Intel® Select Solutions for uCPE Ubuntu* Configurations

Universal CPE (uCPE) systems bring the powerful performance of Intel® Xeon® D processor-based systems to the edge of communication service provider networks for agile service provisioning. Intel Select Solutions for uCPE provide a foundation for the development of uCPE products with a solution reference design and verification of performance.

Introduction

Enterprise adoption of cloud services and digital transformation is opening a new opportunity for communications service providers (CommSPs), as well as the ecosystem partners (e.g., original design manufacturers, independent software vendors, telecommunications equipment manufacturer, and system integrators) serving CommSPs, to meet the cloud and networking needs that arise from this transition with network functions virtualization (NFV)-based customer premises equipment (CPE).

Universal CPE (uCPE) systems provide a single platform dedicated to virtualized network functions including WAN routing, virtual private network, firewall, intrusion prevention system, session border control, carrier-grade network address translation, Wi-Fi, and software-defined WAN (SD-WAN). CommSPs are using uCPE solutions to replace multiple fixed-function appliances, reducing potential capital and operating costs while providing increased service provisioning flexibility.

The business value of uCPE is driving significant market growth. Analyst firm IDC forecasts that the worldwide uCPE infrastructure market will grow to exceed $3 billion for hardware and software by 2022.[1]

CommSPs have defined uCPE to be compute, storage, and networking platforms that can bring virtualized or non-virtualized (bare metal) services to small branch offices and small-to-medium-sized businesses. To support these platforms, Intel has developed the Intel® Select Solutions for uCPE reference design that combines Intel's expertise with NFV systems architecture requirements with the performance foundation of the Intel® Xeon® D processor.

The Intel Select Solutions for uCPE reference design provides a strong value proposition to telecommunications equipment manufacturers (TEMs), original equipment manufacturers (OEMs), independent software vendors (ISVs), and system integrators (SIs), which includes:

- Product-ready reference design that results in faster time to market
- Intel solution verification that reduces network evaluation time needed by CommSPs
- Partnering with Intel for joint go-to-market solutions and strategies

uCPE Use Cases

Intel Select Solutions for uCPE come tested to allow easy integration with a variety of virtual network functions (VNFs) that provide services. SD-WAN has become one of the highest profile services because it automates the provisioning of WAN

connections and lets branch offices continue to more securely access corporate apps while also taking advantage of broadband internet access links for cloud service access. Because uCPE hardware is based on general-purpose computing technology, SD-WAN VNFs that are deployed on uCPE systems are more cost effective than previous generation WAN systems based on proprietary hardware.

CommSPs can also utilize uCPEs for other traditional branch office and small-to-medium-sized business services. With Intel® architecture-based servers supporting a wide range of performance and price points, enterprises can standardize on networking and data security software services across all size facilities down to the smallest branch offices. Organizations with large branch office networks, such as retail stores or banks, can centralize the purchase of their key networking applications and work with their CommSP to deploy the applications across their corporate landscape for consistency and centralized updates and policies.

For small businesses, an Intel processor-based uCPE can provide the compute performance that lets CommSPs provision a single system that enables a wide range of networking and hosted services. CommSPs can also standardize on software used in hybrid cloud-CPE services because the software can run on Intel architecture-based

servers in both locations. In these hybrid cloud-CPE services, complex software functionality is hosted in the cloud and the uCPE is utilized for network connectivity and localized processing.

Intel Select Solutions for uCPE Reference Design

Intel has designed two product configurations as part of the Intel Select Solutions for uCPE reference design:

- Intel Select Solutions for uCPE base configuration: This uCPE design utilizes a four-core or greater Intel Xeon D processor and network and storage products from Intel (see Table 1) targeting value-based solutions with at least two virtual machines in a small-to-medium-sized business environment.

- Intel Select Solutions for uCPE plus configuration: This uCPE design utilizes a 14-core Intel Xeon D processor and specifies the network, storage, and integrated platform acceleration products (see Table 1) from Intel to maximize virtual machine density.

Table 1 shows the hardware required for each uCPE configuration.

INGREDIENT	INTEL® SELECT SOLUTIONS FOR UCPE BASE CONFIGURATION HARDWARE	INTEL® SELECT SOLUTIONS FOR UCPE PLUS CONFIGURATION HARDWARE
PROCESSOR	Intel® Xeon® D-2123IT processor, 4 core, 2.2 GHz, 60 W, or higher SKU	Intel Xeon D-2177NT processor, 14 core, 1.9 GHz, 105 W, or higher SKU
MEMORY	16 GB DDR4 2133 MHz, 4 * 4 GB (16 GB Total) Minimum all 4 memory channels populated (1 DPC) to achieve 16 GB (i.e., 4 * 4 GB RDIMM)	64 GB DDR4 2667 MHz, 4 * 16 GB (64 GB Total) Minimum all 4 memory channels populated (1 DPC) to achieve 64 GB (i.e., 4 * 16 GB RDIMM)
NICS	2 x 10 GbE integrated Ethernet ports	4 x 10 GbE integrated Ethernet ports
INTEL® QAT	Integrated Intel® QuickAssist Technology,[2] or an Intel® QuickAssist Adapter 8970 PCIe* add-in card,[2] or equivalent Intel® C627 Series Chipset QAT Enabled PCIe add-in card[2]	Integrated Intel® QuickAssist Technology, or an Intel® QuickAssist Adapter 8970 PCIe* add-in card, or equivalent Intel® C62x Series Chipset QAT Enabled PCIe add-in card
STORAGE	Intel® SSD Data Center S3110 256 GB 2.5" internal solid state drive (SATA or M.2)	Intel® SSD Data Center S3110 512 GB 2.5" internal solid state drive (SATA or M.2)

Table 1. Example hardware configuration for Intel Select Solutions for uCPE base configuration and Intel Select Solutions for uCPE plus configuration.

Intel Xeon Scalable processors feature important platform technologies as part of a tuned configuration.

- Intel® Virtualization Technology (Intel® VT) provides hardware abstraction to allow multiple workloads to coexist and share common resources while maintaining full isolation.

- Intel® Boot Guard technology is hardware-based boot integrity protection that can help prevent unauthorized

software and malware takeover of boot blocks critical to a system's function.

- Intel® Trusted Execution Technology (Intel® TXT) is a hardware-based platform security technology that tests the authenticity of critical elements of a platform, operating system, and hypervisor against known good results.

What Are Intel® Select Solutions?

Intel Select Solutions are pre-defined, workload-optimized solutions designed to minimize the challenges of infrastructure evaluation and deployment. Solutions are validated by OEMs/ODMs, certified by ISVs, and verified by Intel. Intel develops these solutions in extensive collaboration with hardware, software, and operating system vendor partners and with the world's leading data center and service providers. Every Intel Select Solution is a tailored combination of Intel® data center compute, memory, storage, and network technologies that delivers predictable, trusted, and compelling performance.

To refer to a solution as an Intel Select Solution, a vendor must:

1. Meet the software and hardware stack requirements outlined by the solution's reference-design specifications

2. Replicate or exceed established reference-benchmark test results

3. Publish a solution brief and a detailed implementation guide to facilitate customer deployment

Solution providers can also develop their own optimizations in order to give end customers a simpler, more consistent deployment experience.

Verified Performance Through Benchmark Testing

All Intel Select Solutions are verified by Intel to meet a specified minimum level of workload-optimized performance capability. Verified Intel Select Solutions for uCPE meet or exceed design and testing standards for data throughput and specialized security, encryption and compression performance that are essential in edge networking use cases. There are three key testing standards that are specified for Intel Select Solutions for uCPE:

Intel® QuickAssist Technology: Intel® QAT establishes stringent performance standards for bulk crypto performance across a range of uCPE use cases including when applications are running simultaneously. This benchmark tests both compression and encryption algorithms measured with typical packet sizes.

OpenSSL Performance: In addition to the bulk crypto performance, Intel Select Solutions for uCPE solutions must demonstrate a minimum OpenSSL throughput and sign operations performance requirements as measured by executing OpenSSL Speed Benchmark testing.

Packet Processing Performance: Intel Select Solutions for uCPE require high data plane throughput, and achieving it requires using the open source Data Plane Development Kit (DPDK) to optimize performance. This performance is demonstrated using the DPDK L3 Forwarding sample application.

Table 2 shows the minimum performance standards for both the base and plus uCPE configurations.

MINIMUM PERFORMANCE STANDARDS		BASE CONFIGURATION[3]	PLUS CONFIGURATION[4]
Cryptographic and Compression Operations Performance with Intel® QAT	Compression (compress and verify) throughput[5]	13 Gb/s	55 Gb/s
	Encryption throughput[6]	20 Gb/s	100 Gb/s
	RSA throughput[7]	20,000 sign/s	100,000 sign/s
OpenSSL Performance	AES128-CBC-HMAC-SHA1	20 Gb/s	100 Gb/s
	RSA 2048	20,000 signs/s	100,000 sign/s
Packet Processing Performance using DPDK L3fwd RFC2544 zero packet loss test		100% line rate with 128 B packet size utilizing 2 x 10 Gb/s NIC	100% line rate with 256 B packet size utilizing 4 x 10 Gb/s integrated NIC

Table 2. Minimum performance standards for Intel Select Solutions for uCPE. System builders, system integrators, and solution and service providers can further optimize the reference designs to achieve higher performance and capability.

Intel® Xeon® Processor D-2100 Product Family

The Intel Xeon processor D-2100 product family is based on the Intel Xeon Scalable processor architecture and is optimized for low power consumption and high-density solutions, integrating essential network, security, and acceleration capabilities into the platform. Intel Xeon D processor-based solutions enable CommSPs to bring intelligent services to the network edge by offering low total cost of ownership and power draw, and delivering space-efficient commercial off-the-shelf servers. Key features include:

- Enhanced memory: Up to 512 GB of DDR4 ECC
- Enhanced accelerators: Integrated Intel® QuickAssist Technology (Intel® QAT) for accelerated compression and encryption/decryption
- New extensions: Intel® Advanced Vector Extensions 512 (Intel® AVX-512), a specialized instruction set for outstanding compute performance
- Enhanced networking: Up to four integrated 10 GbE Intel Ethernet adapters

Software and Firmware Stack

All Intel Select Solutions feature a workload-optimized software stack tuned to take full advantage of an Intel hardware foundation. The software and firmware configurations below apply to both the Intel Select Solutions for uCPE base configuration and the Intel Select Solutions for uCPE plus configuration.

		INGREDIENT	SOFTWARE VERSION DETAILS
FIRMWARE		BIOS/MCU	February 2018 release date and later 0x2000043 or later
		Firmware for Intel® Ethernet Connection X722	V3.3
HOST	**Development Kit**	DPDK	18.02
	OS	Ubuntu*	Ubuntu 16.04.3 (kernel 4.4.0-116-generic)
	Hypervisor	KVM/QEMU*	2.5.0
	Libvirt	Libvirt*	1.3.1
	Drivers	Intel® QuickAssist Technology	1.7-L.1.0.5-25
		i40e	2.4.6
		ixgbe	5.3.6
GUEST	**Development Kit**	DPDK	18.02
	OS	Ubuntu	14.04 LTS
		Red Hat* Enterprise Linux*	RHEL 7.4 (kernel 3.10.0-693.11.6.el7.x86_64)
	Drivers	i40evf	3.5.6
		ixgbevf	4.3.4

Table 3. An example software stack for the Intel Select Solutions for uCPE Ubuntu* configurations. (With ongoing testing and optimization collaboration, version levels and components are subject to change over time.)

Ecosystem Enablement

In addition to the reference design, Intel Select Solutions for uCPE benefit from a significant ecosystem of providers of tested and optimized VNFs that run on top of these configurations. For added I/O flexibility, the program has a network of options including xDSL, PON, DOCSIS, T1/E1, voice, wireless, and more. Global original design manufacturers (ODMs) that are part of the ecosystem have experience and expertise in manufacturing these uCPE devices.

Conclusion

The uCPE market is expected to grow rapidly as CommSPs work with enterprises and small businesses to adopt these systems as part of their business strategies. The Intel Select Solutions for uCPE reference design provides the market with the platform, software, and ecosystem required to get to market quickly with a differentiated product. At the heart of the reference design is the Intel Xeon D processor, which offers the performance, acceleration features, security features, and built-in Ethernet connectivity needed for cost-effective uCPE systems.

Learn More

Intel Select Solutions web page: https://builders.intel.com/intelselectsolutions

Intel Xeon D processor family: http://www.intel.com/xeond

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