# Core Insights

From the experts at The Broadcast Bridge.

# Operating An IP Broadcast Facility

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# Introduction

by Tony Orme - Editor at The Broadcast Bridge.

**Whether we're routing signals or remotely operating equipment, the need for reliable system control is one of the most important aspects of a broadcast facility. But as we migrate to IP, some of the working practices we took for granted with SDI operation don't necessarily transfer and this is most evident in signal routing.**

SDI routing matrixes have stood the test of time, but they rely on X-Y signal switching to connect source and destination devices together. Although IP systems still have source and destinations devices, they differ in two main aspects; they are full duplex and are packet switched.

With ST2110 systems, multicasting is often used to distribute signals resulting in potentially thousands of streams being generated in a network infrastructure. As IP has allowed us to move from point-to-point connectivity to mesh networks, keeping a map of the thousands of source and destination IP addresses is both a logistical nightmare and prone to human error.

Software Defined Networks (SDNs) provide a method of abstracting away the low-level IP routing allowing users to easily "see and visualize" the network topology and design. But SDN is more than a simple signal control interface, it provides an entire management layer providing many possibilities of integration for third party equipment. Regardless of the network topology chosen, users, engineers and system designers have a consistent view of the infrastructure.

One of the most important reasons to move to IP is that it provides outstanding flexibility to make the most efficient use of highly valuable infrastructure assets. Devices such as cameras, production switchers and sound consoles can be easily routed allowing both their control and signal processing to made available in different studios thus making the best use of any spare capacity.

It is technically possible to manually route the video and audio signals and control systems but using an SDN solution makes this possible at the touch of a button thus greatly reducing any complexity. Furthermore, entire shows can be stored as presets so they can be recalled allowing entire studio facilities to be provisioned within a few seconds.

As an industry, we have gone beyond the "making it work" phase and are now embarking on truly creative solutions to improve and simplify workflows. This Core Insight, sponsored by Lawo, investigates the problems to be solved and the solutions available.

For a deeper dive into SDN solutions, check out the following articles;

### 1. Control Is Key To Successful IP Facility Operation

Discusses why we need SDN and how it operates in an IP broadcast facility.

### 2. A Forward-Looking Control System Made For Today

Explains how SDN works and how it is integrated into an IP broadcast facility.

### 3. At CBC's New IP Broadcast Center, Communication Is Key

Describes CBC's brand new, state of the art, IP broadcast facility and the importance of communication and control in critical systems.

# Part 1 - Control Is Key To Successful IP Facility Operation

by Michael Grotticelli

**As IP technology continues to mature and the industry gains a better understanding of how IT-centric infrastructures work, many broadcasters are now eager to migrate away from the limitations of SDI to grow their businesses and make them better able to support increased production demands and multiplatform distribution.**

The business case for moving to IP is now being proven daily at a number of new facilities in the U.S. and Europe that are launching new radio and video over IP services without increasing staff or equipment. Thanks to switched network infrastructures these resources are being utilized more efficiently, so the ROI on the required technology is achieved faster.

However, with so much system complexity and third-party interoperability that needs to be designed and managed, centralized control and monitoring of IP infrastructures has become critical to packet-based productivity. Like in an SDI environment where the router was responsible for signals being distributed in a deterministic fashion, data switches and significantly increased signal processing are now under software control. This allows the facility to reconfigure its signal paths at a moment's notice and adjust the workflow to fit the job at hand.

## Facility Management Makes (Business) Sense

Heretofore in a traditional broadcast facility there has never been a need for an overarching control system. That's because all of the systems that are needed to complete a production don't recognize each other on a network. You might have an intercom system and a production switcher and a multiviewer. They are all needed to complete the overall production, but each is a standalone system. Bringing them together under central control is where the magic happens.

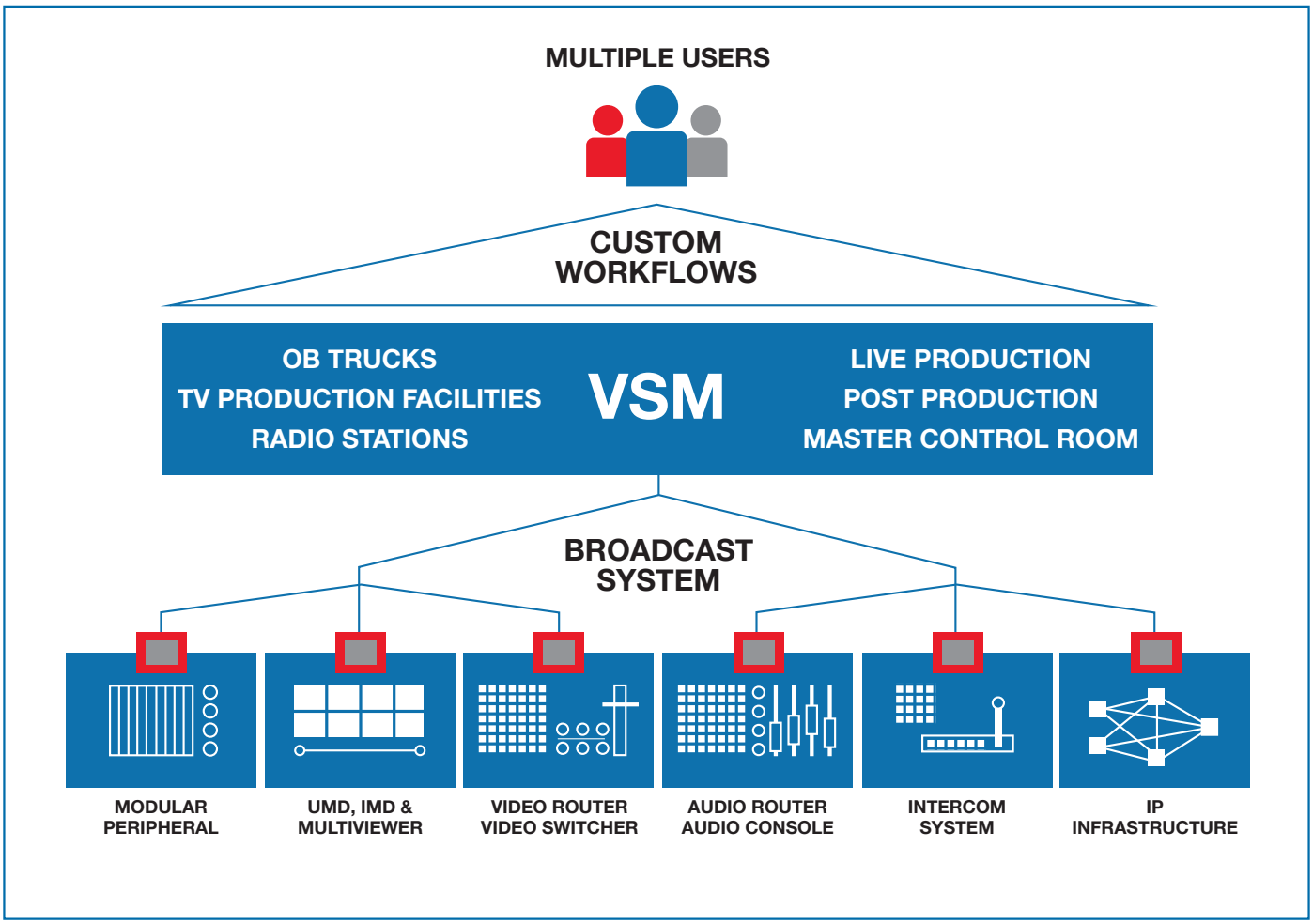
Take the audio guy for example, who is sitting in front of a large console and a multiviewer in his suite. He needs to see images and labels on the multiviewer as he's mixing a project. In order to get the right picture and labels on the multiviewer, he needs to tell somebody to route it to him. Therefore, he needs access to the console, the intercom and the multiviewer. So, either a dedicated person is required to be on call and manage the distribution of signals that the audio guy requires, or he can do this himself by pushing a few buttons—working faster and more efficiently.

## Control And Monitoring Saves Time And Money

"That's what a control and monitoring system does," said Axel Kern, Product Manager for the Lawo VSM broadcast control system. "It saves time and effort and allows the operator to work faster and be more productive by having everything where and when he needs it."

A software-defined IP control system interpolates and tags all of the third-party systems in a facility and forwards the control of them to the end user. So, everybody has access to the signals all of the time, but they use a task-specific remote control at their station for their personal needs. All of the complexity stays in the background.

This, then, is about controlling devices in order to share signals with the least amount of effort.




"We do not forward or touch an IP stream from a transmitting device to a consuming device," said Kern. "We tell the consuming device where to find that stream and how to get it. That's what a broadcast controller does. It's a simple xy routing for the end user but behind the scenes it's much more complicated. This does not mean that working directly with the streams is not necessary, but it makes sense when it comes to deeper system or telemetry monitoring, which Lawo addresses with a product called SMART."

## Network Switch Acts Like a Matrix Router

In an IP facility the central (core) router has been replaced by edge devices that stream directly into the network. The network switch works like a matrix router. In order to perform the stream route, the control system operator tells the edge device to register to an existing stream without working at all with the infrastructure in the middle. A more sophisticated way is to control the infrastructure in the middle to pre-route streams to an egress port on the network where the stream leaves the infrastructure and goes into the edge device. For example, a camera sends its signals into an egress port where the monitor sits and displays the signal.

The big change from baseband infrastructures to IP is that all signaling becomes abstract. With SDI, you had one cable between devices carrying either a separate signal or an embedded signal with video and audio. If you unplug that cable you lose one signal.

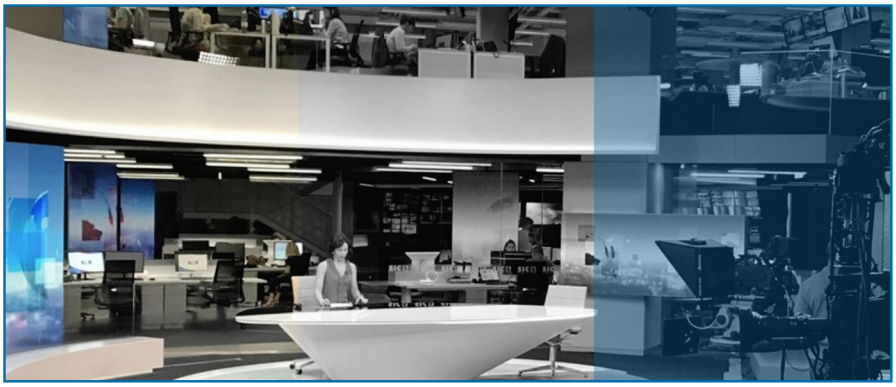
In a networked infrastructure, you use fibers with a bandwidth of 10, 25, 40 and 100 Gbps. On these fibers you have up to thousands of audio signals and hundreds of compressed video signals. If you unplug one of those fibers, the you lose an entire production. Protecting against this failure requires specialized software that maintains control over the entire infrastructure. If one signal goes down, you can move to another signal automatically and not lose time on your production.

## Initial Cost Is Higher

The required network infrastructure discussed here is not cheaper to deploy than a baseband design. Indeed, most current network infrastructures need to be updated every five years or so. But at the end of the day that's why it becomes so much more flexible to operate than SDI. New devices, as they become available, can simply be plugged into the network and be immediately available to any authorized person across the entire facility. In terms of technology, an IP facility is always up to date if it is planned and maintained properly.

## ROI Is Quickly Apparent

Configured correctly, the financial return from a switched IP network becomes quickly apparent. It starts with connecting all of the signals from the studio into a network and at the same time connecting all consumers (RX devices) of those signals. This allows you to connect several studios to the same devices, which can then be used as required—either separately or in parallel with another user.



With IP, you avoid hard-wiring anything. Previously, you had one router per studio, or per facility and there were limits to its I/O capability. The switched network infrastructure greatly exceeds this I/O capability, so you can have many different workflows going on at the same time. Without the need to unplug anything physically, you can reroute streams from one studio to another with a single button push. This allows you to route Studio 3 to Control Room number 4 on one day and Studio 3 to Control Room 2 another day because Control Room 4 is being used by something else.

That flexibility allows you to use existing equipment to the maximum, down to every individual signal processing module.

"The equipment cost a lot of money, so the key is to get as much capability out of it as you can," said Kern.

What the software controller does is to create a pool of available resources. Each resource is tagged and the user simply searches for that tag (e.g., for transcoding) in order to carry out a function on the network. All they look for is the output of the transcoder, for example, and not the signals going into the converter. The control system manages all of the processing in the background.

This allows you to create new types of productions in a much shorter time span. All of your equipment is used to its maximum capability. Many facilities are now running two or three studios with one control room, or even control rooms abroad in remote facilities. So this software-controlled system design allows you to produce more content with the same resources and manpower. At the end of the day many feel this clearly outweighs the cost of migrating to IP.

## Making The Switch

The decision to migrate has to be made very carefully. Most broadcasters migrate from an SDI infrastructure to IP because they want to create more content within the existing facility they are in. An IP system design easily allows them to do that. It also lets them set up remote productions, which again allows you to get the most out of existing resources.

By taking the complexity away from the end users with a switched network control system, production staff can spend more time being creative and focus on the job at hand. When everyone's working smarter, the business improves.

# Part 2 - A Forward-Looking Control System Made For Today

by Michael Grotticelli

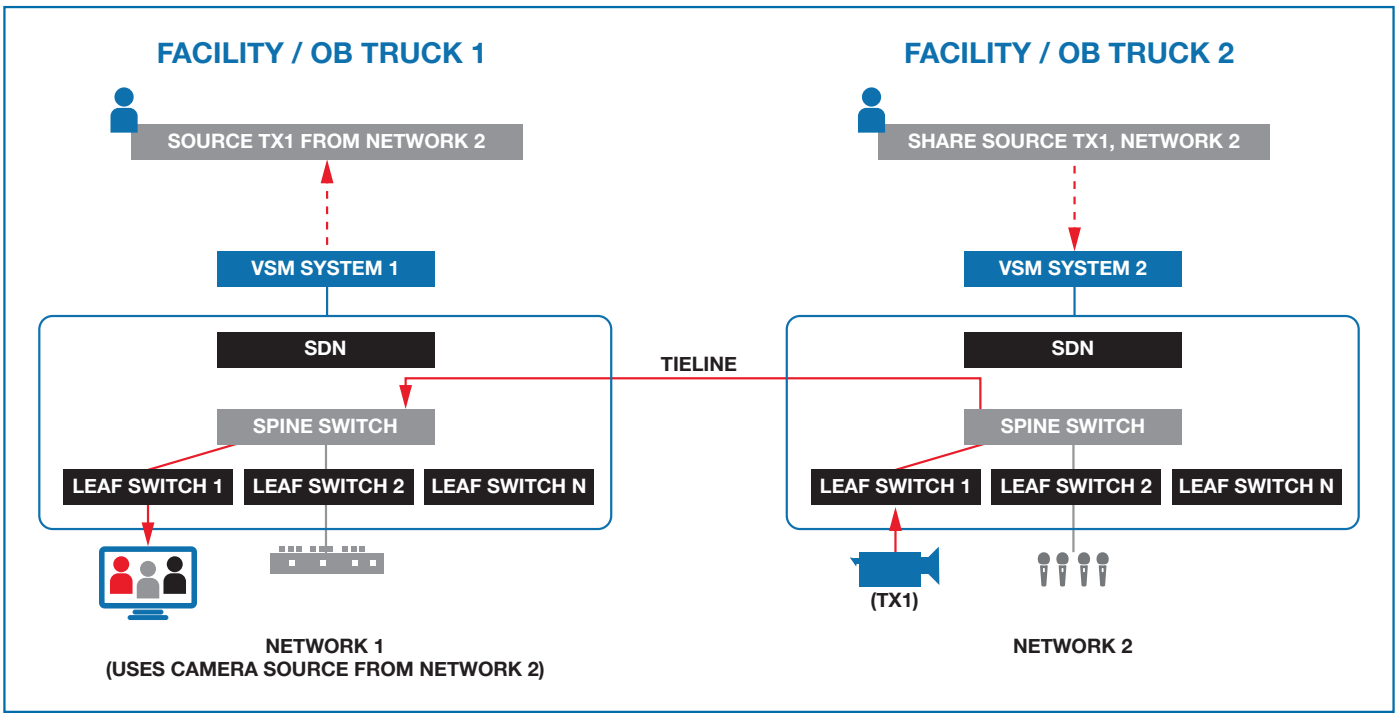
**When Lawo's Virtual Studio Manager (VSM) control system was first developed in the late 90's, it was in reaction to the need to control and monitor the video and audio signals that travelled around a facility or an OB truck. Nowadays, far more than 1000 installs and millions of lines of code later, the genetic roots of the product make it the perfect choice for IP environments. It's one thing to want flexibility to use thousands of signals in a myriad of ways, but it's quite another to quickly and accurately distribute signals to the right person at the right time. That's when the benefits of IP and a powerful control system become fully realized.**

The key is an independent control and monitoring system that allows operation, configuration and system integration of a broadcast or production facility's equipment and third-party devices on a network or across a series of networks.

Major broadcasters like Sky Racing, RadioFr, La Télé and others have all embraced the concept of a software-based control system that unites technical devices and operators in the most adaptable way. Hardware and software user interfaces (vsmPanels) can be configured to meet the requirements of different workflows and applications, while the whole system is under redundant control.

"VSM is a tool that can adapt to every kind of workflow and facility infrastructure," said Axel Kern, Product Manager for VSM at Lawo. "Each staff member operates their own control panel so the software knows who's asking for a signal and what signal they need."

The core of the system is a single piece of software called vsmStudio that runs on a COTS server and acts as the logic engine of the monitoring system. It allows core hardware components to be freely exchanged without changing interfaces or workflows. Training costs and time are saved due to a single control system interface that handles the control and setup of numerous devices.



## Real-Time Feedback

Managing an IP infrastructure is easy, incorporating all control panels, interfaces and external devices. It also leverages the advantages of high data performance and standard management components. Real-time feedback from every single crosspoint and parameter is available to those authorized, as are special applications such as audio metering via the protocol.

All user interfaces display the confirmed action from an attached device, for example, a router. This guarantees maximum transparency for every operator and every control unit. Additionally, a global naming facility for mixers, UMDs, user panels and many other devices provides status information at a glance.

"The VSM Studio module takes care of the communication to the edge devices or south bound connections relating to third-party devices," said Kern, "and it is the host of front end UI generation."

## Serving Both Sides

Then there are several satellite components that are connected to it. One side of the infrastructure is used to communicate with third-party devices and over the past 20 years Lawo has developed support for nearly 400 manufacturer APIs. Indeed, there are so many devices involved with content creation and distribution workflows - VSM can recognize most of them.

A comprehensive GUI provides all the functions, tools and setup functionality to control and customize the system to specific applications and workflow needs. In addition, all connected hardware settings and statuses are shown in real-time, with instant control and feedback.

For example, an audio mixing console sends meter data, fader data and equalizer data to the software. A routing device sends crosspoints and an edge device on the network sends the multicast status of the stream. The system automatically recognizes the different signals, processes them and sends them to the right operator, following a few button pushes on a touchscreen by that operator.

A gateway or protocol proxy gathers all third-party information and puts it into a central communication pipe connected to the system, allowing it to outsource the entire load of traffic that's related to the software.

On the other side of the infrastructure is the VSM panel—available in both hardware and software versions. The hardware version is a 1 or 2 RU push-button panel, where users get feedback of their actions. It's installed in OB vans and workplaces where tactile feedback of the operator's actions is desired. If something more sophisticated is required, the software running on a COTS personal computer with a touch screen is an ideal set up. The operator gets the same push button functionality in a virtualized interface even with graphical representations of the hardware devices on the network.

## Communication With Third Parties

Each staff member operates their own control panel so the software knows who's asking for a signal and what signal they need. The system sends out individualized information to the various staff members, so the video replay guy gets only what he needs and not what the audio mixer needs. The central core sees all of the signals and, by configuration of the actual user UIs, it differentiates who needs to see and operate what and what specific UI they need at that moment. Of course panel layouts and configurations can be adjusted at any time when required.

"Each facility or OB truck has its own specific workflow so VSM deploys the APIs to implement proprietary workflows," said Kern. "The strength of the system is that it adapts to individual

workflows and whatever hardware is being used."

If a single technician is responsible for several different shows, they can store pre-sets within and recall them later on the multiviewer for fast show set up. They can start with specific presets for their specific workstation and specify where the output needs to go.

The system puts these desired parameters into snapshots that can be recalled for a specific workplace. This way the replay operator only deals with replay signals. So, he can have a totally different display of features on screen than the TD or audio guy, for example.

Users can also collect data for an entire production and store it as a whole dataset (a so called box). In the event of a device failure, data can be collected and rerouted to another control room and another similar device. The monitoring and control can take parameters and map them onto a different control room with a single button press. Even if the infrastructure in the second control room is different, like if one has a Sony switcher and the other has a Grass Valley system, the routing will be mapped into that new vision mixer and VSM ensures that it sees the same signals on the Program bus and the Preview bus.

## From Point-To-Point To IP

The system was initially used as a point-to-point signal distribution system. It has now become more enhanced for IP infrastructures. If you have an IP facility and route a signal to an edge device; say, a camera signal to a monitor in the studio. That monitor is hooked up to a specific network port in a patch panel (wall box) on the wall. If that monitor is moved because you are changing the set, you unplug the monitor from the network and replug it into a different port on that switch. The network does not know about this, but the user wants to have the same signal on the same port.

Another advanced network functionality is that you work with IP fabric, which was never designed for real time broadcasting. So, if you route a signal through a network switch, the switch can do it right now or it can take a bit longer to complete the connection. If you press a button, there should be immediate feedback from the network that the action you just did is okay. Because it can be a top of the hour switch, the response can be delayed, causing operators to press the button twice, or three times or four times. This must be avoided because it's possible to send thousands of command signals into the infrastructure again, and again, and again.

VSM takes care of this by saying "we understand our internal metrics as the state of truth for the whole network and independently how fast the connected devices are reacting." It takes the operator's action as the initial trigger and confirms the action. It also makes sure that, independently of how long those devices take to respond, the response is confirmed at that time. And it's all done in software.

## Disaster Recovery

We have a large customer that has over 200 data switches for its audio, video and data infrastructure. If one of those switches goes down, you have to make sure that all of the IP streams are rerouted because those switches don't have an idea of what the workflow is. They will wake up empty, so, you need a brain on the network to tell these devices what to do.

## It's Nice To Share

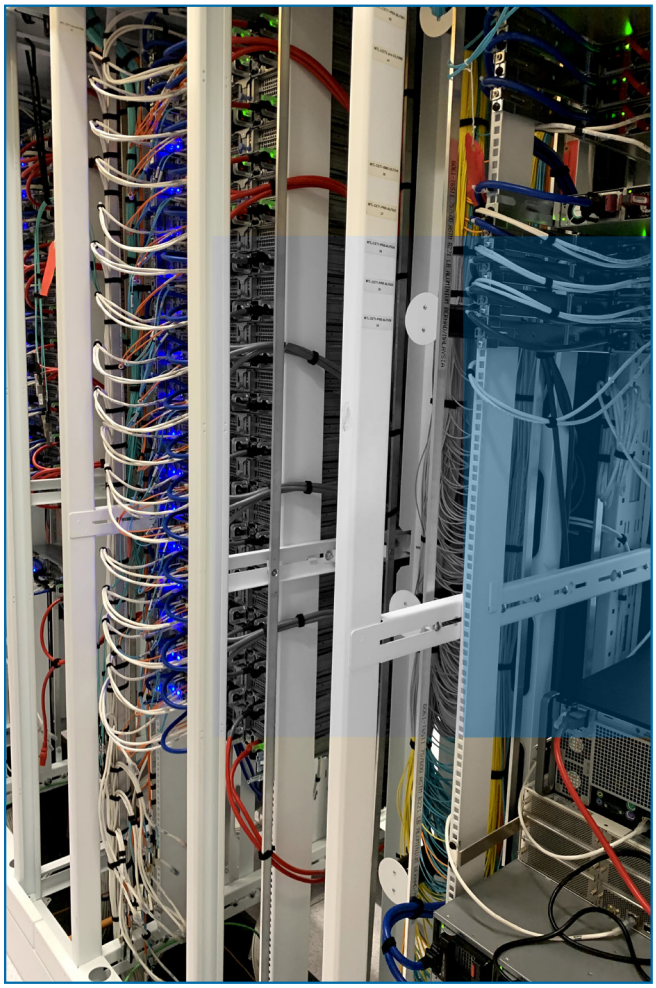
And last but not least is network bridging. It can allow two independent network installs controlled by VSM to be dynamically connected to each other. This could be within the same facility or between two remotely located buildings over a dedicated fiber trunk line. Devices on either network are available to each other, but each user needs to log onto the new network and request a signal from it. This helps keep unauthorized people from gaining access to signals they are not supposed to have.

A mobile production company can use this feature to connect multiple trucks during major live events and share signals between staff on both trucks.

## Have It Your Way

Because the system is software based, it is easy to setup and download updates as they become available (Lawo has just released version 2020-1). This also allows for virtually unlimited customization and system design configurations.

The power of a control and monitoring system is in its ability to accommodate a wide range of parameters, devices, workflows and business models tied to a switched network infrastructure. Every building needs a strong foundation. This field-proven control and monitoring system provides that solid footing upon which to increase productivity and build a flexible infrastructure that supports today's demanding consumers watching on all kinds of IP-connected platforms.



# Part 3 - At CBC's New IP Broadcast Center, Communication Is Key

by Michael Grotticelli

**CBC/Radio-Canada (CBC) is putting the finishing touches to a brand new all-IP broadcast facility that will provide virtually unlimited flexibility across multiple platforms to support highly efficient production and distribution workflows for its radio, TV and online programming.**

At 419,000 sq. ft., the new building—located on the same property as its existing SDI-centric facility in Montreal—is about two-thirds smaller than its previous headquarters, yet when they move in later this year the CBC news and entertainment teams look to be more productive.

The building will be responsible for over 100 TV, radio and web channels while allowing the broadcaster's production teams to seamlessly manage multiple audio and video formats and mix IP live inputs using back-to-back IP sources and file-based clips Adhering to an open standards-based IP approach by basing its workflows on the SMPTE ST 2110 standard allows the CBC to be fully format and resolution agnostic. This complex infrastructure also provides the needed flexibility and scalability to adapt its services to changing viewer demands.

## Spine-And-Leaf Topology

François Legrand, Senior Director, Core Systems Engineering Solutions at CBC/Radio-Canada, said that the infrastructure is designed as an IT-centric spine-and-leaf topology, with two identical and redundant signal paths. However, a pure spine & leaf topology can't be non-blocking for the type of multicast traffic at CBC, so they designed an infrastructure based on this architecture, but had to make two important modifications to make it suitable for broadcast applications.

"Ninety-nine percent of our real-time traffic is multicast, so this is a challenge," Legrand said. "To overcome this we use a single modular spine switch per network area, which is itself internally built like a spine-leaf network. We have four networked areas, thus 4 spine switches and 4 segregated zones of failure (production red, production blue, presentation red, presentation blue), red and blue are the redundant paths."

These Production spines are handled by Arista 7516R2 switches while the presentation spines are Arista 7508R2 switches.

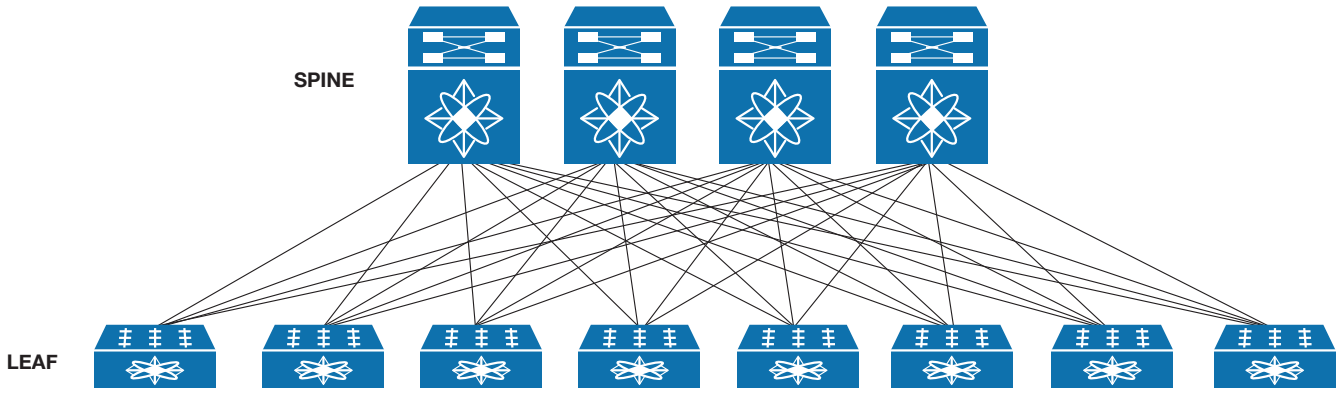



*Figure 1 – A typical leaf spine network topology used at CBC.*

"The second thing is that the random path selection done using IT traditional technique such as ECMP is based on hash compute on IP packet headers," he said. "This yields the same result for all of the packets of a specific media flow. So to work correctly a very high number of flows per 100 Gb/s link is required. This works for audio but not for video, even in HD, and it's worse in UHD. For this reason, the network is software defined using the Arista AMCS software. Equal distribution of flows between all uplinks is then guaranteed."

The new building's data center hosts the spine switch and wherever they need network connectivity they install a leaf switch. The link between the spine and the leaf features as many100 Gb/s bi-directional connectivity as needed, anywhere in the building. Between the leaf and each end device it is whatever the end device requires. So, 100 Gb/s gives them plenty of capacity to seamlessly share audio, video and data.

"The network doesn't care about video resolution or audio stream size," said Legrand, "It just needs to be able to recognize an end device and control it instantly. Unfortunately, every company offers a different way to talk to their devices. That's a problem."

The new building is multifunctional, supporting the CBC's News and General TV production departments. There are three studios for general TV production and two control rooms. Any control room can be assigned to any (or all) of the studios.

"We want the entire building to be used as a giant production studio," he said.

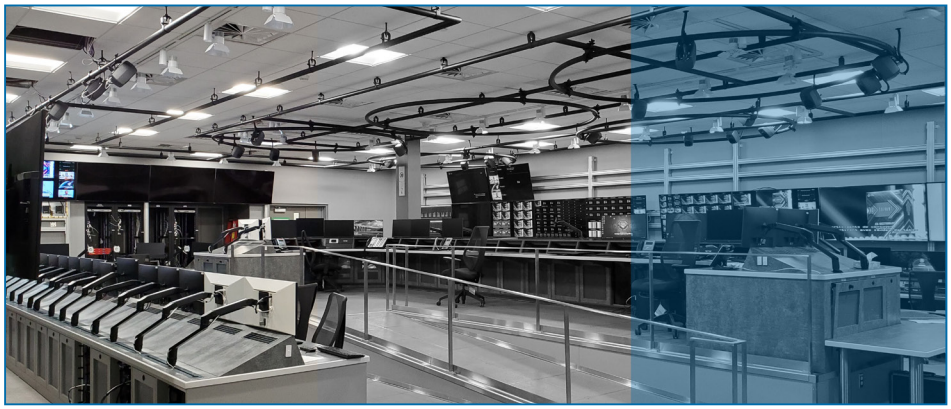
There are patch bays on the walls of each department, allowing journalists to report on-air from their desk in the newsroom or from an anchored news set. They can even plug in a camera on the roof of the building.

## Software-Defined Architecture

The new IP technology installed—from companies like Arista, Canon, Cisco, Dell, Embrionix, Evertz, EVS, Grass Valley, Lawo, NetApp, Meinberg, Riedel Communications, Ross Video, Sony, Tag Video Systems, and Vizrt—enables smaller, more efficient use of the square footage available. In a greenfield IP build like this one, all of the equipment itself requires less space. For example, in the current building they have 550 equipment racks in the machine room. In the new building that number has shrunk to 146 racks. So, the building is smaller, but CBC will have the same number of employees as before creating and distributing content.

"We have fewer studios, but we expect to be producing the same amount if not more shows in the new building," said Legrand. "In the past we had studios dedicated to a specific show. So one studio would do one show. We are changing that model so that our biggest studio in the new building will be able to produce four different shows a week. It is totally reconfigurable and reusable in any way we require. The new IP technology we're installing is much more flexible than any technology we have used in the past."

This flexibility comes from the combination of IP and software. 95% of its Playout/ Master Control capabilities are now Intel x86 software based (the Grass Valley iTX system and TAG Video Systems' multiviewer will also provide full disaster recovery between the broadcaster's facilities in Toronto and Montreal. The Toronto piece will start to be implemented this summer), and 40 percent of its production tools are software-defined as well. This includes multiviewers, video servers, graphics systems, editing, etc. Legrand said he wants the later number to increase as fast as he can get manufacturers to support his ST 2110 architecture and software-defined approach. There are more than 150 Lawo V__matrix C100 software-defined processing blades, used for such applications as multiviewing, system monitoring and content steaming.



## Moving From SDI To IP

Each of the new facility's control rooms include a Ross Video Aquity video production switcher, which is used in tandem with the Ross OverDrive automated production system in several of its control rooms. The switcher is SDI based and therefore does not include an IP input or output. The workaround was to install Embrionix gateways to convert the SDI signal to IP. These gateways are not needed for equipment like the newly installed Sony HDC-3100 cameras (with Canon lenses) for the News department and HDC-3500 models (with a native 4K sensor) for the general TV production team. Both cameras natively support ST 2110 through 25 Gb/s network interfaces. SMPTE fiber is used to connect the cameras and CCUs, but from the CCU its native IP. Most CBC News production will be captured in the 1080i HD format, but the News department plans to move to 1080p and the entertainment department to UHD in the near future.

## Tying It All Together

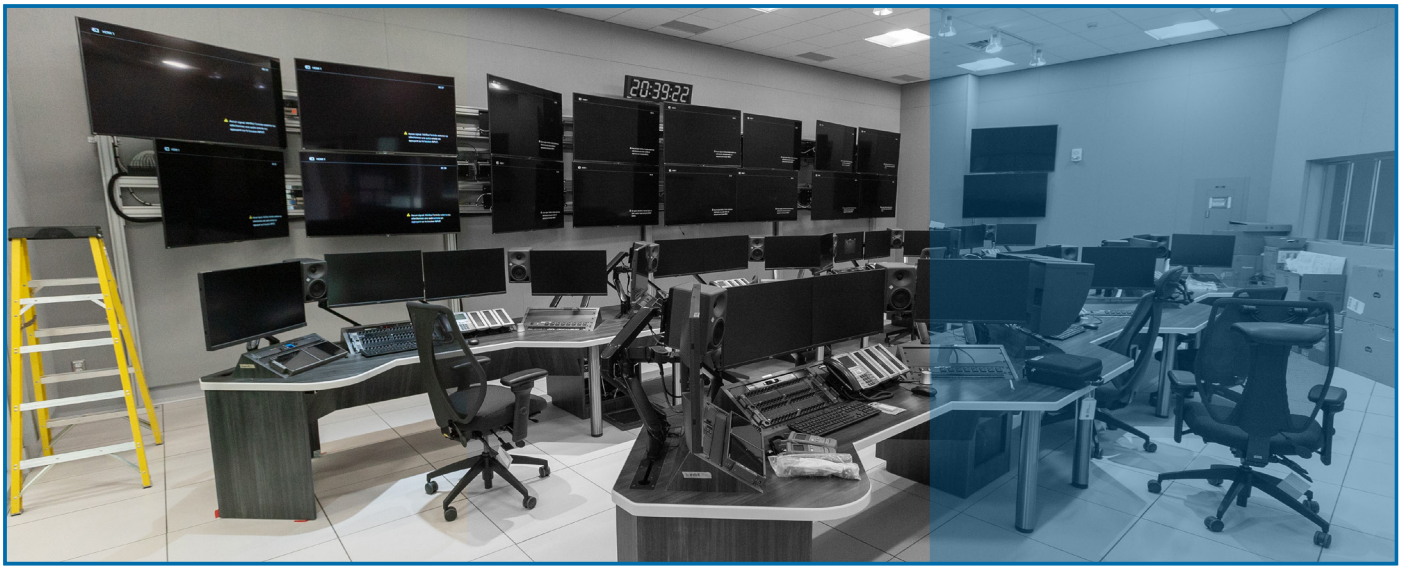
Legrand said one of the biggest challenges to making the facility run smoothly is getting all of the devices on the network to talk to one another. They have solved this problem by implementing a control layer on top of the 2110 network which supports a number of protocols in order to control different devices. That control layer is handed by Lawo's VSM platform.

The virtualized VSM platform has been implemented as two clusters with three servers each. Throughout the facility there are 50 vsmPanels, more than 200 webPanels and over 2,000 control ports.

"The first components we chose for the new building were components that we knew we could easily control," he said. "When we selected the VSM platform, then it was a matter of choosing components that generated the Lawo Ember+ protocol that VSM supported. When he started 18 months ago there were so few of them that it made our equipment choices easy. If they had implemented the Ember+ protocol or some other standardized protocol that was already supported by VSM, that's what we implemented into our ecosystem."

He said VSM has made a huge difference. Six months ago to install a new device on the network and control it would have taken two weeks of work. That's if you have the correct code. If you have to write your own code, and the CBC team has had to do this on several occasions, it takes much longer (two months). Now, the VSM interface recognizes a new device in a much shorter timeframe.

The latest version of VSM supports the AMWA NMOS IS-O5 specification, which has been gaining traction among facilities looking for an open solution that is not tied to any one manufacturer. The spec describes a mechanism for handling connections between receivers and senders on an IP network. It's like the IP version




of patching SDI signals. Automatic discovery and registration requires IS-04, which is not supported by VSM at this time. In the CBC's case, this would allow the Sony cameras and CCU to be automatically added to the network, no matter where in the building they are being used. So, thanks to the VSM system, the Sony cameras can be remotely virtually patched to any sender and receiver using the IS-O5 spec from the control room.

"The role of the VSM control system has become extremely important in the world of IP," Legrand said. "and it's crucial to the success of our project."

Audio equipment includes two new Lawo mc²96 consoles and four mc²56 mixing desks for TV (both with a UHD core) and 17 Ruby radio consoles of varying sizes (12/16/24 faders) that support the AES67 networking standard used at the CBC. Legrand said that other manufacturers provide Dante networking interfaces, which are IP-compliant, but they don't interface very well into a pure 2110 ecosystem. Finding enough audio equipment that does interface with 2110 equipment, he said, was another big challenge for the CBC's facility design.

## In IP, What's An I/O Matrix?

When discussing infrastructure, in the world of SDI you talk about how many input and output ports you have and then what you want to do with them. It's fixed and you don't have a lot of flexibility. In IP you gain access to scalable bandwidth capacity. Control and orchestration of the two SMPTE 2110 spine-and-leaf networks is accomplished with 300 Arista switches, consisting of a 1RU box with 48 ports available for end-device use. Then they have installed four spine switches, which are much bigger, providing 450 Tb/s routing capability.

"As long as we don't exceed that raw bandwidth, we can use it for radio, video (HD, 4K and 8K) and everything we need to do," Legrand said.

So Legrand describes his facility's capacity in terms of the number of multicast "flows" that are in the system. A typical TV signal includes four flows: One flow is used for picture data, one is the ancillary data (closed captioning and associated metadata), and two of them are reserved for audio (a 5.1 flow and stereo flow). The CBC's new building will have more than 50,000 flows moving around at any one time during peak activity. Thanks to the flexibility of IP, one signal can include any number of flows, depending upon if it's audio-only (radio), video (any resolution) or data-only (control and ancillary).

## Opening Soon

The new building will open sometime this year, but due to the unfortunate pandemic the exact date is hard to pin down. The good news is that this IP infrastructure has allowed engineers staying at home to log into the network and monitor, diagnose and solve problems from afar. News operations employees are also remotely using the control room to prepare the next production season.

The first piece of wiring was installed in August 2018 and the finished building (without equipment and production studios) was turned over to his team on February 15, 2020. It's taken over 18 months to get here, but Legrand said it's been well worth it.

"To be honest we accomplished our original goal and went beyond that," he said. "We knew we wanted to be an all-IP facility. We made the decision to go 2110 at a time when the standard was still being finalized and there were questions about other competing standards. But we didn't want to be tied to any specific vendor. And we wanted to use COTs hardware as much as possible to reach maximum flexibility. So, we're exactly where we thought we'd be 18 months ago.

"There's no plug-and-play configuration in IP," he said. "This is something the CBC is working closely with the vendors on. We need to automate the deployment and configuration of devices. We've tried to inspire ourselves by looking at what the cloud industry is doing. Because any device we add to the network is like a little server. Companies like Amazon and Facebook have millions of servers and they manage them in terms of the configuration requirements at the moment. We are currently using Ansible and other open source tools to get there. That's what we're doing with broadcast audio and video: getting any device [signal] to any person and any moment. When it works the way we designed it, it's quite impressive to see it in action."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