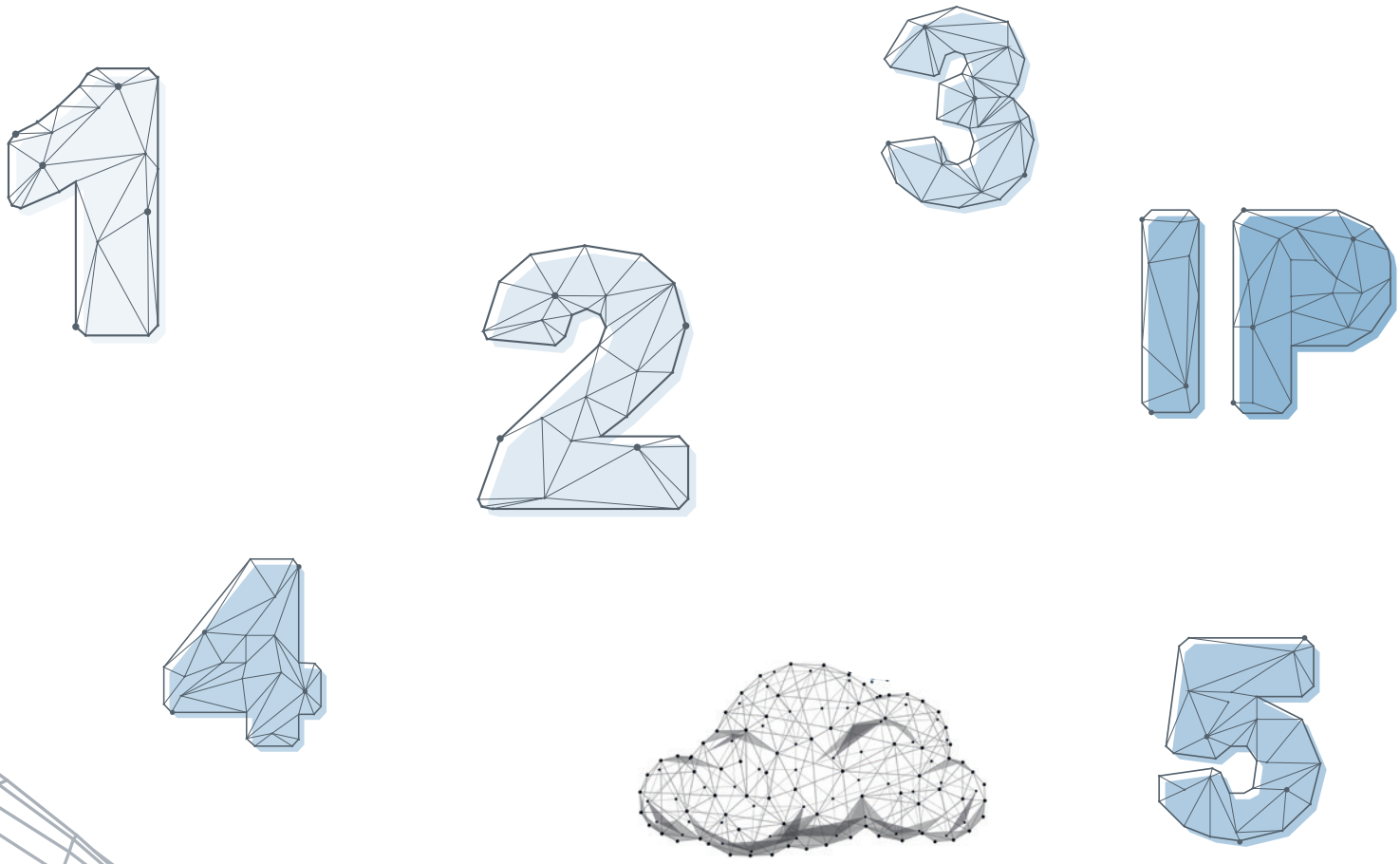
nevion

ARCHITECTS OF VIRTUALIZED MEDIA PRODUCTION

How to move incrementally to IP

A Nevion Whitepaper



Introduction

The broadcast industry is understandably focusing on the infrastructure of the future, and without doubt this will be based on IP.

That said, broadcasters have invested heavily in baseband technology for many years. They have studios and control rooms full of excellent (and expensive) equipment, from cameras and monitors to switchers and mixers. There is simply no business case for replacing all of these, unless the equipment's functionality needs to be upgraded, e.g. to support 4K/UHD.

Instead, broadcasters must concentrate on building out the IP media network, which of course provides the greatest benefits in terms of costs-savings and workflow transformation. As part of this, they need to consider how to accommodate SDI equipment, and indeed in some cases SDI networks.

In short, it's all about managing the transition from an all-baseband to an all-IP world, in an incremental manner.

Drivers for the move to IP

Moving to new facilities

Most of the early adopters of IP have had one thing in common: they needed to move facilities. In that situation, it was clear to them that laying down a baseband infrastructure in the new location, especially the large amount of cabling, made no sense when the future was IP.

The move was potentially risky for the very early adopters, as IP was still largely unproven and even standards like SMPTE ST 2110 did not exist when they made the decision. These broadcasters took the leap nonetheless, and it worked out – for the majority at least.

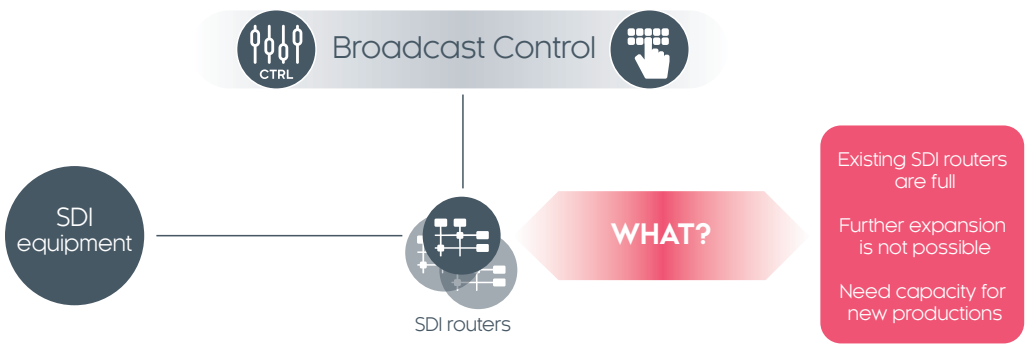
Broadcasters moving premises now have the obvious benefit of the experience of the early adopters and the progress made by the industry as a whole. This makes the move to IP a much safer one now.

Remote production

The need to cover one-off large events (e.g. the Summer Games or the FIFA World Cup) or regular ones (e.g. ice-hockey league) is often a catalyst for broadcasters to investigate replacing outside broadcast (OB) production with a centralized (so called remote production) approach based on IP – primarily for cost effectiveness reasons.

Such events don't usually trigger a move to IP in the central facilities, but they introduce some elements of IP-based production both on site and on the edge of the core facilities. These events often also serve as a contained experimental environment for broadcasters to assess the possibility of an eventual move to IP in their core facilities.

Gradual transition



For many broadcasters there may not be an immediate compelling business case to move to a full IP network environment. However, there may be opportunities to move gradually.

One common trigger is when the central routers are reaching maximum capacity. This means there is no room for additional equipment, new studios or control rooms, or a move to high-definition.

The obvious solution is to buy a larger SDI router. However, an alternative approach is to use this opportunity to build capacity using IP, allowing new equipment to be added, or capacity to be freed on the existing routers.

This is not a wholesale replacement of the baseband network, as is usually the case with a move to new premises, but the creation of a mixed SDI and IP network.

Handling mixed SDI/IP environments

As mentioned, no broadcaster currently operates in an all-IP environment. At best, they will have a mixture of SDI and IP equipment, connected to an all IP network. Broadcast production networks will in fact remain a mixed SDI/IP environment for some years to come.

In order to build such an environment, some key functionality is required.

SDI/IP Adaption

SDI/IP adapters or gateways, such as Nevion's Virtuoso or its Flashlink IP Converters, adapt media signals, clock information and associated data between the technologies (e.g. SDI to/from SMPTE ST-2110, and GENLOCK, black burst/tri-level sync to/from PTP).

NEVION VIRTUOSO

Nevion has a broad offering for media nodes, including those from the Ventura and Video Gateway families.The latest offering, Nevion Virtuoso is a high-density, software-defined media platform designed to perform a variety of tasks suitable for both WANs and LANs, including IP encapsulation (SMPTE ST-2022-6, TR-04, SMPTE ST-2110), encoding/decoding (JPEG2000, TICO and H.264), transport protection, monitoring, aggregation, and signal processing (e.g. video, and audio embedding/ de-embedding).

This functionality can be changed on demand – so called Media Function Virtualization. Regular software updates ensure that more media functions are added all the time, making Virtuoso even more versatile with every release.

These gateways provide the means to connect SDI equipment to an IP network (or indeed IP equipment to an SDI network). Fundamentally, they can also be used to connect IP and baseband networks together, for example in the cases of IP-based facilities network capacity expansion or new studio build-out.

This means that, from a connectivity point of view at least, it is possible to run a mixed SDI/ IP environment.

Connectivity and processing in "baseband islands"

As mentioned above, even when facilities move to a much more flexible and cost-effective IP network, most of the equipment is likely to remain based on SDI technology for some time. SDI/IP adaption equipment (see above) can be used to connect the SDI equipment to the IP core network.

However, connecting a lot of SDI equipment to an IP network may be expensive. Furthermore, it might not be necessary as that equipment will often be used together within the confine of a studio or control room, e.g. SDI camera to SDI switcher or SDI monitor. In such "baseband islands", converting SDI signals to IP and back to SDI may be superfluous.

The most cost-effective way to distribute signals between baseband equipment may then be to use baseband routing technology. Similarly, signal processing, such as audio embedding onto SDI signals or SDI frame synchronization, may best be done directly on baseband equipment rather than converting to IP, processing and converting back to baseband.

This could lead to an argument for keeping the existing large MCR matrices to handle this. This however is likely to be overkill in many cases. It also doesn't help solve the cabling headache, if all the equipment needs to be connected centrally.

NEVION'S SUBLIME X2

Introduced in 2014, Nevion's Sublime X2 is the world's first hybrid compact router. With its management, cross point and power redundancy, it features the reliability of large modular routers. A multi-core signal processing farm makes it a hybrid router. Its compact form factor makes it ideal for applications where size really matters.

For that reason, the most cost-efficient distribution and routing within baseband islands is likely to be smaller SDI routers, such as Nevion's Sublime X2, located within the baseband islands. Obviously, as these routers take on part of the job done by the MCR routers, they also need to offer a high level of redundancy, and include SDI processing capabilities.

These baseband islands can then be connected to the rest of the IP network through adaption equipment.

Existing fiber technology

Traditionally, the transport of baseband signals beyond the studios has been handled by fiber, with technology (such as Nevion's Flashlink product range) providing the interface onto and from the fiber.

FLASHLINK OPTICAL TRANSPORT

For hundreds of organizations across the world, Nevion's Flashlink is the go-to solution for optical transport of video, audio, data, intercom, Ethernet and sync signals. This modular solution transports signals reliably, transparently and with close to zero latency.

Flashlink can handle anything from a few channels over a short distance, to hundreds of multiplexed services per fiber over many miles, with built-in changeover and protection mechanisms to ensure ultimate service assurance. Originally designed for the transport of baseband traffic, Flashlink can also be used to transport IP over fiber and convert signals between baseband and their standards-based IP equivalent.

As the industry moves to IP, the requirement for high data-rate transporting will continue to grow - uncompressed HD requires a minimum of 10GbE data rates. Fiber remains ideally suited to transport signals any distance longer than a typical patch cable.

But even though IP is transported over fiber, the conversion of baseband to optical links are still a less costly solution than baseband to IP conversions. Hence, if equipment located far away is baseband, it can be a more cost-efficient solution to transport the signals through baseband EO converters.

So optical transport technology, will continue to be relevant in an IP world, and any investment in that technology for the transport of signals today is an investment of the transport network of the future – using fiber to transport IP as well as baseband.

Orchestration and control in mixed SDI/IP environments

While adaption equipment can ensure that the SDI world is connected to the IP world (and vice versa), a crucial issue is how to orchestrate and control flows between the two environments.

Most media network management and control systems have been developed for SDI technology and cannot manage IP. Conversely, IP network management systems don't handle SDI.

This is particularly problematic where the preferred option of a broadcaster is to keep some form of SDI routing in the network, for example within specific studios.

This clearly calls for a versatile orchestration and SDN (Software Defined Network) control system, such as Nevion VideoIPath, that can handle both SDI and IP environments.

NEVION VIDEOIPATH

Nevion VideoIPath is a comprehensive orchestration and SDN control system that provides complete connection and resource management (including SDN), service assurance and network inventory capabilities for service providers and broadcasters.

The system is used for managing a variety of networks ranging from international or national contribution networks to broadcast facility or campus infrastructures. It is designed to handle both Nevion and third-party devices, both in a baseband and IP environment.

Such systems hold a complete view of the network and can control both IP and SDI routers, as well as adaption equipment (such media nodes) and other appliances. As a result, this type of orchestration and SDN control system can provide deterministic paths through a mixed SDI/IP network infrastructure. In turn, this makes it possible for broadcasters to have the mixed SDI/IP environment most suitable for them.

In other words, with the right orchestration and SDN control system, broadcasters need not go to an all-IP network at once, and they can choose equipment based on functionality and cost, not SDI or IP connectivity. Ultimately, this flexibility translates into a more cost-effective transition to IP.

Broadcast control

Production staff are typically used to a specific broadcast control interface (panel) and are often reluctant to move away from it. However, popular broadcast control systems are not designed to control IP networks.

The solution is to ensure that the broadcast control system can interface with the orchestration layer. This is typically done via APIs (application programming interfaces) provided by the broadcast control system and implemented in the orchestration system. For example, Nevion's VideoIPath supports (amongst others) the Ember+ API used by some popular broadcast control systems.

A tight coupling of the familiar broadcast control systems and the orchestration layer ensures that production staff can maintain their existing method of working, even as the underlying network technology evolves.

A smooth migration path to IP

The path to an all-IP production involves stages in which SDI equipment, and in some cases SDI networking infrastructure, co-exist with an IP infrastructure.

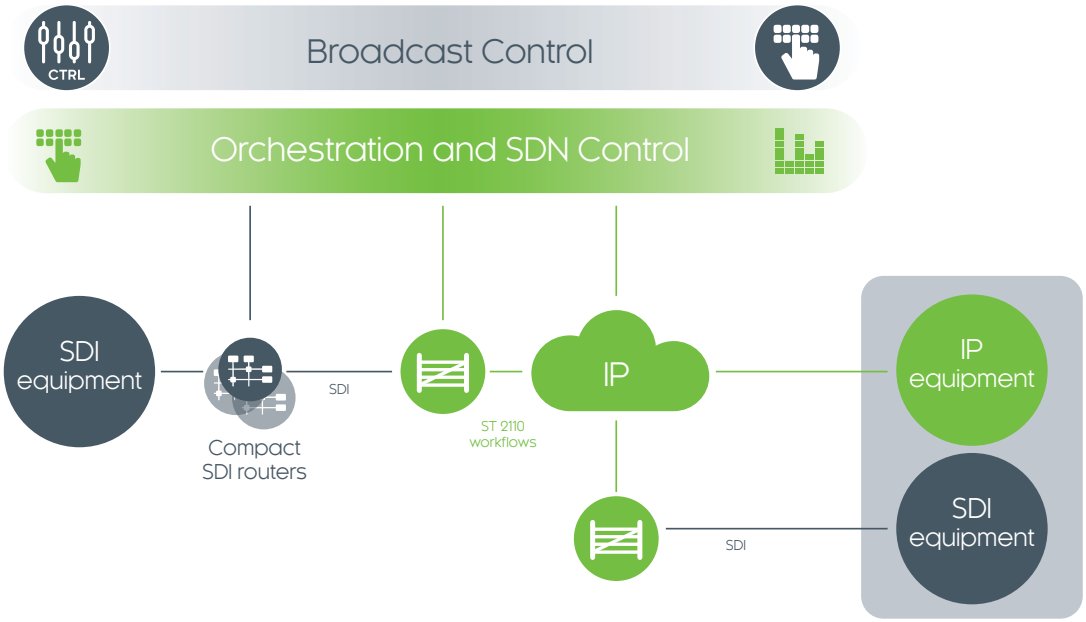
A hybrid SDI/IP network

Realistically, only those broadcasters moving to new facilities and starting with a "greenfield" site have the luxury of building an all-IP network from scratch. Broadcasters who are building out capacity using IP, or adding new IP studios or control rooms, need to maintain their core SDI network, for both practical and financial reasons.

This requires the creation of a hybrid SDI/IP network. This, however, can easily be achieved with the help of SDI/IP gateways and a convergent SDI/IP orchestration system.

The SDI/IP gateways play two roles. Firstly, they provide the tie-lines between the SDI routers and IP network (including converting flows to and from SMPTE ST 2110). Secondly, they allow SDI equipment to be connected to the IP network. Native IP equipment can obviously be "plugged" into the IP network without going through the gateways.

The control of the network is handled by the orchestration system, with the production staff working through the existing and familiar broadcast control surface and logic.



An all-IP network

The next step in the migration is to remove the legacy SDI routers. For broadcasters moving to new premises, this is where their migration typically starts as the a hybrid SDI/IP network is not needed.

In this set-up, the core network becomes all-IP, controlled by the orchestration software, with the production interface remaining the same broadcast control system.

IP equipment is connected directly into the IP network. SDI equipment can be connected through SDI/IP gateways. Where substantial "islands" of SDI equipment remain (e.g. in a studio or control room), routing can also be achieved with the help of small compact hybrid SDI router (see "Connectivity and processing in "baseband islands", p.4). These compact routers are connected to the IP network via gateways.

An all-IP production

Eventually, when all the equipment is IP, the compact hybrid routers and the gateways can be removed, as all equipment will be connected natively to the IP network. This is likely to take many years though, as the business case for wholesale replacement of SDI equipment only becomes compelling when leaps in technology warrant it, e.g. move to higher resolutions.

It is worth noting that gateways that are software defined media nodes, such as Nevion Virtuosos, are likely to be redeployed in another capacity (e.g. audio and video processing), thanks to their versatility.

CASE STUDY: SÝN/VODAFONE ICELAND

Sýn, the Icelandic company formed by merger of Vodafone Iceland and the 365 broadcast media, wanted to consolidate its telecom and broadcast premises for cost-efficiency and work-effectiveness reasons. This required broadcast production to move to new premises.

Rather than transfer the existing SDI production network infrastructure, Sýn opted for a new IP media network that would provide greater flexibility, future-proofing, scalability and cost-effectiveness over time. The production equipment, including cameras, video and audio mixers, would remain unchanged, i.e SDI-based.

The new IP media network was delivered in record time by Nevion and its local partner Exton: it was ready for production in just six weeks.

At the core of the solution delivered in the new facilities is an IP network built around Nevion's COTS (commercial off the shelf) eMerge IP switches. Nevion's software defined media nodes, Virtuosos, provide the gateways between the SDI equipment and the IP media network, as well as video and audio processing, and 4K TICO encoding.

Where many pieces of SDI equipment are used, Nevion's compact hybrid SDI routers, Sublime X2, are deployed to enable easy routing between the equipment, without the need to convert to and from IP.

The satellite reception site, as well as in the DVB and IPTV headend site, which are located elsewhere, are both connected to the core IP network via Nevion's Flashlink (CWDM) over an existing fiber network. The equipment at both these locations is mostly SDI, but as there is little need for SDI connectivity between these, all connections are routed via the central IP network.

The whole network is controlled by a combination of Nevion's Multicon broadcast controller (already in use at Sýn) and Nevion VideoIPath. The solution went live on 8th February 2019.

IP network architecture

Network architecture for broadcast production is discussed in detail in the Nevion whitepaper "Architecture & Control - The two keys to IP infrastructure success in broadcast". The ideal architecture described there is an "end-game" though: broadcasters don't need to leap to a full spine-leaf set-up, particularly if they are building a hybrid SDI/IP network in which the IP component remains small initially. The principle should always be "start small and expand" as needs dictate.

Simple centralized routers

So, for example, the IP network could be a single IP router to which are connected IP equipment and SDI/IP gateways (such Virtuoso) which enable SDI equipment to be connected.

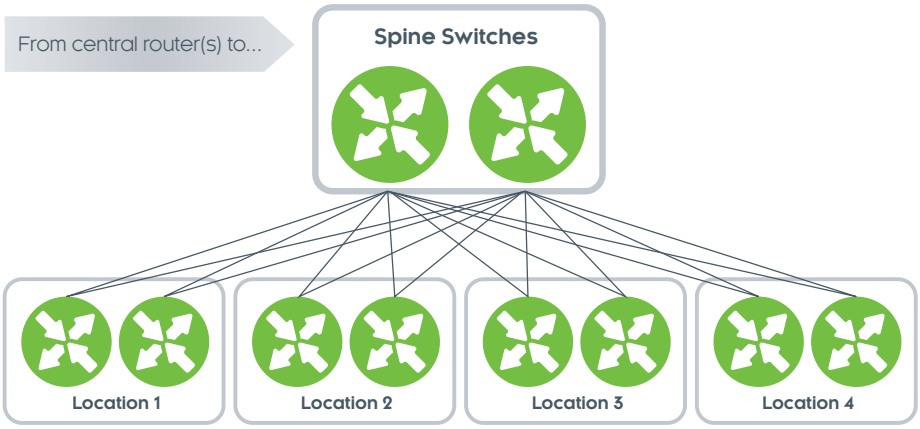
This obviously creates a single point of failure, so it would probably make sense to add a redundant switch. The network remains comparatively small and simple.

IP equipment or SDI/IP gateways to SDI Equipment

Moving to spine-leaf

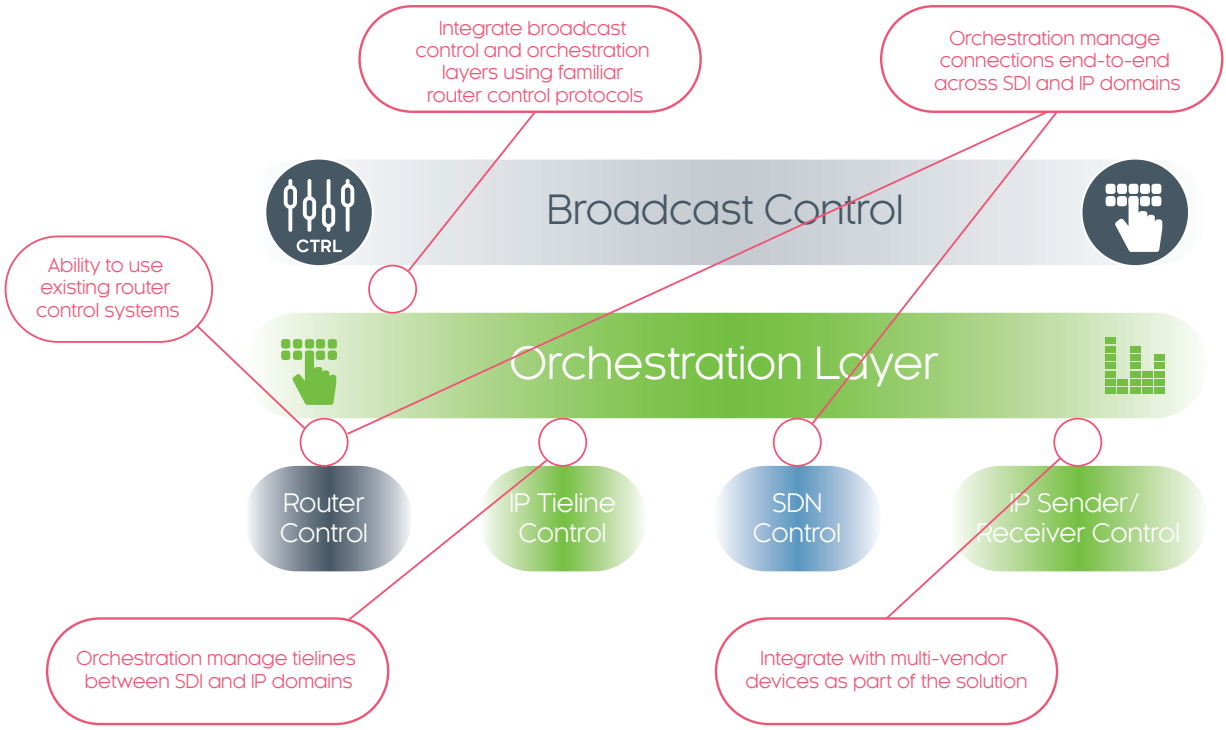
As extra capacity is needed, a spine/leaf approach can be taken, with smaller switches acting as aggregators.

For reference, the table below provides a summary of the capacity of IP switches, expressed in terms of HD signals.



Switch	Max Capacity
10G interface	6+6 HD
25G interface	2+2 UHD
100G interface	60+60 HD
48 port 10G leaf switch	288+288 HD
48 port 25G leaf switch	96+96 UHD
32 port 100G spine switch	1920+1920 HD
32 port 100G spine switch	256+256 UHD

Control



As mentioned in earlier sections, the key to making the whole setup work is the orchestration and control approach.

This approach provides:

- Ability to use existing router control systems
- Integrate broadcast control and orchestration layers using familiar router control protocols
- Orchestration manage connections end-to-end across SDI and IP domains
- Orchestration manage tie-lines between SDI and IP domains
- Multi-vendor devices as part of the solution

For more information about network architecture and control options, refer to the Nevion whitepaper “Architecture & Control - The two keys to IP infrastructure success in broadcast”.

Conclusion

For broadcasters, the transition from baseband to IP need not be an all-or-nothing decision – it will be a gradual transition. Adaption equipment and orchestration are the key to ensuring that the transition can be achieved in a smooth way, without affecting production.

This whitepaper is an extract of Nevion’s “From Baseband to IP to Virtualization - Architecting the media production infrastructure for the future” book, which is available in print at most tradeshows attended by Nevion and its partners.

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