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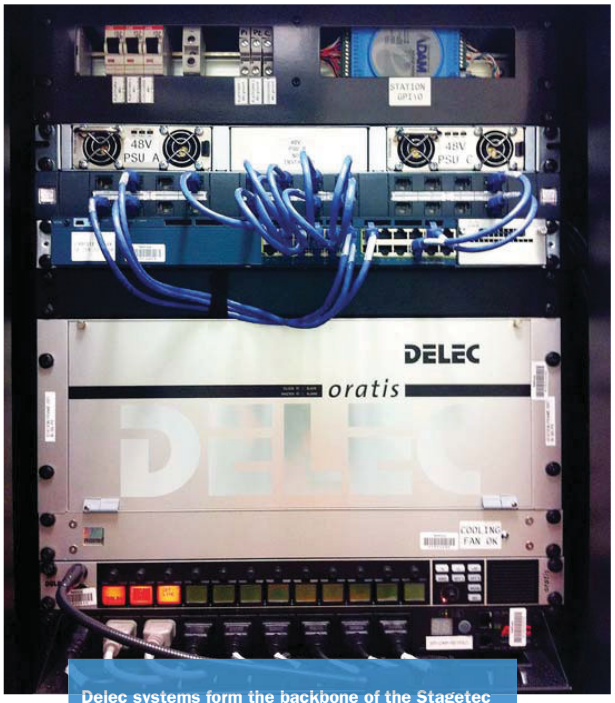


Delec systems form the backbone of the Stagetec solution, while Dante is its lifeblood

Taming difficult acoustic spaces was a key challenge

The 500m Sydney now time aligned to

Sydney's Central Station

A project to improve train station announcements has led to the creation of a vast audio-over-IP network in New South Wales, writes **Barney Jameson**

TRAIN STATION ANNOUNCEMENTS have long been the subject of somewhat unfair criticism, seemingly regardless of efforts to improve them. But for the world's rail operators, the problem is genuine and serious, as are their efforts to solve it.

Indeed, so serious are those efforts that they have now led to the creation of one of the world's largest and most impressive examples of audio-over-IP. The rail networks in question are Sydney Trains and NSW Trains, and the company charged with solving one of rail travel's most enduring issues is Stagetec Australia.

'The underlying theme of the tender was all about reaching a required speech intelligibility,' explains Treva Head, Stagetec Australia managing director, and a man who has seen his company transformed by the Sydney Trains project. After all, adds general manager Mark Lownds, 'geographically the project is as big as Texas'. At the time of writing, 70 full sites have come online while the number will swell by the project's completion, with 178 stations on the Sydney Trains network plus 63 on the NSW Trains network (intercity and regional). Connectivity is already being extended to all of the sites. They range in size and scope from city central hubs with dozens of platforms serving thousands of commuters to remote, unmanned sub-stations. But despite the variety of locations, the required standard of speech intelligibility remained consistent. 'The audio requirements were set out including factors such as environmental pollution,' adds Mr Lownds. 'They were aiming for a 0.75 STI without a train on the platform, and a 0.6 STI with a train, so that was a big challenge – a huge challenge.'

An installed Delec Network Amplifier Module, or NAM - a key to the project's success

And there was more. 'Another requirement was time alignment for speakers down platforms of up to 500m, so up to nearly 1.5s,' Mr Lownds explained. 'They also wanted to decrease their equipment count by centralising more, meaning less maintenance.'

Stagetec calls its solution to all this a 'digital PA', but the description seems too small. Simultaneously centralised in terms of operation but able to focus in on the most minute of details, right down to an individual loudspeaker driver, regardless of physical distance, it has spurred the development of an entirely new product line for Stagetec sister brand Delec. It has also provided ultimate proof of concept for a fellow Australian company, Audinate, as Dante sits at the system's heart.

'To meet the speech intelligibility requirement we needed full bandwidth, uncompressed audio but because there are live announcements they needed to be real-time as well,' continues Mr Lownds. 'Then, because of the time alignment, it all needed to be digital and manipulable at the end point. Every single amplifier channel needed processing. We also had to deliver a system latency of less than 2ms. Every single station has to be linked together on the network and

Central Station Platform 1, allow perfect intelligibility

from the central locations they need to be able to make announcements to any or all of those stations, down to the individual platform level, and everything is monitored, all the way down to individual speaker drivers.' Most crucial of all, meanwhile, was that 'we had to integrate with their existing MPLS (Multi-Protocol Label Switching) network – we couldn't build our own dark fibre net. To do that it had to conform to IP standards – TCPIP. We had to make sure that audio and data could go on the same network.' All of this, he adds, 'was very good for Dante'.

Indeed, had the requirements been drawn up without knowledge of the move towards audio-over-IP, and the rise of Dante in particular, then they would have represented quite a coincidence, but Sydney Trains had an IP-flavoured solution in mind from the beginning. Charles Chan, audio services manager, Customer Services Directorate for Sydney Trains, describes Dante as 'a widely adopted de-facto standard for audio transport over IP'.

'Sydney Trains created a scope with acousticians, so the project was driven around that,' explains Mr Head. 'They wanted the speech intelligibility and then they worked backwards from there and knew they needed to be over IP. They had looked at Dante some time ago. So while Sydney Trains was building its Operations Critical Data Network (OCDN) for its own internal use, this scope was done by Charles Chan. The tender was very technical, very strict. In the past there had been the impression that a train station audio system was not important – it was background noise and not a tool. But Sydney Trains prides itself on being the best in the world and so it set about creating a system that would change that impression.'

To achieve all of this while providing the all-important centralised control, the Stagetec Australia team worked closely with Sydney Trains and Audinate. 'We've built it all around a central management system that sits at the top,' describes Mr Lownds, 'then we have nodes (comprising one or more MF4 matrix frames), and under each node the stations fall. So far we've built 13 nodes that can handle between 20 and 40 stations each'. Mr Head describes the design as 'essentially a tree – at the top there's central management, then there are nodes, then there are the stations'.

The solution could also be thought of as an anatomical system, wherein Dante is the blood being pumped through the OCDN network, ultimately reaching the CNMS central management system – the brain of the entire network. 'The CNMS monitors everything, backs up every configuration and every device – that's thousands of devices,' assures Mr Lownds. Based on the DataMiner platform, it's also fully redundant – 'built into two completely separate buildings with completely separate hardware and with a primary and secondary failover'.

But a further innovation was required to give the system some muscle, and it was delivered via Salzbrenner Stagetec Mediagroup's own comms-focused brand, Delec. Named the Network Amplifier Module, or NAM, thousands of these diminutive but essential IP66-rated products have now been installed.

'The NAM originated out of Australia,' says Mr Head. 'The catalyst was this project – we saw that there was a need for it, but it provides a solution to a problem that exists all over the world.' Falling under Delec's Unito range, the 4-channel NAM is available in both indoor and outdoor versions and is equipped with Audinate's Dante Brooklyn II module. 'Obviously it's Dante so it doesn't just work with our hardware. It has full API so any other Dante vendor could use it. The IP66 rating is important because of rain, water and, in Australia, heat. Sometimes the NAMs are in direct sunlight, all day, under a hot tin roof, so they need to be able to dissipate their internal

heat (because they're sealed) and continue to work, which of course they do. Normally they're 4-channels at 12W but you can go to 2-channels at 24W.' Onboard FIR filtering includes, says Mr Lownds, 'all of the speaker monitoring, the delay for time-alignment and extra EQ'. In effect, it gives Sydney Trains the best of both worlds – centralised control via the CNMS, with FIR filtering right next to the speaker courtesy of as many NAMs as are required.

'We wanted a cost-effective device that was distributable,' Mr Head continues. 'You put the smarts out where the problem is rather than having them centralised. So we were able to have a bit of a mixture – the NAM can drive up to four speakers but we can do processing differently on every single loudspeaker output, which means we can mix and match the speakers. Sometimes you might want to use a line array, sometimes you might want a horn speaker, and sometimes you might want a ceiling speaker. We can process them all differently.'

A total of 745 NAM modules have been installed in Sydney Central Station alone

'And because every NAM is Dante addressable we can easily change zones,' adds Mr Lownds. 'A lot of the time at a train station they might have different audio zones with different announcements, and those zones change. But they don't have to go and rewire the system, they can just change it in Dante. And if they want to add another four speakers then they can just put in another NAM and it's that simple.' The importance of the NAMs is hard to overstate – in Sydney Central station alone, 745 modules have been installed.

Yet as with all truly ground-breaking designs, the brilliance of the Sydney Trains solution is to be found not just in the sum of the parts installed, but in how those constituent parts work together. Not so long ago the industry believed A/V and IT would ultimately converge – this project proves that it's already happened. Nor is the reality a disappointment – far from it, in fact. Midway through describing the technology to *Pro Audio Asia*, Mr Head and Mr Lownds enthusiastically call up a web page and declare that we are looking, in real time, at the portal into which every user of the Sydney Trains system logs-in, the only difference being their access privileges. From here, a user can monitor the status of every single channel on the network and even hear announcements going out live. That functionality is then applied at every level of system operation, from the CNMS down to a station master running a clutch of remote sub-stations via a Delec panel, to an operator wanting to check on a specific platform despite being hundreds of miles away at the time. Staff members can even monitor performance and then make special live announcements via their smartphones thanks to app-based virtual panels running on iOS. Jointly developed by Delec and US company Intracom, the feature, says Mr Head, 'allows a station staff member to make an announcement anywhere in the station without it feeding back

Loudspeaker models differ depending on requirements with some stations served by simple horns with FIR filtering

because it also gets processed correctly and it's very, very low-latency'.

The processing for that is taken care of upstream. 'Ambient microphones on the stations feed back up to the node where we have audio processing,' says Mr Lownds. 'We're using echo cancellation algorithms – when the PA's playing and the microphone picks up the PA, we cancel it out of the microphone so we get pure ambient noise.' The same system provides for automixing when ambient noise levels rise and the announcements must become louder, for example when a train arrives. 'When a train comes in we can smoothly increase the volume of the announcement in real time, then turn it back down again when the train leaves. The same can be done if there are lots of people on the platform. You don't really notice it unless you know it's there but you can always hear the announcements.'

Both Mr Head and Mr Lownds stress that the development of the system would not have been possible without the partnership and support of both Sydney Trains itself and Audinate. 'Sydney Trains have a model room of their entire network,' says Mr Lownds. 'We built three train stations, a node and a CNMS in the model room, and Audinate came in to work with our engineers – we basically did a full proof of concept.'

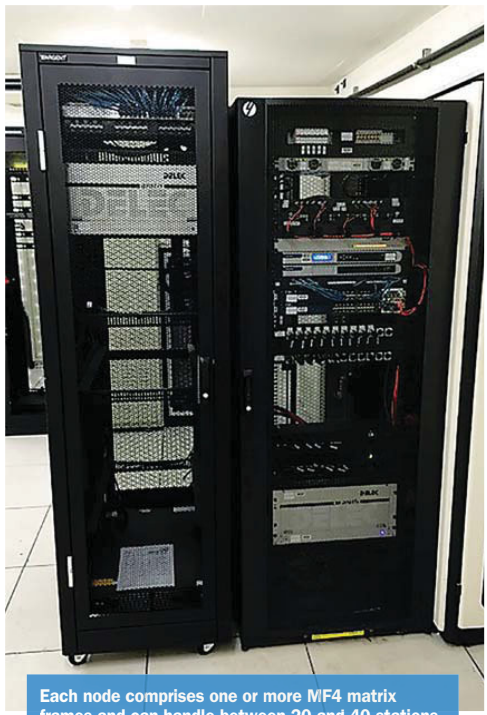
'It was fantastic,' agrees Mr Head. 'Having Sydney Trains, Audinate and us all in that room together meant that if a problem arose we could solve it right there and then.' He adds that attempting the same project without Audinate's support would have been unthinkable. 'They were very invested in it,' he explains, while Mr Lownds clarifies: 'even before we went to the room there had been months and months of designing and planning – we went in there knowing what we wanted to achieve. A lot of that time was spent trying to break it but it came out with flying colours. I think all three parties were very happy with how it performed.'

That result was despite some sites contending with bandwidth constraints as tight as 6MB. Yet still the Dante stream prevailed. 'We've put it through those 6MB pipes without any issues,' grins Mr Head.

At the other end of the system, on platforms throughout New South Wales, are loudspeakers delivering the holy grail of rail operation the world over – truly intelligible announcements. The speakers themselves come in a variety of shapes. In larger sites such as Sydney Central Station, dedicated cardioid models have been employed, named the CS6 and developed by Australian manufacturer Acoustic Technologies Professional. Elsewhere, simple horn speakers do the job with FIR filtering. As with the rest of the design, the front end is continuing to evolve.

For Mr Head and Mr Lownds, however, the project has already taken on a special significance. 'It's been exciting – this project has drawn upon everything that I've learned in my career so far,' says Mr Head. 'The groundwork that we put in many years ago – we're now seeing it come together. The OCDN network is coming online bit-by-bit, so we're seeing lights turn on in our CNMS representing sites we worked on years ago and which are now delivering true data.' Casting his mind back, he remembers the beginning of the project and the first station to be turned on as a real-life proof-of-concept. 'It was the train station Campsie, and when Mark and I switched it on we just sat there for an hour listening to train announcements with the ambient noise system compensating as trains came in. I wouldn't say it was a beer moment, because we were working, but it was certainly a very nice moment.' There are many more to come.

www.audinate.com
www.stagetec.com.au
www.sydneytrains.info



Each node comprises one or more MF4 matrix frames and can handle between 20 and 40 stations

The rack located at Hornsby Railway Station