network Appliances).

Instead, it makes sense to run each vCPE in a Linux container (LXC), a kernel-level virtualization method for running multiple isolated Linux applications or processes on a single platform. For networking, "network namespaces" are used to isolate network interfaces, routing and firewall tables, and to instantiate and isolate a vCPE in a Linux container.

Compared to existing architectures for which CPE services are mostly processed locally, such a centralized solution with thousands of vCPE instances running on top of a vCPE infrastructure on a single server implies significant needs for networking performance. Modern access technologies such as fiber can provide the required bandwidth, but the corresponding throughput cannot be provided by the Linux networking stack on its own.

In addition to efficient and optimized Virtual Routing and Forwarding able to manage large routing tables (one network namespace per container), the vCPE infrastructure must provide security features using encapsulation mechanisms, firewalling and possibly encryption techniques. QoS can also be used to implement rate limitation per port or per vCPE. On top of this, the amount of computing resources used by the vCPE infrastructure has to be minimal, to keep room on the server for as many vCPEs as possible.

6WINDGate Enables High Density CPE Virtualization

6WINDGate is high performance Layer 2 – 4 packet processing software optimized for generic multicore platforms. Based on its fast path architecture, 6WINDGate transparently accelerates Linux and virtualized network environments based on LXCs or VMs to provide 10x network performance improvements compared to standard software architectures.

It allows for 1/10th computing resources to be used to process a defined amount of bandwidth, saving computing resources to implement more vCPEs. 6WINDGate's fast path accelerates Linux data plane processing including bridging, VLAN, forwarding IPv4 and IPv6, IPv4 and IPv6 routing and virtual routing, encapsulation (GRE, PPP…), QoS, firewall, NAT and IPsec.

6WINDGate supports all these features for a very large number of Linux containers thanks to optimized Virtual Routing and Forwarding (one VRF per container and per vCPE) integrated with Linux network namespaces. Each vCPE can be identified by a VLAN identifier or using other encapsulation methods.

6WINDGate's fast path is compatible with all open source and commercial Linux distributions. It reuses standard APIs between the Linux kernel and applications and operates without any change in the Linux kernel. A vCPE running on a standard Linux kernel will work similarly on this Linux kernel accelerated by 6WINDGate's data plane.

6WINDGate is available for market-leading processor platforms including Broadcom, Cavium, Intel and Tilera/EZChip. Most of 6WINDGate's software uses generic code and portability over different platforms ensured by a thin layer called FPN-SDK (Fast Path Networking – SDK) on top of the processor vendor's SDK. For Intel platforms, 6WIND provides its own distribution for DPDK (Data Plane Development Kit) with the support of multivendor NICs and crypto accelerators.

The combination of performance, portability, transparency and feature set makes 6WINDGate the ideal networking software platform for quickly virtualizing a large number of CPEs on generic hardware platforms using Linux containers.

As one of the market's largest data plane portfolios, 6WINDGate provides the following features for vCPE:

- Transparent acceleration of Linux data plane
- Compatible with all open source and commercial Linux distributions
- High performance and scalable IPv4 and IPv6 forwarding
- Virtual Routing and Forwarding support for thousands of vCPE instances within Linux containers
- High capacity for encapsulation protocols such as VLAN, IP in IP, PPP and more
- High performance and capacity QoS, firewall, NAT and IPsec management to increase network security and differentiate services within and between vCPEs
- IPv6 ready for all features