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A leap forward

Diversified guides one of the world's best-known cathedrals through an analogue to full HD-capable transition, shares **Brian Galante**

WORSHIP FACILITIES OF ALL FAITHS and sizes are breaking new ground with technology in an effort to reach congregants. While most of these Covid-era efforts emphasise streaming infrastructure, others are taking time to modernise AV and broadcast systems inside the sanctuary. The famous Washington National Cathedral in the heart of Washington DC is among those doing both.

The sixth largest cathedral in the world, Washington National Cathedral's location and stunning neo-Gothic architecture offers an inviting atmosphere for worship services, visitor tours and special events. In addition to privately booked events, the cathedral has historically hosted presidential funerals and even interments; US President Woodrow Wilson and Helen Keller are among the 220 burials there.

The sheer diversity of services and events, along with the unusual dimensions and architectural design, created a natural need for AV systems many years ago, according to chief communications officer, Kevin Eckstrom. "The interior is roughly 150m from the entrance through to the high altar at the rear of the building," he shares. "That distance, along with the Gothic architecture, creates a number of blind spots and challenging sightlines."

The staff at the time – Eckstrom believes it was in the 1990s – brought in broadcast-quality cameras and IMAG screens to solve these problems. Additional equipment was added in the early 2000s to record and release services on video.

The system was gradually expanded from there, which eventually established a full, mostly analogue, SD infrastructure. These upgrades included an eventual and modest streaming element to reach congregants – and, given the cathedral's stature, viewers around the world – that were unable to attend services and public events.

Technology evolves quickly, however, especially in the broadcast and AV universe. It wasn't long before the system faded toward antiquity. "This was a hodge-podge system built over time and always at risk of failure," says Eckstrom. "We still had a VCR in our workflow not long ago and literally had duct tape and paper clips holding components together. It worked, but it was far from reliable.

"It was time for a substantial change," he continues. "The pandemic that forced our doors closed also accelerated our upgrade. We are now capable of streaming HD content with a robust streaming system, along with a 4K foundation."

Eckstrom notes that there are tens of thousands of people across the country that now look to Washington National Cathedral as their church, because their local venues are closed. "We can record and stream our services in HD and show every spectacular inch of the cathedral," he explains. "The updated technology in the sanctuary complements the architecture for the first time and we can really create a world-class experience. The fact that we can do that at this moment is truly critical given what the cathedral has become to so many since the pandemic began."

Fresh foundation

With a complete "rip and replace" in order, the leadership looked to an outside technology solutions provider for help. Diversified was soon brought in to assist with specification, design and installation, working closely with the Washington National Cathedral's technical staff led by director of video services, Matt Echave. "We moved from eight SD cameras to 12 HD cameras, two of which are on tripods and can move anywhere in the building," explains Echave. "Along with those video upgrades came a new fibre infrastructure that, frankly, makes everything we can do now possible."

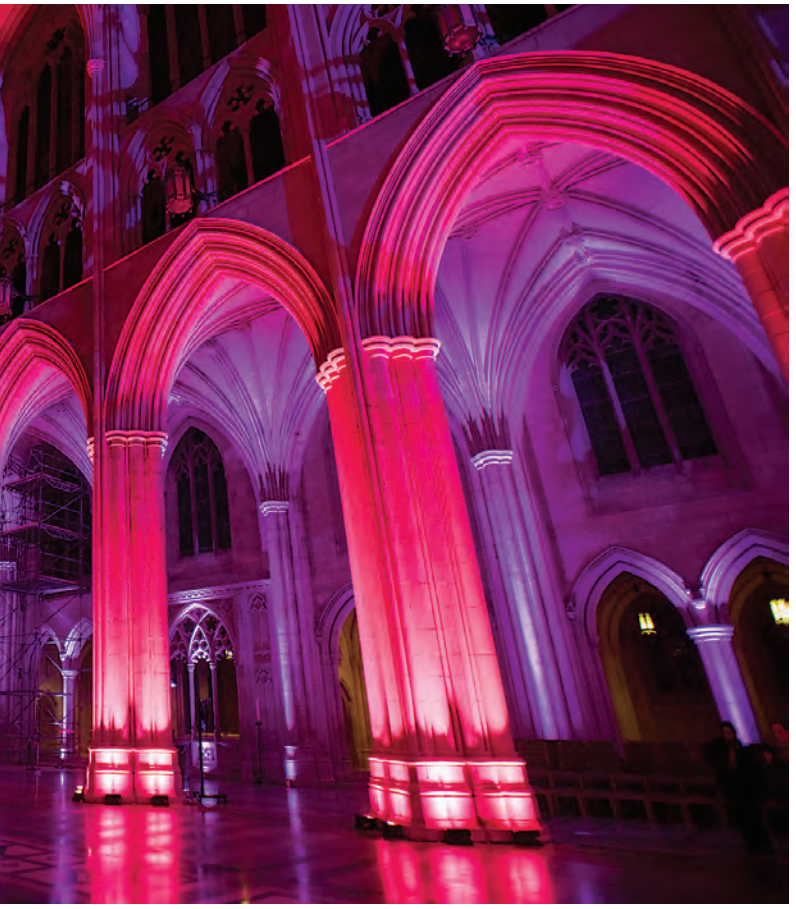
The old SD infrastructure relied on triax and coax connectivity, which Echave dryly describes as "limiting". This connectivity would be used for fixed camera shots during Sunday services as well as for special events. "The broadcast networks would come in for presidential funerals and build out their video systems," he notes. "We would also film certain events ourselves with our own equipment, one of which was President Obama's inaugural prayer services. Let's just say that filming an event of that magnitude in SD was not ideal."

All of these are now in the past thanks to the professional work of Diversified, a technology solutions provider equally skilled in broadcast and AV projects, a perfect fit to modernise the cathedral's infrastructure and workflow.

Light speed ahead

When Justin King first stepped foot in the cathedral, he knew there was some serious work to be done. "What stuck out to me was that it was a difficult system to connect to, which is a problem given how many outside teams come in for productions," recalls King, who serves as design engineer for Diversified's Media and Entertainment specialty. "Instead of tapping into the existing monitors, these production teams would rent HD displays. So, we came in with a plan to overhaul the entire system."

That started with the fibre infrastructure, which was a lengthy process given the building's architectural design. "Some of these cable runs were north of 200m long, which worked for analogue signals but would not work for HD," he furthers. "Those cables were permanently installed underneath the flooring, down into what they call the sub-crypt, and then back up through the floor to the monitors. It took months to convert that infrastructure to fibre; once that



was done, we started building out the racks and then the control room and slowly cut over to the new system."

King elected for a single-mode fibre infrastructure, using Neutrik opticalCON DUO cables and connectors at the core. A variety of MultiDyne's fibre optic systems bring the video elements to life, including POV signal extenders, openGear signal distribution modules and portable power supplies.

"The MultiDyne systems and the fibre core changed everything," says Echave. "We now have fibre running underneath the nave and up to our three balconies. Both our own technical staff and outside production companies can connect to the existing monitors using a special encoding system that was added. I can move our portable Sony cameras and MultiDyne fibre transport bricks around, and power signals over Ethernet back to the control room or to the IMAG screens. There is fibre running everywhere."

Robust capacity

As is increasingly typical, much of the system is IP-enabled. The original specification from Diversified called for a closed network with a Cisco 550X Series switch. However, the cathedral's IT team had other ideas. "The IT team requested that we uplink the network switch to their corporate network, so we relied on them to specify the switch," explains King. "They ultimately gave us our own VLAN and we crossed over some of the AV traffic, most notably from the streaming devices, to their main network. We established that connectivity via a fibre tie-line from our switch."

The adjusted network specification ultimately included two switches, including the original. "We kept the Cisco for the fibre-based IP infrastructure, because the IMAG monitor system powered by AMX's low-latency video-over-IP system in the nave now connects over fibre, and are all IP-capable," King furthers. "We added an HP Aruba 2930F Series Ethernet copper network switch to connect to the corporate network, which allowed us to stream video to other areas in the facility that we couldn't get our fibre infrastructure cabling to easily."

In addition to the monitors, any of the 10 Sony PTZ cameras mounted on the nave can be patched off the fibre infrastructure. There are six strands of fibre in each jacket, with one cable pulled to each dedicated floor box. From there, they are split out to the fibre opticalCON DUO connectors.

"There are 10 main floor boxes throughout the nave floor, with additional breakout panels in the balconies, galleries and organ areas; each of which have three opticalCON DUO connectors," shares King. "They can patch a camera or a monitor from any location and there are backup fibre connections available in the event one fails. The Neutrik connectors are pricey, but extremely durable. They reliably carry the power to the MultiDyne VB-3800 Series signal extenders at the cameras, which are powered remotely."

An added benefit of this strategy is that it eliminated the need to pull individual cables in the sub-crypt area underneath the floor. "These are very tight spaces, and we wanted to make one pull and move on," notes King. "Those connectors give us the ability to transport the power along with the fibre cable, all in one cable."

Diversified went with 12 Sony BRC-H800 HD PTZ cameras, 10 of which are in fixed positions and two of which are portable on tripods. These cameras were partially selected for their low profile. "The older cameras were just hanging there in plain sight and it was a distraction when walking into the nave," King furthers. "We installed Sony BRC-H800 cameras in strategic locations with the goal of blending into the cathedral's architecture. We ordered them in appropriate colours and, where needed, sent the cameras to a vinyl wrap shop to best achieve the goal. Diversified even wrapped any exposed cables in a material and colour that matches the limestone and the columns." The result – nothing sticks out as something that was not originally meant to be there.

Live and streamed video production is managed on the Ross Video Carbonite Ultra

All cameras and monitors in the sanctuary can be patched off the fibre infrastructure. Each jacket includes six fibre strands, with one cable pulled to each dedicated floor box

All the cameras are remotely controlled over IP from the control room, with two camera control positions adjacent to the production switcher. Echave often handles camera control using one of the two Sony RM-IP500 control panels, which have joysticks, zoom toggles and all other features required for PTZ camera control.

"For more intensive productions, we will use both control stations – myself for cameras one through six, and a colleague for cameras seven through

12," said Echave. "I can control which cameras are considered premium for the event, using a companion Ross Ultracore RCP-QE16 remote control panel. These are installed right below the Sony PTZ controllers."

Each camera has a dedicated MultiDyne VB Series fibre transport throwdown. VB-3842 devices are used for the PTZ cameras and VB-3812 devices for the two portable BRC-H800 cameras. With the single-cable architecture in place, the MultiDyne VB solutions take a full complement of camera signals (including HD video, power and Ethernet control) for transport to the control room and/or IMAG screens. The signals are then broken out by MultiDyne OG-3608 openGear modules populated within the openGear frame.

"The VB throwdowns are the modular units that handle the optic transmission and the OG-3608 openGear cards in the frame move the video into the Ross Carbonite Ultra production switcher," explains King. "That's where operators insert the network control over IP back to the cameras, along with the 48V camera power sourced through the MultiDyne Juice 48 devices."

A splash of colour creates an entirely new canvas

The Sony PTZ cameras are discreetly mounted along the nave

In the control room, MultiDyne fibre transport systems bring in Sony camera signals from the sanctuary

Production advances

The control room sits adjacent to the sanctuary on the second floor, along with the technical core. All systems inside the control room and sanctuary are patched into the central equipment rack, which houses the network switches, the MultiDyne receivers and additional processing and power conditioning equipment.

While the original specification included a new rack, the Diversified team made an interesting discovery onsite that helped to leverage an existing investment.

"The IT team had just stripped a couple of fairly new equipment racks that they were ready to throw away," said King. "We were able to salvage those and populate them with new equipment, which reduced some equipment expenses for the customer."

In addition to the technical core, a second rack was built out for the streaming architecture. Video signals are produced using a Ross Carbonite Ultra production switcher, with audio coming in from an existing front of house mixer. A Yamaha TF1 mixer was added to the control room for sweetening, as needed.

"Because of cabling limitations, the existing AKG C451 and Schoeps condenser overhead microphones in the sanctuary generally hit the control room first," he furthers. "We set up the control room mixer to feed those microphones back to the front of house through an auxiliary output. The front of house operator mixes that audio into their audio mix and then they feed that back to us. That audio is then tracked along with the video which streams to the cathedral's YouTube and Facebook Live streams."

A Yamaha TF1 mixer was added to handle basic audio adjustments

All video and audio is managed through a Ross Ultrix 64x64 house router, currently populated to 48x48. That provides room for an additional 16 inputs and outputs to accommodate future growth. Expansion is likely since most of the system is 4K-capable.

"Most of the equipment selected, as well as the fibre infrastructure, is 4K-capable," notes King. "The biggest change we would need to make is to purchase a 4K licence for the Carbonite Ultra switcher and upgrade the cameras."

Viewer response

The streaming devices sit on a shelf above the switcher, according to King. Whereas the previous streaming architecture simply fed an analogue signal to a video card in a PC, the recent upgrade brings in professional streaming encoders from AJA – two Helo encoders – with one streaming to YouTube and the other to Facebook.

A pair of AJA Helo devices sit atop the Ultrix router for streaming

"Right before they start a production, the technician running the switcher can just reach up and hit the encoding button on each unit to start the streaming process," said King. "These are simple throwdown units that take in and encode the video and audio signals."

The improvements have been noticed. Eckstrom notes that their YouTube audience has "doubled in the first three months", while Echave points to a specific service that proves the value and importance of making them available. "We went from an audience of 1,000 or less to nearly 100,000 on Easter Sunday," he says. "Our motivation through this pandemic has been to provide relief and comfort for people who want to go to church, but simply cannot. The work has been worth it. The quality of the productions and the reliability of the streams are far improved, and people are watching."

And while Eckstrom confirms that YouTube is still the more widely viewed platform for their services, the expansion to Facebook Live has opened a new audience. They have since added live captions to the streams to serve hard-of-hearing viewers. "We simply didn't have the computers or the proper technology to serve that audience before," Eckstom concludes. "We want to ensure that everyone joining us online can see the names of the preachers and the lyrics of the hymns, while also enjoying a high-quality live stream. We want to make this as close to the experience of attending an in-person service as possible. This new infrastructure helps us produce that robust digital experience that audiences expect and enjoy."

www.cathedral.org
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