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SD-WAN and uCPE: Introduction

As conventional enterprise WANs expand in capacity and distance, they often leverage multiple carrier networks to deliver applications and services to distributed sites like regional and local offices. Such handoffs across networks can negatively impact orchestration, management, and performance, while also increasing CAPEX and OPEX.

Increasingly, enterprise WANs must also support bandwidth-hungry applications like streaming HD video. Use of latency-sensitive services like VoIP calling and videoconferencing is also on the rise.

In response to these trends, communications service providers (CSPs) and enterprises are turning to software-defined wide-area networks (SD-WANs) and universal customer premises equipment (uCPE). These new technologies offer major leaps in flexibility, performance, and cost that benefit both carriers and end users.

Software-Defined WAN and Dynamic Connectivity Channels

The most notable technical achievement of SD-WAN technology is that one logical SD-WAN can simultaneously support multiple connectivity types. This includes hybrid

Wi-Fi, LTE, DSL, Ethernet, and other forms of high-speed communications.

As shown in **Figure 1**, an SD-WAN is managed by a central controller, which is decoupled from the underlying hardware infrastructure using virtualization technology. Therefore, SD-WAN controllers can set policies that dynamically route traffic over the highest bandwidth links, prioritize traffic flows, and ensure that service-level agreements (SLAs) are met.

In addition, the software-centric approach of SD-WAN communications means that dedicated appliances can be replaced with general-purpose hardware. Because this general-purpose hardware can be sourced from multiple vendors and is easier to deploy, manage, and scale, SD-WANs significantly reduce overall costs compared to conventional WAN architectures.

uCPE Standardizes SD-WAN for Enterprise Communications

The move toward general-purpose hardware also enables network functions virtualization (NFV). Using NFV, specialized network appliances used for services like
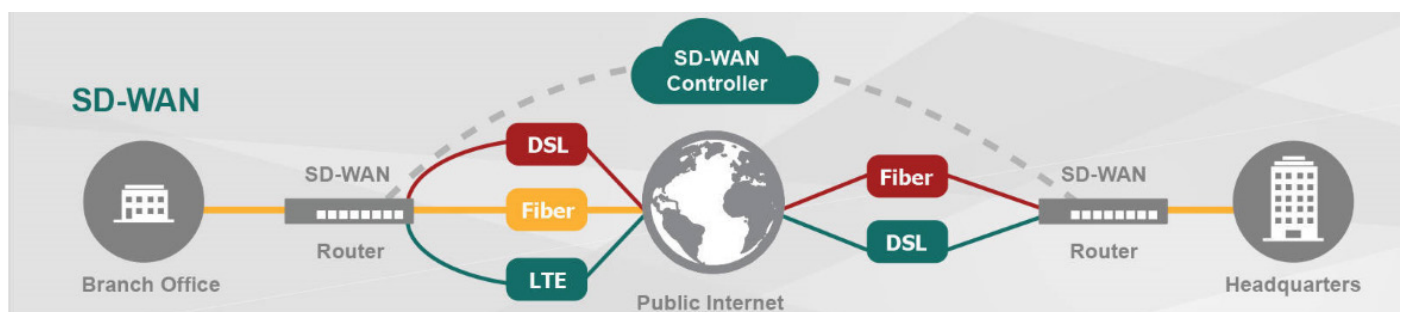

Figure 1. Software-defined wide-area networks (SD-WANs) leverage data center networking concepts to optimize enterprise traffic management and performance. (Source: CSSTECH)

session border control, load balancing, network address translation, firewalls, deep packet inspection (DPI), and WAN acceleration can be migrated to off-the-shelf platforms that deliver these services as virtual network functions (VNFs).

VNFs can be hosted in the cloud or data center and delivered remotely over the network. But hosting them locally at the edge of telecom access networks helps meet the requirements of higher bandwidth and lower latency services that many enterprises demand. uCPEs are the platforms that will support VNFs at the edge.

General-Purpose Edge Network Virtualization

uCPE defines a set of off-the-shelf hardware and open software technologies that bring data center cloud and virtualization capabilities to telecom access networks. As illustrated in **Figure 2**, these platforms must be:

- Flexible enough to support multiple third-party VNFs in a single system

- Powerful enough to meet network performance requirements

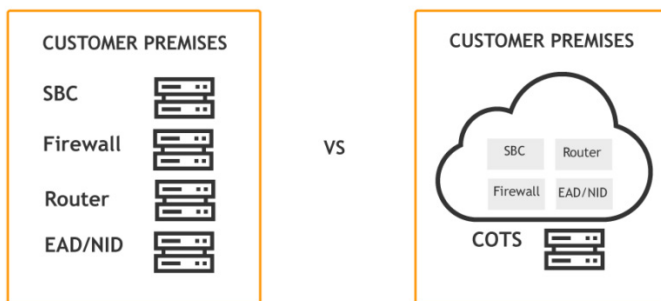- Compact enough to be deployed in small branch offices

Figure 2. Universal Customer Premise Equipment (uCPE) combines off-the-shelf hardware with an open software architecture to support virtualization capabilities in telecom access networks. (Source: CLADIRECT)

For enterprises, uCPE means fewer, more versatile networking appliances on-site that are able to deliver

high-bandwidth, low-latency services locally. For CSPs, general-purpose uCPE platforms can still be managed and upgraded remotely to minimize maintenance costs.

And because SD-WAN controllers are abstracted from underlying infrastructure, general-purpose uCPE hardware can provide all of the resources needed for SD-WAN deployments.

Standardizing uCPE for Reliability and Reduced Costs

The general-purpose nature of uCPE hardware has prompted multi-vendor standardization efforts. This will enable uCPE technology to be deployed and scaled quickly at the lowest possible cost.

Intel®, Supermicro, Advantech, Lanner, and others have developed Intel® Select Solutions for uCPE reference designs. Based on Intel® Xeon® D 2100 series processors, these designs provide a set of scalable solutions that help CSPs, telecom equipment manufacturers (TEMs), internet service vendors (ISVs), and enterprises get uCPE and SD-WANs off the ground **(Figure 3)**.

The hardware and software stacks of Intel Select Solutions are verified by Intel, which ensures the robustness of uCPE reference designs. The reference designs come in two flavors that give CSPs and enterprises a baseline for tuning compute, storage, and networking resources to the needs of small offices or larger facilities:

- Intel Select Solutions for uCPE base configuration – Designed for small-to-medium-size businesses; at minimum the uCPE base configuration integrates a quad-core Intel Xeon D processor, Intel® QuickAssist Technology (Intel® QAT), 2 x 10 GbE Ethernet ports, ample storage and memory, and support for two virtual machines (VMs).

- Intel Select Solutions for uCPE plus configuration– Intended for larger enterprise facilities, the uCPE plus configuration uses a 14-core Intel Xeon D processor, Intel QAT, 4 x 10 GbE Ethernet ports, and even more memory and storage.
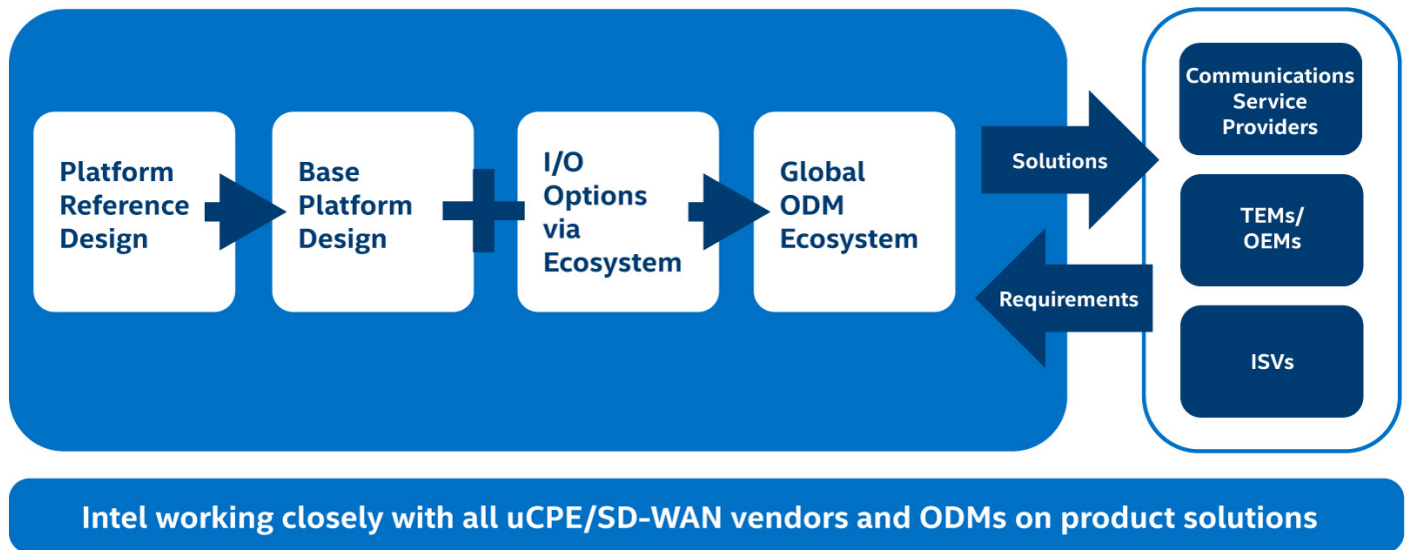
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Ecosystem Enabling Model

Figure 3. Intel® Select Solutions for uCPE provide scalable platform reference designs to accelerate SD-WAN adoption. (Source: Intel® Corp.)

The SuperServer 5019D-FN8TP from Super Micro Computer, Inc. is one of the first Select Solutions for uCPE, providing an 8-core, 16-thread Intel Xeon D processor, built-in Intel QAT, and extensive I/O for SD-WAN services such as network security and edge compute—all in a 1U form factor.

Although Select Solutions for uCPE are deployable off the shelf, they can be optimized to the deployment or specific VNFs using tools like the Intel® Data Plane Development Kit (Intel® DPDK). **Figure 4** shows how Super Micro leveraged Intel DPDK to implement DPU and IPSec services on the SuperServer 5019D and integrate them with an SD-WAN.

Standards-Based Solutions for SD-WAN Flexibility and Savings

As network bandwidth and latency demands continue to increase and services evolve with them, the ability to intelligently manage network infrastructure using off-the-shelf hardware and open software architectures has become a business imperative. In light of this, the performance, flexibility, and cost savings of SD-WANs are simply too hard to ignore.

According to a July 2017 report from research firm IDC, SD-WAN adoption is seeing "remarkable growth" with a compound annual growth rate (CAGR) of 69.6 percent through 2021. CSPs and enterprises just starting the SD-WAN evaluation process are already behind the curve, but uCPE solutions for SD-WAN can quickly close the gap.
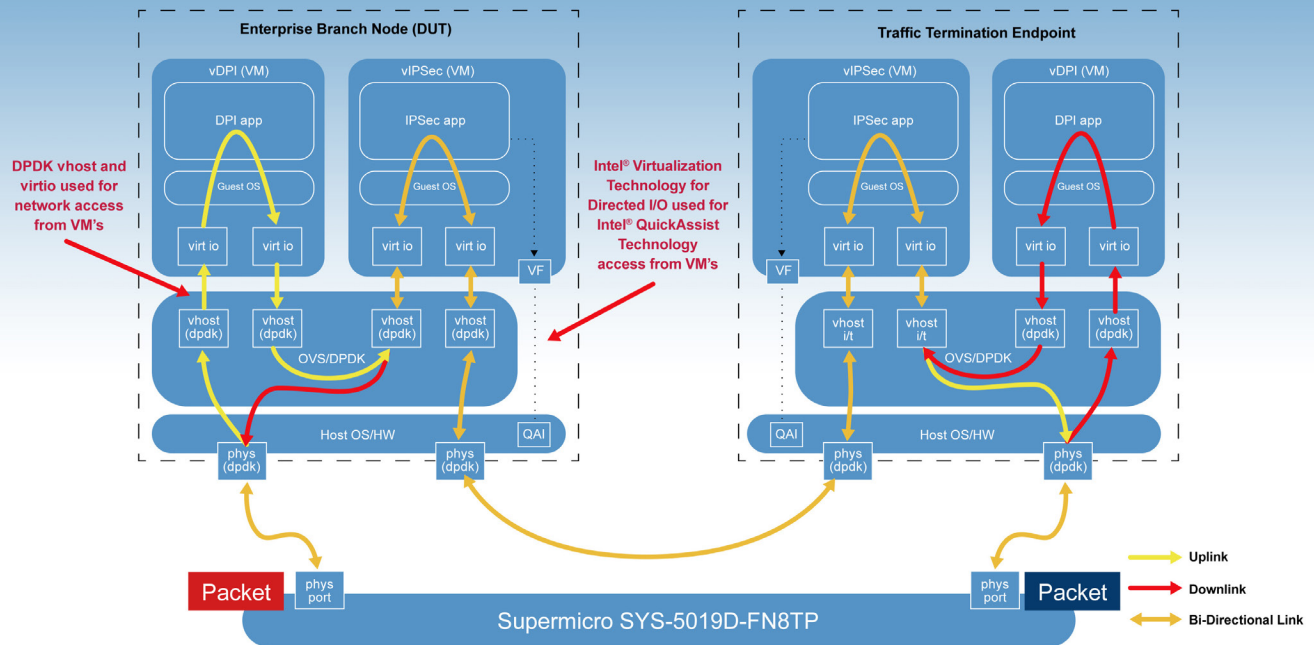
Figure 4. The Intel® Data Plane Development Kit (Intel® DPDK) pairs with Intel® Select Solutions for uCPE like the Super Micro Computer SuperServer 5019D to accelerate the implementation of virtual network functions (VNFs) like security. (Source: Super Micro Computer, Inc.)