The role of Software Defined Networking (SDN) in broadcasting

Whitepaper

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1 Introduction

1.1 Software Defined Networks – basic concept

Software Defined Networking (SDN) has become one of the most 'must-use' tech phrases of the last year. This is due in part because it is correctly seen as an important technology related to IP, but also because some equipment providers are intent on imposing their own variations of the technology. In short, it means so many different things to so many people.

Yet, the basic concept of SDN is fairly simple. Software Defined Networks are IP networks where the routing decision, or control logic, is taken out of the network and handed over to software controllers with enough processing power to pick the optimum routing for the required service. This means the software controller can dictate the path(s) taken by IP packets, thereby making the connection "deterministic" (defined and predictable).

It's this determinism which makes SDN particularly attractive to broadcasters, who are used to knowing exactly what signals travel down what cable and what is the expected performance of a connection. SDN means they can get the best of what standardized IP has to offer (not least the choice and favorable price-points of routing equipment from the IT industry), while getting the performance they are used to with media networks built with traditional baseband technology.

The key here is to take a standards-based approach – proprietary approaches will only lock-in the customer. With a standards-based SDN-enabled infrastructure customers are no longer tied to a single hardware switch vendor, but can mix products from different vendors without compromising any system/solution functionality.

1.2 Overview of Nevion's SDN solution

1.2.1 Standards-based approach

Nevion has chosen to adopt a standards-based approach to SDN. Nevion's media service management solution, VideoIPath supports for the Openflow protocol that is already being deployed by telecom service providers as part of their own SDN strategy.

With Openflow, VideoIPath is able to deliver the deterministic and scalable performance required for the transport of live video and audio. At the same time, this standards-based approach means that the benefits of IP can be realized

1.2.2 Leveraging IP benefits

One key benefit is that of the leveraging of the capabilities and price points of the much larger IT industry. The cost of deterministic, high-bandwidth packet switching and high data rate physical network interfaces is being driven down by

data centers and other key high-volume IT applications. Like it or not, more and more media interfaces are evolving to IP and as this happens the mandate for a switching and control layer that can handle this becomes ever-more important.

1.2.3 Smooth migration from baseband to IP

VideoIPath enables broadcasters to migrate to IP using SDN technology without disrupting the workflows that broadcasters are used to from the baseband environment and without the complexity involved in managing an IP network infrastructure directly. It also allows broadcasters to operate hybrid infrastructures with a combination of baseband, traditional IP and SDN.

1.2.4 Bridging IP networks in studios, campuses and beyond

One major advantage of the standards-based SDN approach is that there are no changes to the transport layer. A service that is delivered using SDN technology may easily traverse into a traditional IP network since the transport layer is still IP. There is no need for additional gateways or conversion to baseband to cross between an SDN controlled and traditional IP network boundary. So in effect, remote studios or outdoor broadcasts become extensions of the central studios and campus.

2 SDN and Broadcasting

2.1 Where does SDN sit with the broadcaster?

For some years now, broadcasters have made use of telco networks for many aspects of their long-distance signal transport, e.g. contribution, primary distribution, distribution, etc. Since telcos have led the way in the adaptation of SDN technology, indirectly SDN has been part of broadcasters' extended networks for some time – even if that capability has not, until now, been readily available to them. SDN is part of broadcasters' extended networks.

However, the current focus in broadcasting is on using SDN in the campus/studio environment. Does SDN have a role to play here and if so what?

2.2 SDN, a natural evolution

In many ways, the way broadcast baseband connectivity has been controlled over the past few decades in a campus/studio environment has been quite "SDN like" in that there is typically a central control system that defines explicit routing of a video feed from one location to another. In that set up, there is an absolute deterministic behavior of the routing, which is inherently expected and desired, and the concept of overprovisioning connections is non-existent.

SDN is a way of reproducing that deterministic architecture using IP networks.

2.3 Benefits of true-SDN for the broadcast studio

As mentioned in the introduction, one key benefit of SDN in facilities is the ability to leverage the capabilities and price points of the much larger IT industry.

The flexibility of switching elements in a distributed architecture can be highly attractive for a neat and cost effective studio/campus installation. Similar to a data center approach, a small top-of-rack switch can provide all local aggregation and can be connected to a central hub with just a pair of fibers.

In addition to the cost benefit, the convergence and unification of real-time media delivery with that of non-real time file transfer means a single connectivity solution can handle both types of data. Likewise, video, audio and data control signals can be handled on a unified switching infrastructure rather than run as separately routed networks.

The benefits of SDN also extend beyond the confines of the studio/campus.

2.4 Benefits of true-SDN for wider area broadcasting

The requirements for wider area real time media connectivity are increasing, especially driven by the burgeoning interest in remote production. For remote production, the ideal requirement is to have all of your studio/campus capabilities over a long distance. The laws of physics are non-negotiable on the

basis of speed of light in fiber (200km/ms) but apart from that, most other studio benefits and capabilities can be realized in a wider area network. Some recent Nevion deliveries have effectively realized the concept of a national video router with low latency and 'transparent' IP connectivity under the lid.

With the help of SDN technology, management and control of the complete network becomes seamless, effectively delivering the flexibility and cost effectiveness of IP, while maintaining the deterministic performance expected by the broadcast industry.

Yet all of this this is only possible if a standards-based approach is used. Vendor-specific solutions only end up locking broadcasters into specific and often costly technology.

3 Nevion's SDN solution

3.1 VideoIPath

Nevion is taking a standards-based approach to SDN, with the VideoIPath managed media platform at the core of the solution. Due to its agnostic, IP-driven nature, VideoIPath has been inherently "SDN-like" since its development, making this adventure a relatively straightforward one for Nevion.

3.1.1 Technology-agnostic user experience

With the ever-increasing complexity of the digital packetized world, it becomes more essential to avoid challenging end users with the underlying technology used for service provisioning. The aim of Nevion's VideoIPath is to achieve precisely this goal – provide a technology-agnostic and non-technical interface to the end user for controlling end-to-end connectivity. So, a user deals with concepts that make sense to their business (connect studio 1 to studio 2), rather than having to handle the intricacies of the underlying network (network router ports, media gateway settings, etc.).

3.1.2 Video routing and network control

VideoIPath is Nevion's overarching Media Network Management System (control, inventory & performance management). VideoIPath's control capabilities were born several years ago out of the need for a modern next generation video router control system. After its inception, the system very quickly became a much more generic controller, able to communicate with a variety of both different broadcast-specific and IT network elements. Thus, VideoIPath functions both as a robust broadcast video router controller as well as a high performance network controller.

3.1.3 Baseband and IP (Nevion and 3rd party)

VideoIPath is now a fully featured technology agnostic control system capable of controlling both media edge and network connectivity. The system can provide full connectivity orchestration both in the traditional broadcast space (SDI routers) and in the modern IP network. It can also integrate with many manufacturers of high performance Ethernet switches, including Cisco and Juniper, as well as with Nevion's own eMerge Ethernet media routers.

3.1.4 Smooth migration

Leading broadcasters and service providers across the world are using VideoIPath to provide both immediate and future-booked connectivity control. One of the most positive features of the VideoIPath platform is that it allows the underlying technology base to be migrated while the user interface remains constant and familiar. This can therefore facilitate the transition from traditional SDI routers to an IP-based solution with no visible change in the user control experience.

3.1.5 Supports OpenFlow

VideoIPath has used several different vendor-specific protocols to interact with devices in the network. Although this works fine for controlling the equipment that has already been integrated into the solution, it does require some special adaptation every time customers want to add equipment from new vendors. In addition to these vendor-specific communication protocols, VideoIPath also integrates with OpenFlow – a key SDN technology for making the infrastructure vendor agnostic.

3.2 What is OpenFlow?

OpenFlow is the name of the standardized protocol used to control the flow of data through a network by direct communication with the forwarding plane of the network elements. OpenFlow defines a standard protocol for a central controller to communicate with network devices and for applying a set of rules/filters to each network element. The protocol also allows the network orchestrator to automatically learn the network topology.

OpenFlow provides for easy scaling up to the equivalent of even the largest central video routers, and beyond.

3.3 How VideoIPath uses Openflow

3.3.1 Auto-discovery of the networks

VideoIPath uses an OpenFlow controller to determine the network topology and insert flow table entries to establish end-to-end flows between edge devices (encoders and decoders). The OpenFlow discovery uses specially crafted LLDP messages out of OpenFlow switches so that it can learn the network topology. It raises events (which you can listen to) when links go up or down. So every time a new device or link is added to the infrastructure, the OpenFlow controller will automatically be notified of the added capacity, and will add it to the topology database. This enables customers to start with a very small system (and thereby a very small investment), and still being able to easily grow to a very large system when required.

3.3.2 Intelligent routing

The network topology is used to make intelligent routing decisions between edge devices, which takes into account protection and bandwidth requirements for every service that is provisioned across the network. The outcome of the routing algorithm is a set of flow table entries that are installed in OpenFlow-capable switches to enable forwarding of packets from end to end.

The flow table entries are based on matching the destination IP or MAC address and telling each switch along the data path where to forward the packet (what output port). This way, VideoIPath is able to maintain full control of the traffic flows from end to end (with the help of an OpenFlow controller), which is necessary for transport of real-time services with high bandwidth.

VideoIPath utilizes a shortest-path-first algorithm to provision the least costly path from source to one or more destinations, and performs diverse path routing to support service redundancy mechanisms. The system keeps track of bandwidth allocation on each link within the network to avoid any over-provisioning and thus delivers predicable performance for video-over-IP services.

The system includes a network design tool that allows the administrator to define how edge devices are connected to the determined network topology. Each link is assigned a cost and may have constraints, such as bandwidth or format that are considered by the path-finding algorithm when performing path calculations. Alternatively, the system can also use a topology-aware addressing scheme to determine how edge devices are connected to the infrastructure, in order to avoid having to configure this information into the system.

3.3.3 Clean switching

One of the application of the intelligent routing is to provide clean switching. Through OpenFlow, VideoIPath is able to switch seamlessly, and with very little latency between sources, effectively replicating one of most demanding aspects of baseband routing.

3.3.4 Summary

VideoIPath provides the following features for provisioning media services across an OpenFlow-capable network infrastructure:

- Auto discovery of the network topology
- Path finding to establish the optimal transport path across the network infrastructure
- Application of constraints like bandwidth and format to the path-finding algorithm (defined per link)
- Least cost path-finding algorithm (each link has an associated cost)
- Diverse path routing, for service protection, including automatic geographic redundancy
- Provisioning of flow table entries in OpenFlow-capable switches
- Management of bandwidth allocation (to avoid over provisioning)

3.4 Media Edge Hardware

Nevion has an extensive portfolio of interface hardware to compliment VideoIPath media orchestration. Almost any media format can be adapted in and out of IP and transported at high speed with high availability and no degradation.

SDN concepts also apply to Nevion’s media edge adaption – with a focus on generic hardware that can be reconfigured to fulfil a number of key adaption and protection functions.

4 Conclusion

SDN for broadcast has the potential to provide more flexibility, lower cost and a future-proof route to a world where the real time and non-real time converge. Nevion's VideoIPath control solution, including the soft-reconfigurable media edge adaption, provides a fully open, standards compliant way of navigating this brave new world with confidence.

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