



Intel Select Solutions for Visual Cloud Delivery Network

The Intel® Select Solutions for Visual Cloud Delivery Network reference designs provide a fast-track specification for building and deploying next-generation content delivery network (CDN) servers based on Intel Xeon® Scalable processors.



Introduction

Consumer streaming media consumption is growing exponentially and evolving to richer and more interactive content. Consumer expectations are that this rich content is delivered in real time anywhere they are, anytime they want it, and on any device they are using.

This rapid growth in demand and the changing nature of visual content is an opportunity for communications service providers (CommSPs) to add visual cloud delivery network services as they have the network and the customer relationships that make them uniquely poised to offer these services. Emerging visual services like game streaming, virtual reality, and volumetric video are driving need for more capacity, high bandwidth, and ultra-low latency. There is also an additional business opportunity for CommSPs to open their network to content providers and over-the-top (OTT) service providers. Virtualized visual cloud delivery network solutions can help CommSPs to deploy their infrastructure with fast time to market and low total cost of ownership (TCO) while ensuring high-quality services for consumers.

To support CommSPs, Intel and its solution definition partners have developed the Intel Select Solutions for Visual Cloud Delivery Network. These Intel Select Solutions are based on a hardware and software reference design that reduces development time for ecosystem partners and streamlines procurement and deployment of solutions for CommSPs.

Solution Overview

The Intel Select Solutions for Visual Cloud Delivery Network consist of optimized hardware resources and an open-source software stack residing within a virtualized infrastructure. The solution stack leverages the most common and popular open source CDN caching frameworks such as NGINX and Apache Traffic Server (ATS). It also leverages open source media libraries such as FFmpeg, Media Service Studio, and Scalable Video Technology for media transcoding. Acceleration is built into the system for key CDN workload functions such as cryptography, data compression, and transcoding.

Intel Select Solutions for Visual Cloud Delivery Network provide high-performance, well-balanced systems along with flexible configuration options to meet different requirements. The solutions utilize non-uniform memory access (NUMA)-balanced I/O for maximum throughput and consistent latency. It also features new memory and storage solution options for improved scalability, reduced latency, and cost savings.

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.

Intel Platform Technologies

The Intel Select Solutions for Visual Cloud Delivery Network integrate a number of advanced Intel technologies for their performance, data security features, and other functionality.

2nd generation Intel Xeon Gold processors are specified in all models of the Intel Select Solutions for Visual Cloud Delivery Network. These CPUs are available with up to 24 cores per socket and frequency up to 2.3 GHz for workload-optimized performance. Intel Xeon Gold processors also feature important platform technologies that can play a role in Intel Select Solutions for Visual Cloud Delivery Network, including the following:

- 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 helps prevent unauthorized software and malware takeover of boot blocks critical to a system's function.

Intel Optane™ DC persistent memory helps to address memory constraint challenges for latency-sensitive CDN use cases such as live streaming. For CDN applications, the ability to provision content closer to the consumer for a faster, better user experience is critical. Operators have turned to high performance storage technologies (such as PCIe storage devices) and are increasingly hosting rich content in memory to make it faster and more accessible. But large capacity memory DIMMs can be cost-prohibitive to scale. Intel Optane DC persistent memory helps to address this challenge because it can offer lower per-Gigabyte memory cost, and similar performance as DRAM. Higher memory density enables operators to host more channels per node at similar cost. Intel Optane DC persistent memory modules are available in per module capacities of 128 GB, 256 GB and 512 GB per module.

Intel Visual Compute Accelerator 2 (Intel VCA 2) is a full-height, full-length, two-slot PCIe Gen 3 hardware accelerator card that provides high-density video transcoding capability. The Intel VCA 2 enhances the Intel Xeon Scalable processor platforms with P580 Iris® Pro graphics for powerful media performance and Intel Quick Sync Video for ultra-fast media transcode performance.

Intel Solid State Drive Data Center Family (Intel SSD Data Center Family) includes NVMe-based Intel SSD Data Center P4510 Series, and Intel Optane DC SSD P4800x that are based on Intel 3D NAND Technology and designed for cloud infrastructures, offering outstanding quality, reliability, and advanced manageability and serviceability to minimize service disruptions. The Intel 3D NAND Technology-based SSDs provide high capacity storage. The Intel Optane DC SSD P4800X supports fast caching and fast storage at low latency and high endurance compared to traditional NAND and hard disk drives. When used for caching, Intel Optane DC SSDs help to increase scale by accommodating more capacity than alternative DRAM based memory technologies typically used for caching.

Intel QAT is a hardware acceleration technology that provides lookaside cryptographic and compression/decompression co-processing services for the CPU. Intel QAT is built into certain Intel processor platform chipsets and can be added to a server as additional PCIe adapter and is included via PCIe-based add-in card options.

The 25Gb **Intel Ethernet 700 Series Network Adapters** accelerate the performance of Intel Select Solutions for Visual Cloud Delivery Network. The Intel Ethernet 700 Series delivers validated performance ready to meet high-quality thresholds for data resiliency and service reliability with broad interoperability.¹ All Intel Ethernet products are backed by worldwide pre- and post-sales support and offer a limited lifetime warranty.

2nd Generation Intel Xeon Scalable processors:

- Offer high scalability that is cost-efficient and flexible, from the multi-cloud to the intelligent edge
- Establish a seamless performance foundation to help accelerate data's transformative impact
- Support breakthrough Intel Optane DC persistent memory technology
- Accelerate artificial-intelligence (AI) performance and help deliver AI readiness across the data center
- Provide hardware-enhanced platform protection and threat monitoring

Base and Plus Configurations

Intel and its solution definition partners have carefully designed the hardware platform requirements of the Intel Select Solutions for Visual Cloud Delivery Network to deliver performance and efficiency for CDN applications. There are two configurations that offer different value-performance tradeoffs for different use cases. The base design is configured for video on demand (VOD) applications, while the plus design offers higher performance for live streaming, live transcoding, and VOD applications. Figure 1 demonstrates the software stack and some of the available configuration options for the solutions.

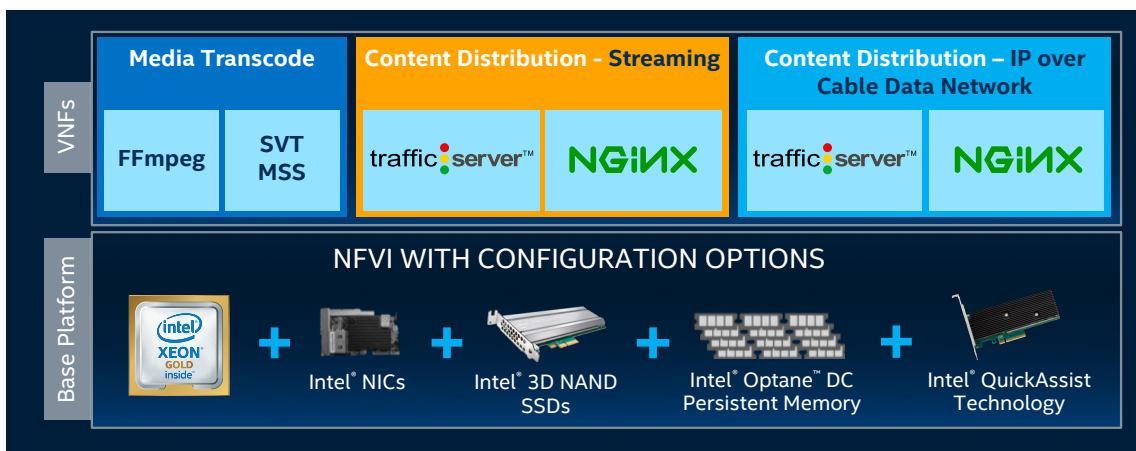


Figure 1. Built in application layer for CDN services and hardware configuration options.

Table 1 outlines some of the high-level hardware requirements for both configurations.

INGREDIENT	BASE CONFIGURATION	PLUS CONFIGURATION
PROCESSOR	2 x Intel Xeon Gold 6230 processor (2.1 GHz, 20 cores), or Intel Xeon Gold 6230N processor (2.3 GHz, 20 cores), or Intel Xeon Gold 5218R (2.1 GHz, 20 cores), or higher number SKU	2 x Intel Xeon Gold 6252 processor (2.1 GHz, 24 cores), or Intel Xeon Gold 6248R (3.0 GHz, 24 cores), or higher number SKU
DRAM AND INTEL OPTANE DC TECHNOLOGY	Option 1: 384 GB DRAM Option 2: 192 GB DRAM plus 512 GB Intel Optane DC persistent memory ³	Option 1: 384 GB DRAM plus 1.0 TB Intel Optane DC persistent memory ³ Option 2: 192 GB DRAM plus 1.5 TB Intel Optane DC persistent memory ³ Option 3: 384 GB DRAM plus 2 x Intel Optane DC SSD P4800X Series @ 750 GB ³
NICS	2 x 25GbE Dual Port Intel Ethernet Controller XXV710	2 X 25GbE Dual Port Intel Ethernet Controller XXV710
INTEL QAT	Intel QuickAssist Adapter 8960 (PCIe) add in card (AIC), ³ or Intel C627 chipset with Intel QAT enabled integrated with minimum PCIe x 8 uplink or higher SKU ³	Intel QuickAssist Adapter 8970 (PCIe) AIC, ³ or Intel C627 chipset with Intel QAT enabled integrated with minimum PCIe x 16 uplink or higher SKU ³

VISUAL CLOUD ACCELERATION CARD	Not applicable	Intel Visual Compute Accelerator 2 ³
INTEL 3D NAND SSDs²	2 x Intel SSD Data Center P4510 Series for NVMe @ 2.0 TB (for OS and primary data), and 12 x Intel SSD Data Center P4510 Series for NVMe @ 4.0 TB (for content) ³	4 x Intel SSD Data Center P4510 Series for NVMe @ 2.0 TB (for OS and primary data), and 10 x Intel SSD Data Center P4510 Series for NVMe @ 8.0 TB (for VoD, IPCDN workloads) ³
LAN ON MOTHERBOARD	2 x 10 Gbps or 25 Gbps port pre-boot execution environment (PXE) and operation, administration and management (OAM), and 1 Gbps or 10 Gbps port for management NIC	2 x 10 Gbps or 25 Gbps port for PXE and OAM, and 1 Gbps or 10 Gbps port for management NIC

Table 1. Hardware configurations for Intel Select Solutions for Visual Cloud Delivery Network.

Software and Firmware Stack

The Intel Select Solutions for Visual Cloud Delivery Network are designed to offer an optimized and validated software stack to allow CommSPs to deploy their preferred CDN software. CommSPs have the flexibility to use either open source CDN software or commercial CDN software. This stack includes media frameworks, operating system and drivers, and BIOS recommendations. The frameworks supported include the following (see also Table 2):

- **Media Transcode:** FFmpeg is a widely used framework for media processing and media transcoding applications. Intel provides a highly optimized software development kit (SDK) for HEVC encoding and also for media transcoding using the Intel VCA 2 hardware accelerator card.
- **Live Streaming Distribution:** HLS and DASH are recommended for live streaming benchmarking as they are used worldwide and have been well supported by the NGINX and Apache Traffic Server (ATS) framework.
- **Content Distribution (IP CDN):** The Intel Select Solutions for Visual Cloud Delivery Network support both NGINX and ATS. By supporting both of these alternatives, Intel covers the CommSP market with support for two of the most popular frameworks.
- **Media Solution Development:** Intel Media Server Studio is supported on the solution to provide software development tools and libraries needed to develop, debug, and deploy enterprise-grade media solutions on Intel VCA 2. The tool set supports development of tools for transcoding live, over-the-top broadcasting, and streaming video, as well as for cloud gaming, virtual desktop infrastructure (VDI), and video conferencing.

SUPPORTED FRAMEWORKS	FRAMEWORK	VERSION LEVEL
Caching Frameworks	NGINX	V1.14.0
	Apache Traffic Server (ATS)	V7.1.5
Media Libraries	FFmpeg	N4.0.3
	Scalable Video Technology	V1.2.0

Table 2. Caching and media open source library frameworks deployed with the Intel Select Solution for Visual Cloud Delivery Network.

Operating Systems and Drivers

Solution partners can create an Intel Select Solution for Visual Cloud Delivery Network using either CentOS or Red Hat Enterprise Linux. Table 3 details the optimized software and firmware stack for both operating systems. Intel has worked with CommSPs and ecosystem partners to develop the stack and recommends that the software listed below be utilized in a design to achieve a high level of performance.

OPERATING SYSTEM, SOFTWARE AND DRIVERS	CENTOS 7.6	RED HAT ENTERPRISE LINUX
Host OS	CentOS 7.6-kernel-3.10.0-957.5.1.el7.x86_64	RHEL 7.6-kernel-3.10.0-957.el7.x86_64
Libvirt	4.5.0	4.5.0 ⁴
QEMU	2.10.0	2.10.0 ⁴
Intel QAT	1.7-L.4.3.0-00033	1.7-L.4.3.0-00033
CollectD	5.8	5.8 ⁴
NVMe	1.0	1.0
DPDK	18.11	18.11
i40e	2.3.2-k	2.3.2-k
i40evf	3.2.2-k	3.2.2-k
ixgbe	5.5.5	5.1.0-k-rh7.6
ixgbevf	4.5.1	4.1.0-k-rh-7.6

Table 3. Software stacks for Intel Select Solutions for Visual Cloud Delivery Network for both CentOS and Red Hat Enterprise Linux operating systems.⁵

Table 4 details the firmware and BIOS versions recommended for the Intel Select Solutions for Visual Cloud Delivery Network.

	INGREDIENT	SW VERSION DETAILS
FIRMWARE	BIOS MCU	SE5C620.86B.0D.01.0241 Release Date Nov 19'2018 0x04000010
	Firmware for Intel Ethernet Server Adapter X520	E68793-005_rev1_0
	Intel Ethernet Network Adapter X722 Firmware	v3.3 or later
	Intel Ethernet Controller XXV710 Firmware Intel Ethernet Controller XXV710 Dynamic Device Personalization	v6.02 or later GTPv1 or later
	Intel SSD Data Center P4510 Series for NVMe Firmware	VDV10131
	Intel Optane DC SSD Firmware DIMM Firmware	NVMDIMMDriver: v01.00.00.3371 NVMDIMMHii: v01.00.00.3371

Table 4. BIOS and firmware stack.⁵

Verified Performance through Benchmark Testing

To validate the performance of Intel Select Solutions for Visual Cloud Delivery Network, Intel has devised a series of key performance indicator (KPI) targets for both the base and the plus configurations. Table 5 highlights some of these KPI benchmarks.

KEY KPI TARGETS		BASE CONFIGURATION ⁶	PLUS CONFIGURATION ⁷
Cryptographic and Compression Operations Performance with Intel QAT	Compression (compress and verify) throughput ⁹	24 Gb/s	54 Gb/s
	Encryption throughput ¹⁰	40 Gb/s	100 Gb/s
	RSA throughput ¹¹	100 K Ops/s	100 K Ops/s
OpenSSL Performance (PKE operation with 1 thread)	Software 1 thread	1 K signs/s	1 K signs/s
	Utilizing Intel QAT	100 K signs/s	100 K signs/s
Open SSL Performance (AES128-CBC-HMAC-SHA1 operation with 8 threads with 16 KB packet size)	Utilizing Intel QAT	40 Gb/s	100 Gb/s
IP over Cable Data Network NGINX Performance	HTTPS (in memory)	30 K req/s with 4 K users ¹²	30 K req/s with 5 K users ¹²
	HTTPS (in SSD)	28 K req/s with 4 K users ¹²	30 K req/s with 5 K users ¹²
Video Transcoding Performance	H.264 to H.264 (1080 pixels, 30 frames per second)	12 streams	20 streams
	H.265 to H.265 (1080 p, 30 fps)	12 streams	16 streams
	H.264 to H.264 (1080 p, 30 fps) using Intel VCA 2	Not applicable	48 streams
	H.265 to H.265 (1080 p, 30 fps) using Intel VCA 2	Not applicable	9 streams
Video Streaming Performance	H.264 (1080 p, 30 fps) VoD video streaming (HLS in memory)	25 video streams	27 video streams
	H.264 (1080 p, 30 fps) VoD video streaming (HLS in SSD)	20 video streams	22 video streams
Business Value of the Plus Configuration			2.25 times increase in Intel QAT compression throughput, 2.5 times increase in Intel QAT encryption throughput

Table 5. Key benchmark requirements.

Conclusion

CDN services are a rapidly growing market opportunity, and the evolution to virtualized CDN platforms gives CommSPs new capabilities and business models. To help their partners develop and deploy these services, Intel and its solution definition partners have specified the Intel Select Solutions for Visual Cloud Delivery Network that deliver workload-optimized performance for a wide range of CDN use cases built on the 2nd generation Intel Xeon Scalable processors. For more information on the Intel Select Solutions for Visual Cloud Delivery Network, and other Intel Select Solutions, visit the Intel Select Solutions page on the Intel Builders website: <https://builders.intel.com/technologies/IntelSelect>.

Learn More

Intel Select Solutions web page: intel.com/select

Intel Xeon Scalable processors: intel.com/scalable

Intel Select Solutions are supported by the Intel Builders Program: <https://builders.intel.com/>

Intel Visual Cloud Delivery Network Solutions: <https://www.intel.com/visualcloud>



¹ The Intel Ethernet 700 Series includes extensively tested network adapters, accessories (optics and cables), hardware, and software, in addition to broad operating system support. A full list of the product portfolio's solutions is available at intel.com/ethernet. Hardware and software is thoroughly validated across Intel Xeon Scalable processors and the networking ecosystem. The products are optimized for Intel architecture and a broad operating system ecosystem: Windows, Linux kernel, FreeBSD, Red Hat Enterprise Linux (RHEL), SUSE, Ubuntu, Oracle Solaris, and VMware ESXi. Supported connections and media types for the Intel Ethernet 700 Series are: direct-attach copper and fiber SR/LR (QSFP+, SFP+, SFP28, XLPP1/CR4, 25G-CA/25G-SR/25G-LR), twisted-pair copper (1000BASE-T/10GBASE-T), backplane (XLAUI/XAUI/SFI/KR/KR4/KX/SGMII). Note that Intel is the only vendor offering the QSFP+ media type. The Intel Ethernet 700 Series supported speeds include 10GbE, 25GbE, 40GbE.

² All storage options should be symmetrically attached to both CPU sockets (NUMA aligned).

³ Recommended.

⁴ Available as an extra package from Red Hat Enterprise Linux.

⁵ The software versions listed in the above table are minimum requirements. It is recommended to use the latest version if available.

⁶ Testing conducted by Intel on Feb. 20, 2019, with the following hardware and software configurations: 1 Node, 2x Intel Xeon Gold 6230N processors; 1x Intel Server Board S2600WFT, Intel C628 chipset; Memory 384 GB (12x32 GB) DDR4 RDIMM; HyperThreading: Enable; Storage: 2x1.2 TB Intel SSD DC P3520 Series for NVMe; Network devices: 2x 25GbE Dual Port Intel Ethernet Controller XXV710 SFP28+; ucode: 0x04000010; OS/Software: CentOS 7.6 (kernel 3.10.0-957.el7.x86_64); CDN components – NGINX 1.14.2, SVT 1.2.0, FFmpeg 4.0.3.

⁷ Testing conducted by Intel on Feb. 20, 2019, with the following hardware and software configurations: 1 Node, 2x Intel Xeon Gold 6252 processors B Step; 1x Intel Server Board S2600WFT, Intel C628 chipset; Memory 192 GB (12x16 GB) DDR4 RDIMM + Intel Optane DC persistent memory 2-1-1 (4x128GB); HyperThreading: Enable; Storage: 2x1.2 TB Intel SSD DC P3520 Series for NVMe; Network devices: 2x 25GbE Dual Port Intel Ethernet Controller XXV710 SFP28+; ucode: 0x04000010; OS/Software: CentOS 7.6 (kernel 3.10.0-957.el7.x86_64); CDN components – NGINX 1.14.2, SVT 1.2.0, FFmpeg 4.0.3.

⁸ Intel QuickAssist Technology is recommended for Intel Select Solutions Visual Cloud Delivery Network technical verification.

⁹ Performance to be measured at 8 KB packet size.

¹⁰ Performance to be measured at 4 KB packet size.

¹¹ Performance to be measured at 2 KB packet size.

¹² Based on projections as of Feb. 20, 2019. Results have been estimated or simulated using internal Intel analysis or architecture simulation or modeling, and provided to you for informational purposes. Any differences in your system hardware, software or configuration may affect your actual performance.

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