

THE NATIONAL ARTS CENTRE

Augmented Audio Systems for Canada's Cultural Hub

BY MICHAEL RAINE

Since first opening its doors in 1969, the National Arts Centre (NAC) has held a special place in Canada's performing arts landscape. Standing at the foot of the Rideau Canal and across the street from Parliament Hill in Ottawa's picturesque downtown, its stages have hosted countless iconic performers and classic moments over the past 50 years. But being a publicly-owned venue, the NAC must not only cater to the world's most renowned artists; it also serves as a creative incubator for the performing arts of all levels and disciplines in Canada.

By 2017, though, the NAC clearly needed to be rejuvenated and brought up to the modern technological standards befitting its stature and purpose. And so, it's not surprising that as Canada prepared for its 150th birthday in 2017, the NAC was one of the projects the federal government selected for a significant revitalization. That included a two-phase, \$225-million architectural and production renewal project. The first phase, the Architectural Rejuvenation, was done in time for the Canada 150 celebrations in 2017. The second phase, the Production Renewal that included all new sound systems for the NAC's performances spaces as well as a building-wide Optocore network, was completed through the summer of 2018. Being a publicly-owned facility and national historic site – not to mention the cost, magnitude, and complexity of the job – the NAC required a unique and comprehensive procurement and bidding process. The task of coordinating the AV elements fell on Martin Van Dijk, senior consultant and partner at AV consulting firm Engineering Harmonics Inc.

"Essentially, the Production Renewal was all about bringing the NAC up to current production standards. Of course, it was built in the '60s, so in terms of infrastructure, not a lot had been added and it was definitely long overdue," Van Dijk says.

To ensure he got the right products combined with the right integrators for the technological overhaul, Van Dijk and the NAC's team devised a unique bidding requirement. "In the case of this kind of purchase, it's not about the lowest bid; it's about the best value proposition for the client, so you need to include other factors besides whether or not somebody can sell you a speaker for \$10 less than someone else," he explains. "We organized it in a way that the proponents had to come to the table in a partnership between the vendor, the integrators, and the manufacturers. What that does for the client is ensures that whoever comes to the table and whomever wins is going to be a [unified team] that will support the client after all the consultants and everybody are gone. That is really important to a successful project of this magnitude."

Of the eight bids that came in for the loudspeaker procurement, Van Dijk and the NAC narrowed it down to three who were then brought in for a blind loudspeaker listening test in Southam Hall, the NAC's largest performance space. Ultimately, the winning integrator was Solotech, with its team led by Senior System Designer Mark Radu, which outfitted the NAC's two theatres and its black box studio with a massive assortment of d&b audiotechnik speakers, Digico SD series consoles, and a cutting-edge Optocore network, among other support systems.



DIGICO SD7 AT THE CENTRAL FOH POSITION IN SOUTHAM HALL



PHOTO: ROY GROGAN

SOUTHAM HALL

One of the focal points of the \$114.9-million Production Renewal Phase of the project is a new orchestra shell that has greatly enhanced the acoustics and aesthetics in the 2,000-seat Southam Hall, the largest and most prestigious venue in the building.

The old shell was designed when Southam Hall was primarily an opera house, but these days, its chief resident is the National Arts Centre Orchestra, which obviously has much different acoustic needs. But in addition to the orchestra, the shell also had to accommodate a wide array of performances, from rock bands to dance troupes, musicals, and spoken word.

To create a more intimate experience for patrons, the shell's design moved the orchestra closer to the audience. In total, it took 18 months for the conglomerate of Diamond Schmitt Architects, Fisher Dachs Associates, Threshold Acoustics, Engineering Harmonics, and the NAC to design the solution, which was then manufactured by Wenger & JR Clancy and took an additional three months to install.

The shell, which Wenger & JR Clancy says is the biggest and most complex it's ever created, is made up of 11 onstage towers, three onstage reflectors, one forestage reflector, and eight forestage towers downstage of the proscenium. Each of the onstage towers can be arranged in different configurations for the orchestra's needs, while the three ceiling reflectors can move to above the stage in the fly loft or along the upstage wall thanks to a new rigging and hoist system.

"The new shell has been completely designed with acoustics in mind and is architecturally stunning, but the reflections of this shell itself create a natural amplification that is easily felt from any point, either on the stage or in the audience. That's a very powerful thing," says Dan Holmes, one of the NAC's head audio engineers. "There is a massive difference with the acoustics from the old shell to the new, just in terms of clarity and the overall warmth of the room."

To complement the new orchestra shell, Southam Hall was also outfitted with two separate PA systems to fit its various performances. The smaller, more commonly-used system is made up of d&b's

V-Series speakers and subs, while a larger d&b J-Series system is also available for the louder shows that come through as part of the NAC Presents concert series. In both configurations, the seven-speaker centre cluster remains the same and is comprised of a combination of V8 and V12 line array cabinets. The smaller system features eight boxes in each left and right array, again a combination of V8s and V12s, with two ground-stacked V-Subs per side. The larger J-Series concert system features 11 J8 and J12 boxes in each flown left-right array and a J8 and J12 atop two J-Subs ground stacked on each side.

Additionally, throughout the auditorium, there are eight d&b E6s, 14 Y7Ps, six V10Ps, and 30 E4s for fills, with an amplified source in each of the lodges and private boxes.

"d&b has a large catalogue, so you've got their concert [J-Series] system, you've got the V-Series system, you've got front fills, you've got proscenium fills, you've got over-balcony fills, and the list goes on and on. They basically have a tool for every job," says Radu at Solotech on why d&b was the best fit, not to mention that it won the blind listening test. "I think one of the big things, too, is the sonic characteristics of d&b products are very, very similar; they all have the same voicings. Another big advantage in this particular application is that all their boxes are very low-power and high-efficiency. When you have a 400-watt speaker that is just as loud as the competitor's 1,200-watt speaker, with the power consumption and the number of amplifiers you need, there are some cost benefits."

Holmes adds that his favourite part of the new package is its comprehensive amplifier system, which features 280 discreet amplified channels. "It's massive and we have a ridiculous amount of control. We're basically able to utilize any space to have discrete audio placed. We have never had this much amplification in any of the spaces," he says. "I think one of the biggest parts of this new design was the ability to have a manipulatable and multi-configurable system. We always wanted to have the ability to deploy a system that is necessary for whatever the touring act may be."



For processing in both Southam Hall and the 897-seat Babs Asper Theatre, Holmes says it's a unique arrangement in that it is simultaneously handled in the Meyer Sound Galileo Galaxy 816 AES 8-input/16-output digital processor, as well as in d&b's R1 remote control software and ArrayCalc simulation software. "So, the Galaxy basically handles routing, but there is very little delay or anything in regards to processing actually happening in the Galaxy. All equalization, compression, and time alignment pretty much happens within R1 and ArrayCalc," he explains.

Adding to the highly-configurable nature of Southam Hall, there are two available FOH positions. There is, of course, the ideal FOH spot in the centre of the room, but for sold-out shows, that central FOH position can be filled in with seats and FOH can move to the back of the room.

To control the new audio systems, the NAC now has a total of 13 Digico SD series consoles, with two in each venue and others that float around as needed. In Southam Hall, the main console is usually the flagship SD7; in the Babs Asper Theatre, it's the SD10, and in the other spaces, it's the SD9.

"Because they have multiple venues, we decided it's important to have a platform where the knowledge is transferable across the different sizes of consoles in the various venues," adds Van Dijk. "So, once you develop a familiarity and understand how it works, you can work with whatever console size you happen to have that day, from a crew point-of-view."

The mid-sized Babs Asper Theatre again features d&b V-Series arrays, with each five-box left and right column being a combination of V8s and V12s. The centre cluster in this theatre, though, is comprised of d&b Y12 line array boxes. It then has two V-Subs ground stacked on each side. For amplification, the theatre has a total of 19 amplifiers – five d&b D80 four-channel DSP amplifiers and the remaining 14 being D20s. A complement of d&b's compact 8S, E6, Y10P, and Y7P speakers fills out the room.

"It is a very highly-configurable space where I'm able to take any audio source and have it playable in any location," says Holmes. "There are a lot of times where, in theatre, there might be a discrete audio requirement – perhaps a cell phone or dog barking in the distance or an airplane that's going to cross overhead. We have the ability to make multipoint channel systems and we're not limited by this."

Another feature that makes the theatre very adaptable is tracks built into the building's

infrastructure downstage of the wings just in front of the proscenium. This allows the line arrays to move around according to line-of-sight requirements. "It has the ability on either side to move on or off stage, roughly 6 ft., and it accommodates for line-of-sight," explains Holmes. "So, if it's in a rock and roll scenario, the speakers would then sit quite tight on stage, but there are a lot of times in theatre where having that line of sight is absolutely imperative, so moving them to either a mid-position or to a fully-offstage position will completely alleviate any restrictions while not completely removing the directionality of the audio."

"The theatre is kind of unique in that it's a very wide venue and it has a thrust, so it presents some challenges in terms of gain-before-feedback," adds Van Dijk. "So, we also have these custom Polar Focus bumpers that allow us to give various pan angles to the arrays."

Additionally, the Babs Asper Theatre's proscenium opening can be moved to accommodate different types of shows. When they're needed, deck carts can be brought out for front fills with larger V-Series boxes for concerts and smaller d&b E4s for theatre.

The Azrieli Studio is a roughly 100 x 100-ft. black box space that can be used for anything from corporate presentations to dance, theatre productions, or more intimate concerts. With flexibility and adaptability being the central characteristics throughout the NAC's revamped performance spaces, it's not surprising that the studio can be configured in almost any way.

"It's your typical black box theatre where everything is absolutely portable and configurable on the day, even the bleachers and seating. I mean, the stage could be on one end of the theatre one day and the other end the next day," notes Radu. "So, in terms of putting permanent infrastructure in, there are patch points and everything else to deal with all the different configurations, but aside from your typical left-right band set up, there's no real system presets and stuff like that."

For the band-style set-up, there is a compact left-right speaker configuration made up of d&b's smaller V10P and Y7P boxes with two ground-stacked E15X subwoofers.

Until 2017, the NAC's facility-wide networking infrastructure was mostly copper-based, so a major part of the Architectural Rejuvenation and Production Renewal phases involved a switch to a state-of-the-art digital fibre optic network provided by Optocore.

In total, 54 Optocore units are deployed across the three net-



The NAC Renewal at a Glance

- Approx. 600,000 ft. of cable pulled
- More than 9,000 connection points
- More than 100 network switches
- 50 km of new electrical & AV conduit
- 200 km of new electrical wire, AV cable & fibre
- 300 new speakers
- 1,300 new light fixtures
- 19,000 sq. ft. of veneer on the orchestra shell
- 32,500 sq. ft. of isolation material to minimize sound transfer backstage

works, with each of the three main performance venues having its own dedicated network. As well, there is a mix of permanently-installed Optocore network devices and mobile racks that can be moved between connection points in a room or from one venue to another to accommodate larger shows that need additional I/O. The Optocore units are run at a 2 GB network speed and 96 kHz sampling rate for premium audio quality and optimal channel count.

There are network connections at all FOH and monitor console positions in the venues, which allow guest consoles to tie into the network via analog or AES and distribute audio to any network device. With the pre-programmed macros in the Optocore control software, users can easily change the network's routing to feed AES or analog from any location to the PA, monitor amplifiers, or installed monitor speakers.

At the core of each Optocore network is the company's new Route66 AutoRouter. "The Route66 is a welcome product, because Optocore is a ring network and, obviously, if you're going to bring Optocore into a big facility with multiple networks, trying to establish a ring is very difficult, and maintaining that ring without somebody breaking it is even more difficult. They just need to unplug it and they could possibly bring down all three venues," explains Van Dijk. "So, the Route66 allows us to wire what I would call 'subrings' within each venue. The granularity is dependent on a number of optical ports and things like that, but you can have small rings, even within the venue, that can loop back to the Route66 and all come together there. So, it's almost like going to a star network, which is a fundamental design principle typology behind IT... The Route66 also keeps the venues isolated, so you basically have a Route66 talking to another Route66 in another venue and if one goes down or you lose that link, the venue can still run, whereas conversely, if somebody unplugged something in the studio, they

could possibly bring down Southam Hall. That was a big issue for the client."

Being one of the NAC's head audio engineers and experiencing the Optocore network on a daily basis, Holmes is thrilled with its ease-of-use. "The advantage is it's easy to have another device put onto the system at any moment. It's very, very easy to accommodate the need for, say, an extra monitor system or an extra rack for more I/O. Transporting audio from room to room has never been this easy. You could easily have a console with an I/O rack in a separate room and have it communicating instantaneously," he says. "At the moment, it is our way of communication for audio, but it's also ready for future applications. We've basically created the infrastructure for future applications in audio transport where we would be able to, say hypothetically, do a full multitrack recording in a separate room without even slightly interrupting a performance that's happening."

Holmes says it's made troubleshooting issues easier, too. "Everything is seen all within one network, so you can stay in one location and remotely troubleshoot another aspect of the system. That is another thing we haven't had before is the ability to see problems that are quite far away," he adds before mentioning the new Riedel wireless communications system that works hand-in-hand with the network. With the comm system on the network, a technician wearing a comm pack can enter one venue, join its network, and then wander down the hall to another venue and join that network.

"I'm able to use this system to communicate with anybody," continues Holmes. "So, if you're wearing a communications pack, you're now wirelessly communicating throughout the entire facility with no drop-outs or issues whatsoever. Hypothetically, if I'm trying to locate a problem within an amplifier rack and it happens to be in a completely separate remote location within the facility, I can have another technician in that position while I remain at a console

or maybe another rack to actually source down what the issue is."

Commenting on the network, Radu adds: "With pretty well every piece of gear having a network port now, I think the amount of networking that goes on in there is pretty remarkable. I think it's close to 100 Luminex switches in there. There are basically five complete networks in there with a couple routers that can access all the networks, but everything is sort of discrete on its own."

"From an installation point-of-view, they didn't really have pathways to the building, so the conduit system and everything that needed to be installed to enable all of this was substantial. It was quite an undertaking and Solotech and everybody really stepped up. Mark Radu and his team, they did a great job at sorting through all of that," says Van Dijk at Engineering Harmonics, noting that everybody was working under an extremely tight deadline. "The venues were only shut down from June through August of last year; the rest of the time, everything was being done while the building was operational, so things had to be done overnight and it was crazy."

The project being a renovation instead of a fresh build also introduced unforeseen hiccups. As Van Dijk points out, the electricians encountered many problems because the power and grounding systems had been compromised, and the mechanical infrastructure also had to be redone in many areas. "It was an incredible undertaking with a lot of pressure on everybody to get that project done. It is actually quite remarkable in hindsight, but they opened on time and, again, credit to Solotech and everybody – all of the other contractors, too – they didn't lose a show."

"I believe the National Arts Centre is now Canada's leading performance space in both flexibility and technical abilities," Holmes adds in closing. "We have an infrastructure that I think will easily handle any technology that will be offered in the next 20-plus years."

And so, at the end of its expansive Production Renewal Phase, the National Arts Centre is well-positioned to continue being the beacon of Canadian performing arts for decades to come.

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