



(Clockwise from top): Nexo Geo S830s are concealed behind fake A/C vents in the retail space; Chris Lo, PCCW; Nicolas Kirsch, Nexo; Henry Chan, Arup; Leo Ho Man Him, Nexo; NG Chi Man, PCCW; MFC is a five-storey building located between the two existing runways; Part of the MFC's brief was to improve on all previous audio installations

Flying high

A groundbreaking Nexo installation is providing sound clarity and intelligibility at Hong Kong International Airport's new concourse. **Caroline Moss** visits



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HONG KONG AIRPORT HAS COME

a long way since the days of flying into the SAR between the skyscrapers of Kowloon. Since moving to Chek Lap Kok island in 1998, Hong Kong International Airport (HKIA) has become the world's eighth-busiest, handling almost 70 million passengers annually and becoming the busiest cargo airport in the world.

Unsurprisingly, this growth has led to proposals for a third runway and terminal, but extra capacity was needed in the interim. In 2010 the Hong Kong Airport Authority (AA) initiated the Midfield Concourse (MFC) project as part of the HKIA expansion plans. A five-storey building located between the two existing runways, the MFC opened in December 2015, adding an extra 30 gates and the capacity to serve an additional 10 million passengers every year. Covering an area of 105,000 sq-m, the MFC connects with Terminal 1 via an extension of an automated people mover system.

Part of the MFC's brief was to improve on all previous audio installations in Terminals 1 and 2, plus other satellite concourses, a challenge which fell to Arup Hong

Kong. 'Arup's involvement in this project was very long term, as we worked on all the engineering for the building, not just the acoustic design and sound systems,' says Arup HK associate, Henry Chan. 'However, getting the acoustics right in the MFC was a very important criteria in the success of this new project.'

'The AA showed us the sound system designs for Terminals 1 and 2, which weren't powerful enough. We couldn't use such small speakers in the MFC because of the high ceilings; they would never be able to achieve the requirements, unless mounted at a very low level. But the AA wanted everything hidden and neat, so we had no choice but to conceal them inside the ceiling, which is 10m high.'

The difficulty of achieving even coverage was compounded by the building's asymmetrical design, which features a curved and sloping ceiling of varying heights.

'It was important that we choose the correct type of speakers and make sure the reflection of the sound would be absorbed,' continues Mr Chan. 'Such a large volume of space, with lots of reflective surfaces such as glass, concrete and marble

floor, would generate a lot of noise when people were talking; not a good acoustic environment in which to hear flight announcements. So firstly, our acoustic design had to reduce the reverberant noise from the building's surfaces. Secondly, the AA assigned us to ensure the many airport announcements being made are crystal clear.'

The project was put out to tender and Arup set about testing the proposed systems, working with the architect, Aedas, to simulate the concourse's environment. 'At the beginning we had five or six different options, and we needed to balance the cost with the performance,' continues Mr Chan. 'We didn't want to save, say, 30 per cent of the total cost of the PA system and achieve an outcome that was totally unacceptable, and we needed to demonstrate this to the AA.'

Nexo was one of the companies approached to provide a solution. The French manufacturer's Asia sales manager, Nicolas Kirsch, proposed low-impedance systems using the company's latest generation amplification to drive speaker lines as long as 300m. This was particularly feasible in such a

dense multi-zone situation.

'By removing 100V transformers we could totally control distortion and remove points of failure that eventually make 100V systems lose performance quite rapidly,' explains Mr Kirsch. 'Going low-impedance, one can then look at all the latest technologies from the architectural and theatrical acoustics such as the Nexo Hyperbolic Reflector waveguide which are true scientific acoustic devices able to create well-controlled, well-balanced soundfields with great evenness, clear separation, and predictable results. This would allow a very high STI to be reached, even in a sub-optimal acoustic environment. The Speech Transmission Index (STI) target was aiming for 0.65. This high level was unheard of for airport PA systems where the best current solutions barely reach over 0.5. The promise from Nexo was to exceed 0.65 and aim for 0.7.'

Nexo spent the next three years supporting Arup on the system design solution for the MFC. The Asian team of Mr Kirsch and Leo Ho Man Him, bolstered by engineering support from Nexo France's Francois Deffarges and David Hochstenbach, took the design to a working concept, providing acoustic and electronics simulations and tests, live demonstrations and value engineering. Ultimately, the team was able to demonstrate that the original intent of adopting Nexo Geo S805 and Geo S830 line source modules was the right one, acoustically and financially.

'When we were designing the MFC, the Nexo speakers were the best, smallest and most powerful models available,' says Mr Chan. 'They also had the angle of coverage and SPL handling we were looking for. Of course there are a lot of small speakers on the market, but they couldn't do what we needed them to. The angle was very important because of the high ceilings; it needed to be as wide as possible otherwise we would have needed to use more speakers.'

With a fully functional and validated design, the final pledges of performance were made and the project went to tender in 2013. PCCW, a leading contractor for



All speakers needed to be concealed behind the perforated triangular ceiling panels

communications systems in Hong Kong, approached Nexo's China distributor, Top Plot International, and the companies worked together to build a competitive budget proposal. A year later, PCCW was awarded the system installation. Arup, PCCW, Nexo and Top Plot met regularly to keep track of the project, in particular the concealment of the loudspeakers into the giant suspended ceiling, which is lined with triangular panels. All speakers needed to be concealed behind these perforated ceiling panels, which carried the risk that high frequencies could suffer from comb-filtering, at best losing energy and the very worst reflecting back into the ceiling, creating unwanted noise.

'We worked closely with the architect during the design phase, and they took on board our suggestions,' says Mr Chan. 'The PA design had to have very good acoustic control to minimise the need for heavy acoustic treatment and keep the MFC terminal in par with the aesthetics and architectural styles of Terminal 1. And I'm happy to say that the only compromise needed to be made was that the panels concealing the speakers are a bit different; the perforations are a little larger, to allow the sound to come through. We tested it using the original panels that cover the rest of the ceiling, and it just didn't work. The panels look a little bit more grey because of the perforations, which are bigger, but that's the only difference. That was the sole compromise, and the architects were very happy with the outcome.'



PCCW needed to calculate all speaker positions, angles and tilts precisely and minutely

And importantly, the Nexo speakers were small enough that they could fit behind just one panel.'

PCCW needed to calculate all speaker positions, angles and tilts precisely and minutely, so that the real performance could be as close as possible to the simulations. Considering the intricacies of working with more than 100 clusters inside an airport ceiling, it took nearly six months of installation work for PCCW to complete the rigging and wiring of the system. A great deal of technical support was provided by Nexo Asia's Mr Ho Man Him, studying 3D views of the ceiling space to work out how to integrate the speakers with all services, catwalks, grids and beams. A rigging system was designed to interface as accurately and transparently as possible with the perforated ceiling panels, so the speakers would retain their acoustic integrity.

Mr Chan also had to take into consideration the many functional requirements of a system with a matrixed zone grid, capable of relaying a variety of different messages and signals to different zones, either through automated playback, live playback or in emergency situations. While the existing CobraNet infrastructure was able to deal with the signals, acoustic zones including fire zones, PA zones, gate zones and general zones all needed the correct sound and acoustic performance for their



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The entire system is powered by 27 NXAMP 4x4 TD controllers

different functions. For example, live announcements in the gate zones needed to draw travellers towards the boarding gate and fire zones needed to be acoustically separated or identifiable as much as possible, while the general PA should provide seamless sound coverage across the entire terminal without echoes or delay issues. Peavey Media Matrix software was used to handle the zoning and distribution networking, while Nexo Remote ESMonitor software looks after the Nexo amplifiers through a dedicated network.

The final system consists of 81 clusters composed of one Nexo Geo S830 vertical/horizontal array module plus one Geo S805 ultra-compact vertical array module, running through the MFC's central building between the gate concourses, which fire alternately

from the periphery into the atrium space. A further 29 single Nexo Geo S830s have been used for the smaller terminal zones, as well as the Node retail space, where they are concealed behind the fake A/C vents of the retail bulkhead, providing a clear and uniform isophase soundfield across the circular gallery. The entire system is powered by 27 NXAMP 4x4 TD controllers loaded with Ethersound cards.

The positioning and spacing of loudspeakers was calculated so that listeners nearer the speakers and others further away, in the centre of the atrium space, would receive the same SPLs. This has created a surround soundfield that is clear and intelligible, no matter where the listeners are standing or which direction they are facing.



Peavey Media Matrix software was used to handle the zoning and distribution networking

The seamless soundfield is especially apparent as one moves along the central traveller between the gates on either side. Live announcements are made at the gates, while general PA messages are heard as a background system, blended in with BGM. Even with various announcements being made at the same time but across different zones, the different SPLs allow the listener to naturally focus on the principal message.

Shure MX412 Microflex gooseneck microphones and Denon DN-F300 audio playback units have been installed at the gates for announcements.

PCCW carried out a rough SPL alignment to balance the overall sound levels at 67dBA across the entire terminal, as requested by the client. Aiming preliminary tests and measurements at some of the problem areas revealed an STI of 0.7, nearly eight per cent above target.

'We have clearly achieved excellent results after many years of dedicated work and detailed design,' comments the AA's project manager, Steven Tam, on the completed MFC. 'We have trust in the consultants' and designers' approach, and have totally reached our goal to create a sound quality way above Terminal 1 and Terminal 2. A new standard has been established; this is now probably the best sounding airport terminal in the world.'

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