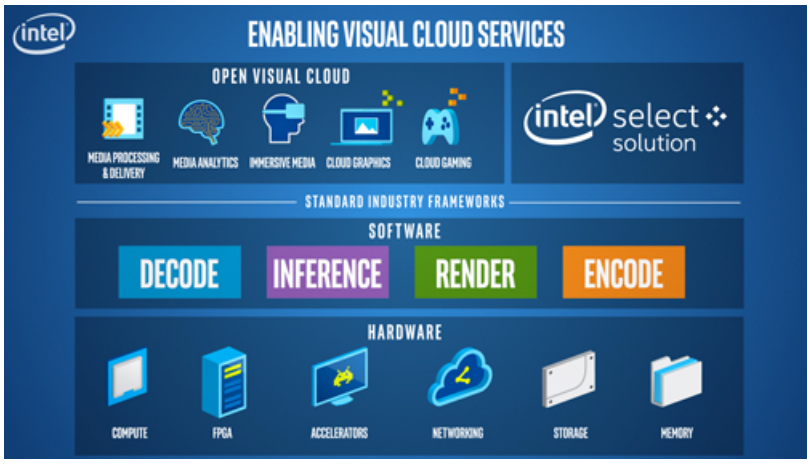

# intel Visual Workloads Demand a Modern Edge Infrastructure User Guide



Contents



## intel Visual Workloads Demand a Modern Edge Infrastructure




**The meteoric rise of streaming media requires finding new ways to deliver rich content closer to the user**
Emerging visual cloud workloads —including streaming video, 360 volumetric videos, smart cities, cloud gaming, and other forms of rich media content—will demand highly evolved data centers and edge networks. Providers need resilient, scalable infrastructures and the right combination of modern hardware, advanced software, and optimized open-source components. They need a comprehensive, balanced portfolio with a low total cost of ownership (TCO)—scaled to meet their needs, including:

- **Moving Content Faster** Evolving media formats—including 4K and 8K video, live video streaming of events, video analytics, virtual reality applications, cloud gaming, and more—place increasing demands on storage, network, and distribution platforms.
- **Taking on Storage** Installations at the network edge that handles media must be aware of storage constraints and implement dense storage solutions that fulfill requirements.
- **Matching Processors to Workloads** Every media scenario has its own processing requirements. In some cases, the goal is to provide compact, low-power processing at the edge. In other cases, maximum processing power is needed to perform complex analytics or manage high-bandwidth network traffic.
- **Optimized Software for Optimal Experiences** The complexities and performance issues that confront organizations delivering high-quality visual experiences require more than just a hardware infrastructure.
- **Partners Driving New Technologies** A vibrant partner ecosystem is a necessity for designing, developing, and deploying next-generation video and media solutions.

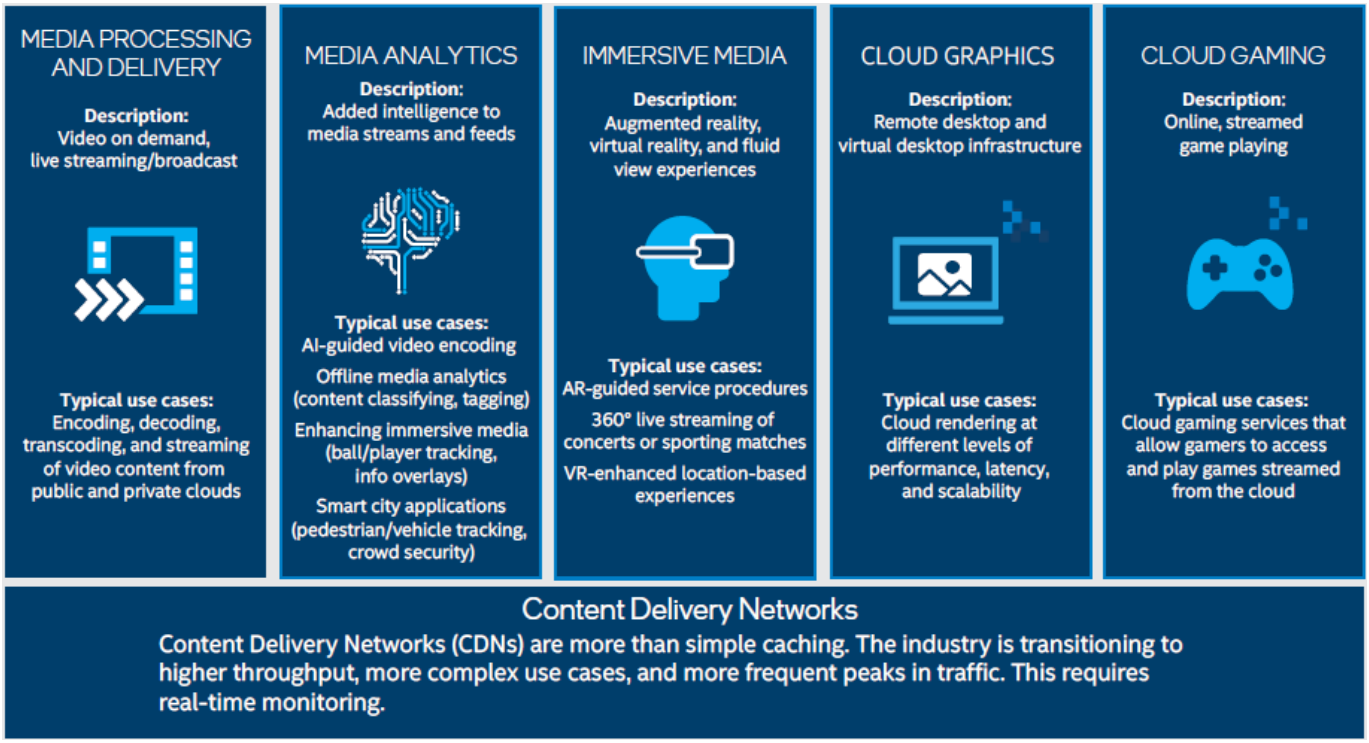
“Our collaboration with Intel has been consistent throughout our history. Being able to lean in and look towards what the road map is going to bring in, sure that they are understanding what our hardware requirements are based on our customer business requirements. This has been a critical, critical component for us growing success over the last 15 years.”1

### What is the Visual Cloud

With visual computing workloads growing at an accelerating pace, cloud service providers (CSPs), communication service providers (CoSPs), and enterprises are rethinking the physical and virtual distribution of computing, networking, and storage resources. Visual cloud computing consists of a set of capabilities for remotely consuming content and services that center around the efficient delivery of visual experiences—both live and file-based—as well as applications that add intelligence to video content and tap into machine learning and other artificial intelligence areas, such as object recognition. Learn about Intel’s visual cloud solutions through the resources at **www.intel.com/visualcloud**, including white papers, blogs, case studies and videos.

### Visual Cloud Services

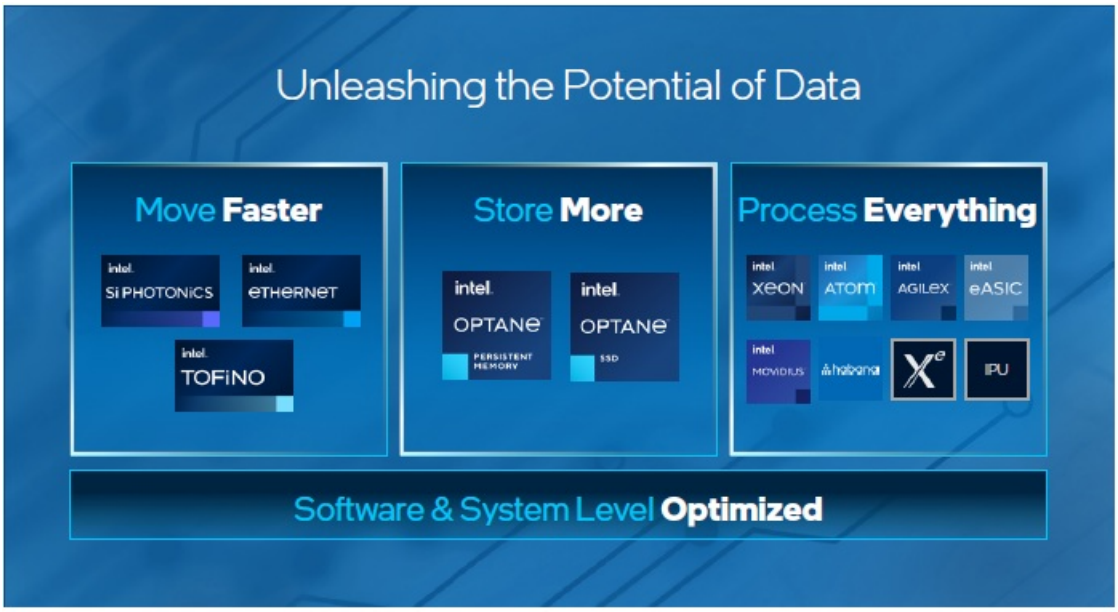
All require high performance, high scalability, and full hardware virtualization




### Get the Data Where It Needs to Be

Choosing the appropriate solution and partners should involve more than just selecting a certain CPU or GPU. Evaluating the complete system—considering the full range of components in the hardware and software stacks—is required to develop a balanced, top-performing platform for hosting new and enhanced visual experiences. When selecting a visual cloud platform, service providers should ensure partners offer a comprehensive approach, allowing them to:

- **Move faster** – With the growing explosion of data center traffic, connectivity is becoming the bottleneck to fully utilizing and unleashing high-performance computing. In response to the demand for enhanced connectivity, Intel has invested in technologies to help move data faster— from Ethernet to Silicon Photonics, to high-speed, programmable network switches.
- **Store more** – Data-centric infrastructure must also store massive amounts of data with the capability to quickly access that data, delivering rapid, real-time insights. Intel innovations, including 3D NAND and Intel® Optane™ technology, enable these capabilities.
- **Process everything** – The Intel Xeon® processor family provides the foundation of today's data center, and, by extending the processing range into power-constrained use cases the Intel Atom® processor product family is powering the intelligent edge. Other XPU offerings include FPGAs, GPUs, Intel Movidius™ technology, and Habana which are all designed to further accelerate workloads.
- **Software and system level optimized** – Underlying everything, the software and system-level approach that Intel uses helps remove performance bottlenecks wherever they exist. Intel continues to develop new ways to optimize the system performance and improve TCO when combining hardware and software ingredients to build cost-effective, high-performing visual cloud solutions.




**Moving Content Faster**

Evolving media workloads and formats—including 4K and 8K video, live video streaming of events, video analytics, virtual reality applications, cloud gaming, and more—place increasing demands on storage, network, and distribution platforms, reinforcing the absolute necessity for maximizing speed at every level. To contend with the low-latency, high-bandwidth requirements of modern Content Delivery Networks (CDN) and other media distribution outlets, responsive, efficient technologies are necessary to move and store video and rich media. Service providers as well as media creation and distribution organizations look for balanced and optimized solutions to satisfy growing demands for premium content, new use cases, and complex, data-intensive applications.

**Maximize performance on edge nodes and cloud-based data centers.**
Intel QuickAssist Technology (Intel QAT) offloads cryptography from the CPU to expand its Secure Sockets Layer (SSL/TLS) throughput cost-efficiently. Freeing the processor from these compute-intensive tasks allows faster processing of other applications and system processes, resulting in overall higher system performance. CDN operations on edge nodes are also improved by handling secure content through Intel QAT. Among the range of tasks that can be efficiently accelerated by using Intel QAT are symmetric encryption and authentication, asymmetric encryption, digital signatures, Rivest-Shamir-Adleman (RSA) encryption, Diffie-Hellman (DH) key exchange, Elliptic Curve Cryptography (ECC), and lossless data compression. These tasks are vital to the security and data integrity of many cloud-based visual workloads.

Intel QAT technology is available as part of the Intel QuickAssist Adapter family and in the Intel Quick Assist Communication 8920 Series and 8995 Series.

**Accelerate performance for CDNs and other media distribution channels**
Intel Ethernet 700 Series Network Adapters are key components of Intel Select Solutions for Visual Cloud Delivery Network, chosen to provide validated performance and service reliability and to consistently maintain high-quality thresholds for data resiliency. With data rates per port up to 40 Gigabit Ethernet (GbE), this series delivers a consistent, reliable addition to high-demand CDNs to meet the requirements of service-level agreements.

**Deliver high-bandwidth, low-latency performance for AI applications**
Intel Stratix® 10 NX FPGAs are programmable solutions for a wide range of edge computing tasks that enhance media processing and delivery close to the proximity of visual cloud customers and users. Employing an AI Tensor Block tuned for common AI functions, such as matrix-matrix or vector-matrix multiplications, boosts throughput in AI applications as high as 286 INT4 TOPS.2

**Supporting Stat**

In combination with built-in Hyper-Optimization tools based on Intel HyperFlex™ architecture, core performance increases up to 2X can be achieved .3

To reduce memory-bound bottlenecks in large AI models, an integrated memory stack in the Intel Stratix 10 NX FPGA supports persistent on-chip storage, delivering expanded memory bandwidth and reduced latency. Additional registers, referred to as Hyper-Registers, use advanced design techniques to eliminate critical paths and routing delays.

**Taking on Storage**
Dense storage solutions and effective caching are two areas of importance for CDNs and necessary to ensure efficient media delivery. Caching of video and media for lower latency delivery, particularly at the network edge, is a challenge that must be overcome for service providers to meet service-level agreements (SLAs). Installations at the network edge that handle media must be aware of storage constraints and implement dense storage solutions that fulfill requirements.

**High-capacity, high-volume storage**
Intel Optane SSDs, including the Intel Optane SSD P5800X, bring fast, high-volume storage to data centers. The high reliability and performance of SSDs from Intel are ideally suited for many applications designed to deliver high-quality visual experiences and space-efficient capacity. Geared for ultimate performance, Intel Optane SSDs effectively handle hot content use cases, for those applications in which popular video content is in high demand by users—in use cases requiring fast access and prompt delivery.

**Faster access to storage in a cost-efficient package**
Intel Optane persistent memory brings data closer to the CPU. Applications such as live streaming (captured and delivered in real-time) and linear streaming (aired live from prerecorded material) require the level of low latency operation that is delivered by Intel Optane persistent memory.

**Partner Proof Point – Streaming Live 360 Video at the Edge**
A collaborative team composed of staff members from Migu, ZTE, China Mobile, and Intel successfully completed a commercial trial of a virtual CDN (vCDN) running over a Guangdong Mobile network based on 5G multi-access edge computing (MEC). Using advanced field-of-view coding technology, video transcoding, and intelligent content distribution through the vCDN, the 5G MEC platform was able to reduce bandwidth requirements by 70 percent and provide a high-quality 8K virtual reality experience to audiences. The project, which incorporated a slate of Intel vision technologies, helps refine commercial techniques for handling the selection, editing, transmission, and broadcasting of VR content. This technology milestone, highlighting the viability of 5G-8K VR solutions, opens business opportunities for companies ready to explore VR applications and 5G networking and demonstrates the strength of collaborative enterprises to further the development of exceptional visual experiences.

## Matching Processors to Workloads

Every video and media workload scenario has its own processing requirements. In some cases, the goal is to provide compact, low-power processing for embedded applications or IoT implementations at the edge. In other cases, maximum processing power is needed to perform complex analytics, manage high-bandwidth network traffic, or to render ray-traced images. Cloud-based and edge network operations require a powerful yet scalable processor to achieve optimal TCO.

**Partner Proof Point – iSIZE Live Streaming**
A strategic partnership with iSIZE combines Intel AI technologies with iSIZE BitSave precoding technology to boost video streaming performance by up to 5×, substantially reducing streaming costs. Developed in collaboration with Intel, iSIZE optimized its AI models to take full advantage of Intel Deep Learning Boost (Intel DL Boost), featured in Intel Xeon Scalable processors. To further strengthen the solution offering, iSIZE tapped the capabilities of the Intel Distribution of OpenVINO™ toolkit, using tools and libraries from Intel oneAPI, a unified cross-architecture programming model, to improve the development and deployment of data-centric workloads spanning multiple architectures.

Customers of iSIZE experience bitrate savings as high as 25 percent, which can result in savings of $176 per hour based on 5,000 streams (as detailed in an AWS technical paper). The iSIZE technology also can be configured to deliver higher quality content, using AI techniques for optimizing streams across a diverse range of codecs, including AVC, HEVC, VP9, and AVI. More details about this strategic partnership can be found in this iSIZE Technologies press release.

**Industry-leading, workload-optimized platforms with built-in AI acceleration**
3rd Generation Intel Xeon Scalable processors, based on a balanced architecture with built-in acceleration and advanced security capabilities, deliver significant increases in performance over predecessor platforms, as well as availability over a wide range of core counts, frequencies, and power levels. This provides a strong technology foundation to build flexible infrastructure that is cost-effective for today and able to meet the needs of the future. With enhanced hardware-based security and exceptional multi-socket processing performance, these processors are built for mission-critical, real-time analytics, machine learning, artificial intelligence, and multi-cloud workloads.

**Intel Server GPU for Android Cloud Gaming and Live Streaming**
With a combination of Intel Xeon Scalable processors, open source and licensed software ingredients, and the new Intel Server GPU, Intel's customers can now provide high-density, low-latency Android cloud gaming, and high-density media transcode/encode for real-time over-the-top video streaming. With a low cost per stream, the Intel Server GPU helps bring Android gaming and media streaming to more users with less infrastructure for a lower TCO.5

"Intel is an important collaborator on our Android Cloud Gaming solution. Intel Xeon Scalable Processors and Intel Server GPUs offer a high-density, low-latency, low-power, low-TCO solution. We are able to generate over 100 game instances per 2-card server for our most popular games, King of Glory and Arena of Valor."

Developers can easily create applications on the GPU through tools such as Intel's open-source and proprietary software libraries, Intel Media SDK, and FFMPEG. The GPU also supports AVC, HEVC, MPEG2, and VP9 encode/decode as well as support for AV1 decode. For more information, including a product brief, solution brief, videos, and customer testimonials, visit Intel Server GPU.

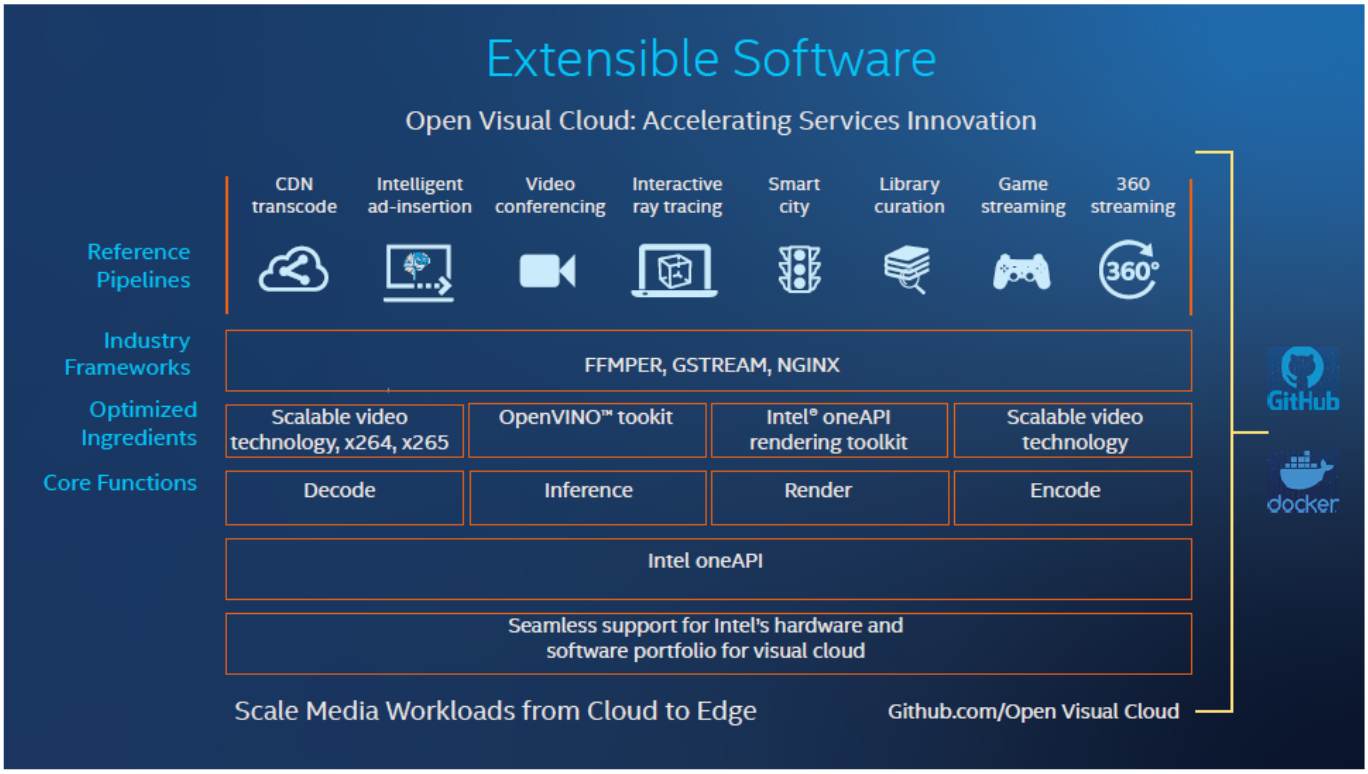
**Accelerate Media Analytics for Fast and Accurate Detection**
The Celestica Visual Cloud Accelerator Card for analytics (VCAC-A) features the Intel Core™ i3 processor and Intel Movidius Myriad™ X Vision Processing Unit (VPU). The VCAC-A is supported by the OpenNESS edge computing toolkit, which is discussed in a later section of this paper.


**Implement Custom Vision, Imaging, and Deep Neural Network Workloads**
The Intel Movidius Myriad X Vision Processing Unit is programmable with the Intel Distribution of OpenVINO toolkit for deploying a neural network on the edge. Intel Movidius VPUs provide a foundation for many smart city solutions, such as active traffic monitoring and surveillance of city utilities and public spaces. The card contains a dedicated hardware accelerator—the Neural Compute Engine—to handle deep neural network inference. Movidius and OpenVINO are supported by the OpenNESS edge computing toolkit, which is discussed in a later section of this paper.

## Optimized Software for Optimal Experiences

The complexities and performance issues that confront organizations delivering high-quality visual experiences require more than just a hardware infrastructure to achieve targeted goals. Collaborating with companies across the media and entertainment sectors, Intel has collaboratively developed a deep portfolio of frameworks, libraries, codecs, and development tools, offering these software resources through the Open Visual Cloud. The objective of the Open Visual Cloud is to reduce roadblocks to innovation and help organizations find ways to monetize the acquisition, processing, and delivery of rich media and video content. Provided as containerized software stacks and reference pipelines, and support for standardized industry frameworks like FFMPEG and gstreamer, the Open Visual Cloud provides a rich sandbox for developer creativity and offers highly tuned and optimized solutions to reduce time-to-market and accelerate time to revenue.

Figure 5 shows the pipelines, frameworks, ingredients, and functionality provided by the Open Visual Cloud.




### Overcoming VOD and Live Streaming Compression Challenges

To tackle the challenge of streaming high-definition video—including 4K and 8K—industry attention is increasingly focusing on an open source codec, Scalable Video Technology for AV1 (SVT-AV1), that promises to lower video streaming costs through efficient reduction of bitrates while maintaining video quality. As momentum rises

throughout the industry and interest in AV1 grows, Intel, partners, and members of the Open Visual Cloud initiative are collaborating on advanced video compression techniques to accommodate the anticipated massive volumes of online video content. Leading video service providers, developers, and researchers are driving AV1 adoption and discovering how AV1 successfully maintains visual quality and delivers outstanding streaming performance for customers and users.

Alliance for Open Media (AOMedia) has announced the open-source scalable video technology for AV1 (SVT-AV1) encoder that Intel developed in collaboration with AOMedia member Netflix, as the production reference encoder to create production-ready AV1 encoder implementations. As mobile and live streaming become more prevalent, these implementations will enable and deliver excellent video compression across a wide variety of video applications. Optimized for video encoding on Intel Xeon Scalable processors, SVT-AV1 uniquely enables developers to scale performance levels when using more processor cores, or for higher resolutions. This encoding performance can help developers achieve specific quality and latency requirements for their video-on-demand (VOD) or live-streaming applications, and efficiently scale across their cloud infrastructure.

“Intel® Xeon® Scalable Processor and SVT-HEVC enable Tiledmedia to stream Premier League Football matches in very high quality VR for our customers BT Sport and Sky UK, while realizing bitrate reductions up to 75%, which allow them to reach the widest possible customer base.”

The Scalable Video Technology developed by Intel and released to the open source community has been applied to another coding technology, SVT-HEVC, and is discussed in more detail in a white paper, Scalable Video Technology for the Visual Cloud with Azure Cloud Instance Measurements. A closely related paper, Scalable Video Technology for the Visual Cloud with AWS Cloud Instance Measurements, discusses Amazon’s use of this technology. A newly released version of this technology, SVT-AVS3, provides improved coding efficiency with support for a wider range of coding tools. Sessions from a recent IBC Showcase event highlight the ways that enterprises are rethinking the physical and virtual distribution of visual cloud workloads and adapting to the ever-growing needs of this industry sector.

**On the Edge with OpenNESS**
Open Network Edge Services Software (OpenNESS) is an open-source toolkit through which platforms can be built and used to support applications, services, and accelerators in an edge environment.

An edge environment puts a premium on the ability to manage many distinct platforms in a uniform manner, as they must be located close to their end users, and must be able to achieve high compute density (for example, by deploying accelerators) in order to support applications In a cost-effective manner. Platforms built with OpenNESS take advantage of modern cloud-native software technology with edge optimizations to achieve these benefits. Intel has developed a proprietary distribution of the OpenNESS toolkit with additional functionality: Intel Distribution of OpenNESS. This distribution provides additional features, including increased workload capacity and security hardening, suitable for deployment in industrial and enterprise environments. It supports a larger catalog of hardware and software building blocks to help systems integrators and application developers to deploy edge platforms into production more rapidly. More details about this technology are provided in Using OpenNESS to Increase Innovation at the Network Edge.

## Advantages of Hosting at the Edge

The advantage of hosting applications on the edge include:

- Reduced latency – Typical latencies for cloud-based applications are around 100 milliseconds. In comparison, applications hosted on the edge latencies typically range from 10 to 40 milliseconds. Latency for an on-premises deployment can be as low as 5 milliseconds.8
- Reduced backhaul – Because in some cases data does not have to go to the cloud, service providers can lower network costs by upgrading network access points in response to demand. Usually, it is not necessary to have to upgrade the full network path to the cloud, simplifying deployment and maintenance expenses.

- Strong enforcement of data sovereignty – For highly regulated or sensitive data, many operations can be performed using the on-premises edge, ensuring that the data sovereignty measures are strictly followed. In these cases, data never leaves the data owner's site.

**Partner Proof Point – Cloud Native CDN**
Video streaming has become an essential service and an integral part of consumer needs. With insatiable consumer appetite for live and on-demand video and the COVID-19-related explosion in consumption, CDN providers are continuously challenged to keep innovating in optimizing their infrastructure for cost and performance. Being able to dynamically scale CDN infrastructure to meet unexpected demand is one of such key challenges. Most recently, Intel has been collaborating with several customers and ecosystem partners to create an optimized cloud-native platform design with best practices for automation and life cycle management. Intel and Rakuten at IBC 2020: A case for Cloud Native CDN Intel and VMware at VM World: Deploying a Scalable Media CDN soluton on VMware Telco Cloud Infrastructure Intel QCT and Robin webinar: Architecture for High-Performance Cloud-Native CDN.

## Partners Driving New Technologies

A vibrant partner ecosystem is a necessity for designing, developing, and deploying next-generation video and media solutions. Intel's understanding of the business needs, technology options, and media workload challenges gives organizations within the ecosystem access to the expertise, building blocks, and collaborators needed to build rich media solutions.

Following are some of the programs and technology enablement available through this partner ecosystem:

- Intel Network Builders – Over 400 members of the Intel Network Builders program offer a range of solutions for developing CDNs. These solutions lower barriers to containerized network function development at the edge, optimize workloads for more efficient media delivery and meet requirements for rapidly designing and deploying full-featured software platforms, as well as addressing many other challenges involved in deploying an effective CDN.
- Commercial ecosystem solutions are available through the Intel Solutions Marketplace, including Intel Market Ready Solutions, Intel RFP Ready Kits, and Intel Select Solutions.
- Intel Select Solutions for Visual Cloud Delivery Network – Provides a fast-track specification for building and deploying next-generation CDN servers based on Intel Xeon Scalable processors.
- Intel Select Solutions for Media Analytics – Provides a starting point for the development of solutions in the areas of media/entertainment and smart cities. Preverified hardware and software configurations eliminate the need for solution providers to select and tune those stacks, reducing costs and risk, and accelerating time-to-market for new services.
- The Open Visual Cloud is a set of open-source software stacks (with full end-to-end sample pipelines) for media, analytics, graphics, and immersive media, optimized for cloud-native deployment on commercial-off-the-shelf servers and supported by an actively growing open-source community.

The complexity of data centers today requires the right mix of hardware and software components to build an infrastructure that meets each organization's requirements. Intel Select Solutions eliminate guesswork with rigorously benchmark-tested and verified solutions optimized for real-world performance. The reference designs provide specifications for the hardware and software stacks to support next-generation operations, including numerous open-source software tools and frameworks, created by the open-source communities.

**Partner Proof Point – Live 8K, 360-Degree Streaming at IBC 2019**
Live media streaming is one of the most exacting video applications and one that requires contributions from tech

partners with different fields of expertise. To bring the IBC and Intel Visual Cloud Conference to a worldwide audience in September 2019, Intel teamed up with several partners with expertise in live 8K VR streaming: Akamai, Tiledmedia, and Iconic Engine. The conference was aimed at media technology leaders to explore Visual Cloud business opportunities, demonstrate technology solutions, discuss the challenges, and outline the different available implementations.

VR feeds were routed to 12 countries—complementing the onsite, standing-room participants at the host site in Amsterdam—and they covered six individual events during the conference. This use case has enormous potential for business conferences, meetings, and other online venues where travel limitations or geographic issues favor remote gatherings. Producing Live 8K, 360-Degree Streaming Media Events covers the specifics of this conference and discusses the technologies that were employed.

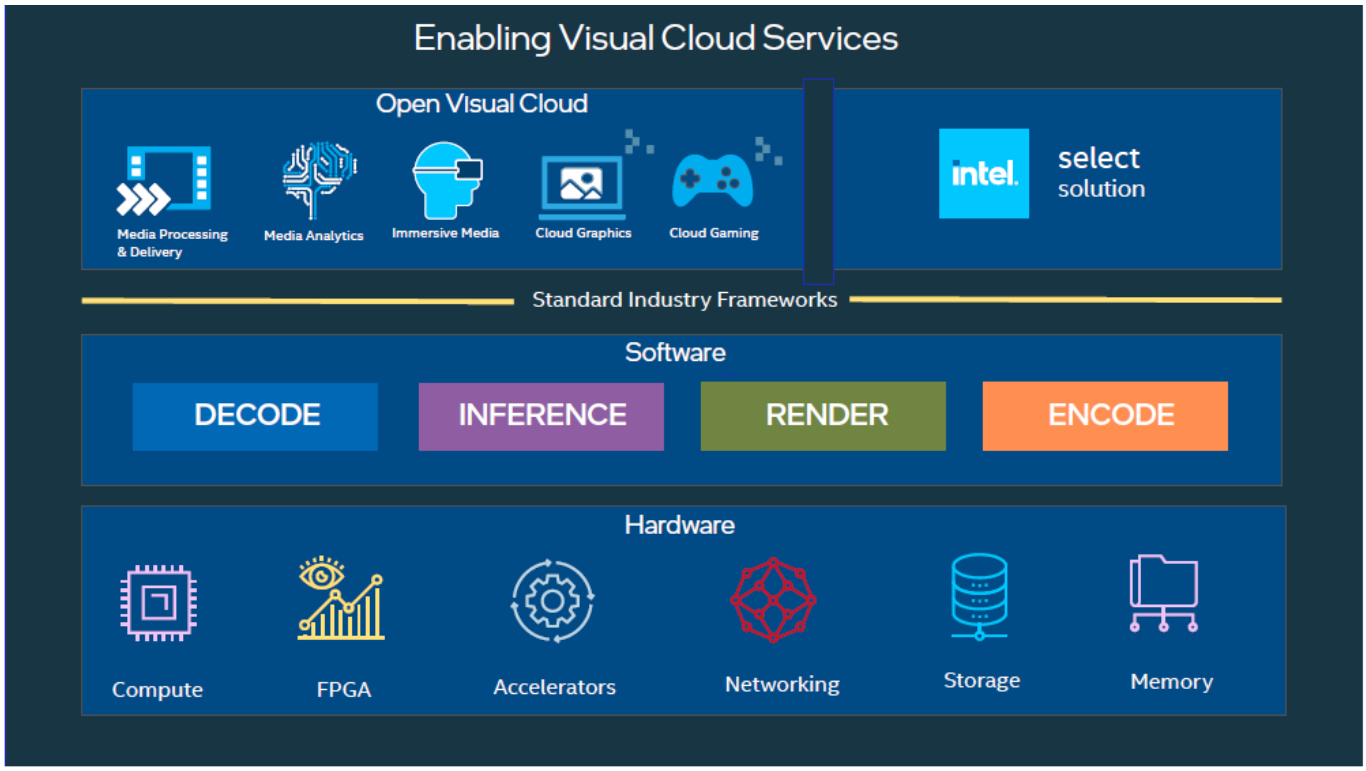
**Partner Proof Point – CDN Proof of Concept**
As an example of the benefits of an I/O optimized architecture, Intel and Dell Technologies developed a proof of concept (PoC) to demonstrate how Dell's fully balanced R640 platform (codenamed Keystone), featuring NGINX (a free, open-source, high-performance HTTP and reverse proxy optimized by Intel), delivers maximum performance in edge computing applications, focusing on the kinds of workloads encountered by a CDN. Results demonstrated that this balanced I/O architecture provided strong performance advantages for streaming video, serving web content, and media processing.

The PoC achieved high throughput (200 GbE) and low latency storage through the use of Intel NVMe SSAs (solid state arrays) and Intel 100 GbE network interface cards, as well as Intel Optane™ DC persistent memory. Intel Ethernet 800 Series Network Adapter, Hardware Queue Manager, and the NUMA-balanced platform from Dell contributed to the performance advantages, and Intel Xeon Scalable processors rounded out the performance capabilities. Details about this project can be found in a Intel Network Builders web presentation, IO-optimized Architecture from Dell: CDN and High-Performance Storage.

## Providing the Complete Portfolio

To support this explosion of evolving media, organizations and service providers need resilient, scalable infrastructures and the right combination of modern hardware, advanced software, and optimized open-source components. The comprehensive, balanced portfolio offered by Intel delivers industry-leading visual experiences at a surprisingly low TCO—scaled to meet the needs of each individual customer. Learn about Intel's visual cloud solutions including white papers, blogs, case studies and videos through the resources at Intel Visual Cloud.

**Enabling Visual Cloud Services**




## End Notes

1. Visual Cloud vSummit Q&A Panel. Intel Network Builders. https://networkbuilders.intel.com/events2020/network-edge-virtual-summit-series
2. Based on internal Intel estimates. Tests measure the performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. Consult other sources of information to evaluate performance as you consider your purchase. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks. For further specifications, visit https://www.intel.com/content/www/us/en/products/programmable/fpga/stratix-10/nx.html
3. Comparison based on Stratix® V vs. Intel® Stratix® 10 using Intel® Quartus® Prime Pro 16.1 Early Beta. Stratix® V Designs were optimized using 3 step optimization process of Hyper-Retiming, Hyper-Pipelining, and Hyper-Optimization in order to utilize Intel® Stratix® 10 architecture enhancements of distributed registers in core fabric. Designs were analyzed using Intel® Quartus® Prime Pro Fast Forward Compile performance exploration tool. For more details, refer to Intel® Hyperflex™ FPGA Architecture Overview White Paper: https://www.intel.com/content/dam/www/programmable/us/en/pdfs/literature/wp/wp-01220-hyperflex-architecture-fpga-socs.pdf. Actual performance users will achieve varies based on level of design optimization applied. Tests measure the performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. Consult other sources of information to evaluate performance as you consider your purchase. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks.
4. The Challenge of Keeping Up with Data. Intel Optane Persistent Memory Product Brief. Intel. https://www.intel.com/content/www/us/en/products/docs/memory-storage/optane-persistent-memory/optane-dc-persistent-memory-brief.html
5. TCO analysis is based on internal Intel research. Pricing as of 10/01/2020. The analysis assumes standard server pricing, GPU list pricing, and software pricing based on estimated Nvidia software license costs of $1 per year for 5 years.

6. Performance may vary based on the specific game title and server configuration. To reference the full list of Intel Server GPU platform measurements, please refer to this performance summary.
7. Liu, Yu. AV1 beats x264 and libvpx-vp9 in the practical use case. FACEBOOK Engineering. April 10, 2018. https://engineering.fb.com/2018/04/10/video-engineering/av1-beats-x264-and-libvpx-vp9-in-practical-use-case/
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## Notices and Disclaimers

Performance varies by use, configuration and other factors. Learn more at www.Intel.com/PerformanceIndex. Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure. Your costs and results may vary. Intel technologies may require enabled hardware, software or service activation. Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.



## Documents / Resources

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|  | intel Visual Workloads Demand a Modern Edge Infrastructure [pdf] User Guide<br>Visual Workloads Demand a Modern Edge Infrastructure, Visual Workloads Demand, Modern Edge Infrastructure, Edge Infrastructure, Infrastructure |

## References


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- Edge computing and 5G give business apps a boost | Computerworld
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- Intel® Stratix® 10 NX FPGA Overview - High Performance Stratix® FPGA