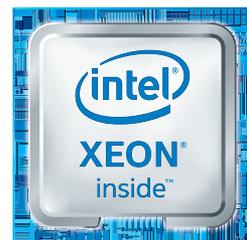




**INTEL® NETWORK BUILDERS  
SOLUTION BRIEF**

**INEOQUEST\* AND INTEL -  
END-TO-END VIDEO QUALITY  
ASSURANCE THROUGH  
VIRTUALIZATION**





## Introduction

Video traffic on the Internet continues to grow at an accelerating rate. According to the Cisco\* Virtual Network Index,<sup>1</sup> nearly a million minutes of video content will cross the Internet each second by 2019. The index further predicts that global consumer Internet video traffic will constitute 80 percent of all consumer Internet traffic in 2019, up from 64 percent in 2014. The VNI also expects that content delivery networks (CDN) will deliver over half of all Internet video traffic by 2019.

Centralized walled gardens of video and networking equipment are no longer a viable architecture for video delivery. Video providers of all types are moving to distributed infrastructures for their delivery chain in order to accommodate continued growth and changing usage.

The competition for a dedicated audience is a big challenge, driven by providers that offer broadcast TV, cable, Internet, VoD, over the top (OTT), and other technologies. With so many choices, consumers can and do change providers as a result of poor video performance, buffering, or other viewing problems. It is essential that providers minimize service disruption, maintain high quality, and offer new services in a timely manner. In order to minimize churn and attract new customers, providers must proactively monitor, analyze, optimize, and monetize their video delivery chain – all in the face of the rapidly changing landscape of CDNs, networks, transport mechanisms, and viewing devices.

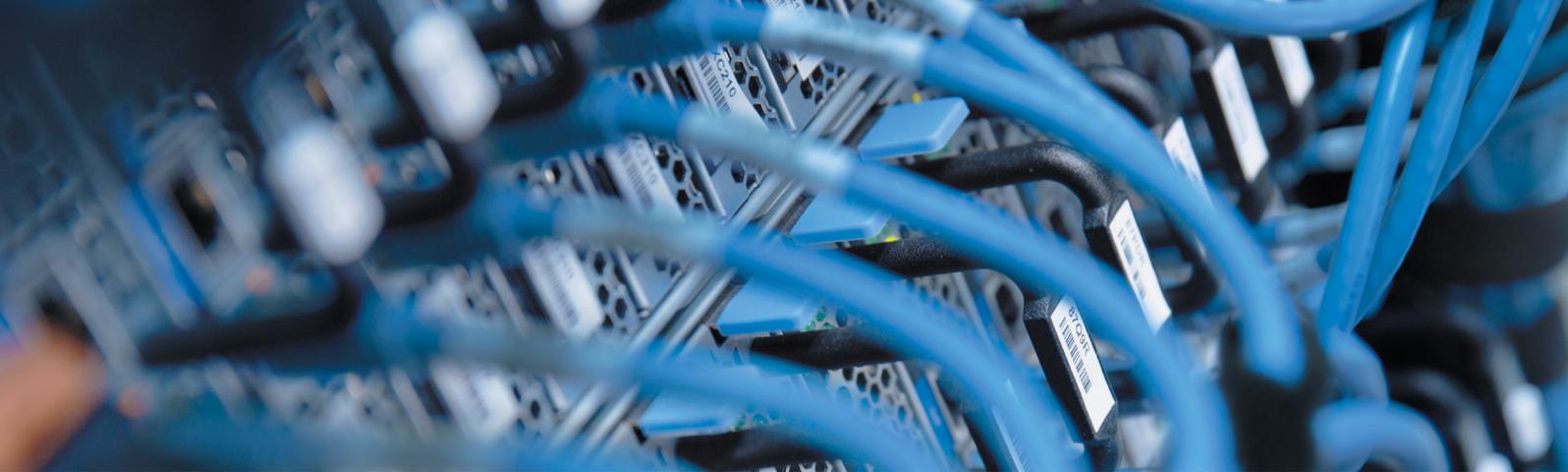
IneoQuest™ Technologies, a leading vendor of video quality assurance (VQA) products, offers comprehensive end-to-end video monitoring and analysis tools within its FoQus™ Platform product portfolio. A variety of products are available in virtualized packages, allowing customers to adopt network functions virtualization (NFV) architectures for scalability and deployment flexibility that can keep pace with anticipated growth and the changing manner in which video is stored, transported, and delivered.

The transformation from physical appliance-based products to software-based NFV-capable products was significant for IneoQuest, whose reputation was historically based on its very high-performance custom-built, dedicated hardware. The transition was the result of a three-year collaboration with Intel that has led to the successful launch of its first series of virtualized products.

## Challenge

Video consumers have an ever-increasing set of choices, including broadcast, cable, satellite, and OTT/Internet delivery, with OTT offerings increasing every day. And consumers are turning to streamed content in preference to discs (Blu-ray\* and DVD) in many cases due to the convenient and cost-effective service options. Because of this, they have less and less tolerance for connectivity problems and poor video quality. It only takes a few poor experiences for them to look for alternative channels.

<sup>1</sup> Cisco Visual Networking Index: Forecast and Methodology, 2014-2019 White Paper. [http://www.cisco.com/c/en/us/solutions/collateral/service-provider/ip-ngn-ip-next-generation-network/white\\_paper\\_c11-481360.html](http://www.cisco.com/c/en/us/solutions/collateral/service-provider/ip-ngn-ip-next-generation-network/white_paper_c11-481360.html)



Streaming providers and service providers must stay on top of their game by monitoring and analyzing their delivery pipeline in real time. And as audiences continue to shift from linear TV to over the top (OTT) content, closed, single owner/operator networks commonly associated with cable and telco TV are being challenged by the OTT model, where video sources, preparation services, networks, and delivery mechanisms sourced from multiple service and network providers are combined together to provide a service. And the complexity does not end there: adaptive video, multiple CDN sources, cloud hosting, new protocols, HEVC/4k, mobile network, and new viewing devices all create their unique challenges.

Customer experience management (CEM) is now an essential tool for video providers, offering not only a constant awareness of quality of service (QoS), but also of consumers' quality of experience (QoE). Real-time monitoring and analysis of video streams allows providers to anticipate and respond to service quality issues before consumers see them.

Advanced correlated analytics are required on three planes to make this happen:

- End-to-end from content source to consumer device
- Across multiple fixed and mobile networks
- Across multiple services

The use of multiple video platforms means that faults and errors that affect QoE can occur during the encoding process, on network segments, due to transport methods, and at interface points. Figure 1 shows a delivery chain model that includes delivery to Wi-Fi, mobile, and residential viewers.

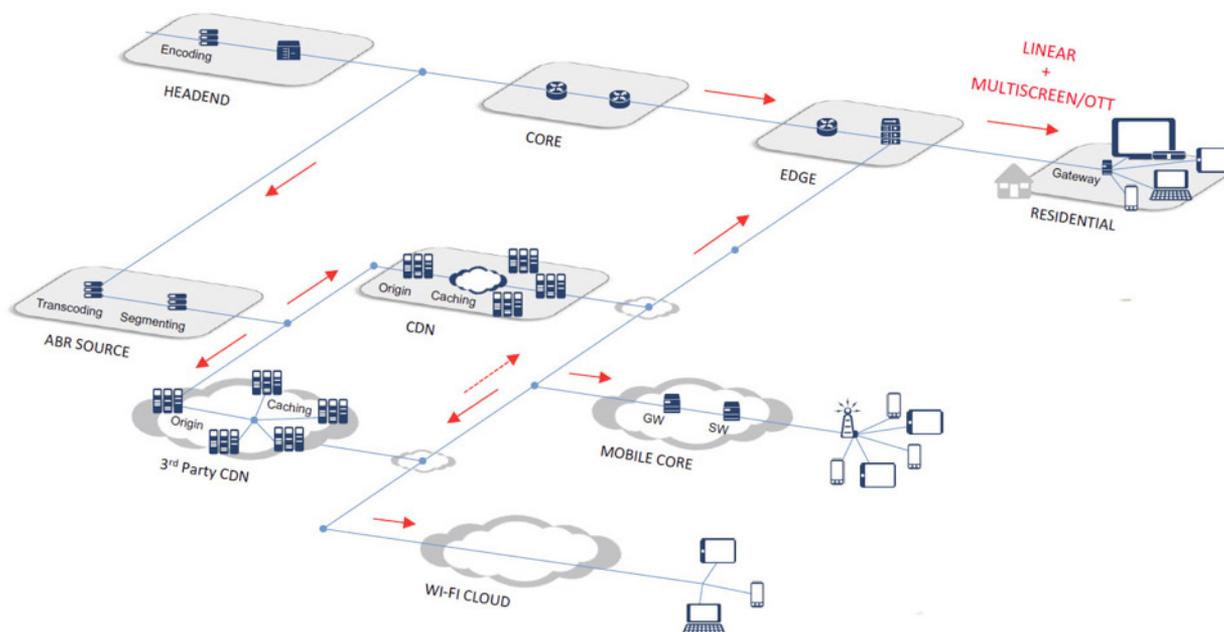


Figure 1. Video Delivery Chain



Effective CEM requires end-to-end visibility into every stream/channel, ad, viewing experience, and viewer response to that experience. Real-time analysis along with historical summary data enables monetization of video services by providing the behavioral data needed to better target advertising and new services, tuning of service efficiency, and demographic profiling of customers.

IneoQuest's FoQus products monitor, analyze, and validate both traditional linear and adaptive bitrate streaming (ABR) networks. IneoQuest traditionally used special purpose, highly optimized, FPGA-based hardware appliances designed to simultaneously analyze hundreds of channels in parallel – consistent with the needs of traditional linear IPTV networks. However, IneoQuest recognized that OTT distribution was a game changer, and they realized that as the demand for anytime/anywhere/any device video viewing intensified, NFV and SDN architectures would be crucial to the success of future networks. This meant migrating away from custom hardware products to completely software-based products that could run on standard hardware platforms.

The challenges in shifting to software-only architectures while maintaining hardware-like performance involving multi-gigabyte per second networks and massive, parallel channel analysis were substantial. IneoQuest also needed to ensure that their virtualization efforts were compatible with NFV and SDN standards, while being portable across multiple hypervisors and scalable enough to meet the needs for ubiquitous distribution of video analytics in future networks. To help ensure success in this major initiative, IneoQuest turned to Intel.

IneoQuest, through collaboration with Intel, has developed and now offers virtualized, software-only versions of their FoQus Platform solutions to provide the scalable, distributed CEM architecture that is needed to match the flexibility and elasticity of the video delivery networks they must analyze.

## Solution

IneoQuest made the crucial decision to virtualize its product line. Their first NFV-based line of products for monitoring, analyzing, and displaying video network status was announced in February of 2016, culminating a three-year effort. The initial set includes:

- Inspector™ Live – verifying the quality of ABR video content preparation
- Surveyor™ ABR Active and iQDialogue® ASM – monitoring video QoS across the entire ABR delivery infrastructure
- iVMS® ASM – cohesive video management system for understanding and correlating video assets across the assurance platform

Other CEM elements in the IneoQuest portfolio are planned for virtualization throughout 2016.

The largest effort in virtualizing the solutions revolved around the move from a hardware platform to a software architecture. The FPGA-based hardware is capable of simultaneously analyzing hundreds of channels of video in real time. Once a compatible software version was developed, virtualization became more straightforward, but then involved scaling the solutions across multiple hypervisors and soak-testing on different blade architectures. Additional effort is required to ensure compatibility with the [ETSI](#) NFV management and orchestration architectural framework (NFV-MANO) implementations, such as OpenStack,\* and IneoQuest is actively pursuing this with customers and as part of the EANTC NFV interoperability testing.

The virtualized versions of Inspector Live, Surveyor ABR Active, iQDialogue ASM, and iVMS ASM are highly scalable and flexible. They can be used independently or in conjunction with existing appliances. Virtualized elements may be distributed throughout the delivery chain, as opposed to the centralization that often occurred with

hardware-based monitoring entities. Whereas a centralized set of appliances was previously used to analyze hundreds of channels, now analysis can occur in lower channel densities at the content ingress points, throughout the network, or toward the edge for greater visibility. Analysis takes place where and when video processing and forwarding is performed.

Virtualization has also provided an opportunity for monitoring traditionally difficult locations, such as at network edge devices and CDN nodes. IneoQuest technology embedded in wireless network smart cells,<sup>2</sup> small cell aggregation nodes, or mobile edge computing nodes, for example, can provide much greater video intelligence at the mobile edge, allowing a service provider to measure performance as it is delivered to consumers' wireless devices. As a proof of concept, IneoQuest deployed video analytics on the Intel® architecture-based smart cell platform, as shown in Figure 2, and this was soon followed by a small cell aggregation node and prototype mobile edge computing (MEC) platform. As video analytics becomes more pervasive and embedded, video service providers will enjoy reduced call center loads, fewer truck rolls, and a significant reduction in both mean time to diagnose (MTTD) and mean time to repair (MTTR).<sup>3</sup>

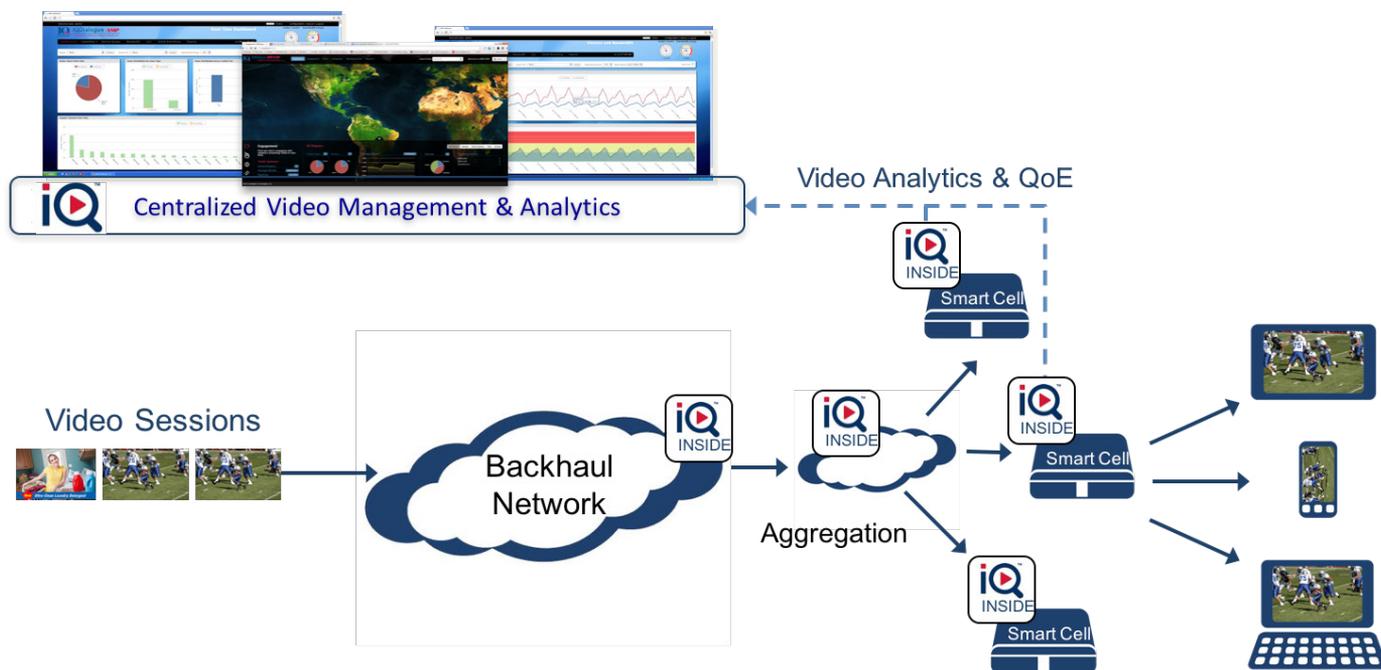


Figure 2. Real-Time Analysis Within Smart Cells

IneoQuest has worked with the Intel® Network Builders organization for four years, and has been extensively involved in early developments of video analytics in MEC platforms. They have participated in a number of proof of concept (PoC) demonstrations during that time. As part of one PoC, IneoQuest helped BT\* to use an NFV-based iQDialogue ASM QoS probe for monitoring of adaptive video from a virtualized cache.

## Intel Technology

IneoQuest is a founding member of the Intel Network Builders ecosystem. Intel has been a major driver behind SDN, NFV, and smart cell development and deployment and provided IneoQuest with substantial development aid and roadmap planning. IneoQuest virtualized solutions are optimized for the high volume networking and multicore execution capabilities of the Intel® Xeon® processor E5-2600 products.

A key enabling technology that allowed IneoQuest to achieve the desired multi-gigabyte per second throughput is the Data Plane Development Kit (DPDK). The DPDK, initially developed by Intel, is now an open source project. The DPDK software library is used by IneoQuest to route network packets around the Linux\* OS kernel and its implementation of Open vSwitch\* (OvS).

<sup>2</sup> Smart cells receive and transmit across multiple frequencies and wireless disciplines, controlled by centralized software management.

<sup>3</sup> "Smart Cells Revolutionize Service Delivery," Intel White Paper. <http://www.intel.com/content/dam/www/public/us/en/documents/white-papers/smart-cells-revolutionize-service-delivery.pdf>

## IneoQuest QoS Monitoring Features

- **Virtualized platform compatible with NFV/SDN.** Virtual video acquisition/probe elements are placed in the same data center and even on the same platforms used for video processing.
- **Scalable and elastic.** Virtual instances may be instantiated or torn down to match video channel usage.
- **Extensible.** Virtual components work seamlessly with existing IneoQuest installations.
- **Flexible.** Virtual components may be installed at more points in the delivery chain, providing further visibility into device, network, and transport operation.

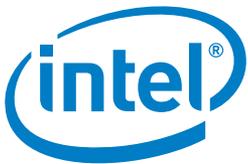
## IneoQuest QoS Monitoring Benefits

- **Economical.** Virtual components may be hosted on existing and commodity servers.
- **Pay-as-you-grow.** Additional IneoQuest components may be deployed as needed for new CDNs, services, channels, and consumers.
- **Enhanced customer service.** Visibility at the edge enables faster and more accurate customer service, leading to higher customer loyalty and reduced churn.
- **Reduced time-to-market for new services.** Monitoring and analysis can be tied to new services as they are being evaluated and deployed, ensuring high-quality operation on day one.

## Conclusion

Virtualization in general and network function virtualization specifically are changing the face of video delivery. Consumers expect high quality delivery from multiple sources, making it essential that providers monitor and analyze their video sources and delivery from all sources and for all consumers.

Video service components are being virtualized and the only way for providers to keep up with this growth and flexibility is to use virtualization for quality (QoS and QoE) monitoring. To do this, they require tools that are flexible, scalable, and powerful. IneoQuest's virtualized monitoring and analysis tools perfectly match the needs of a growing, morphing video delivery architecture.



## Disclaimers

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