

An excellent background



Stagetec's Berlin premises

Operating reliably in the background, Stagetec's Nexus modular routing, networking and DSP system isn't an obvious entry into the professional audio hall of fame. **Richard Lawn** finds out more about this acclaimed industry standard

CELEBRATING ITS 30TH ANNIVERSARY THIS JULY, Stagetec has continued to listen to its customers and reinvest its resources, ensuring that its distributed router equipment remains at the cutting edge of technology. But when the Berlin-based manufacturer launched its first product just four months after inception, few of the engineers working on that pioneering project could have imagined that the digital audio interconnection and routing system would remain in production today.

The unveiling of Nexus as the first distributed audio router connected by fibre-optic cabling may have been somewhat muted at the outset. Combining an audio network, a router and an I/O matrix, its longevity is partly down to a modular structure. Based on the industry-standard 19-inch rack, the Nexus system consists of one or more base devices into which up to 21 plugin boards can be inserted on one level. Available in 1U, 3U, 6U, 9U, 12U and 15U versions, the mainframe base devices are suitable for mobile use and fixed installations, its flexible modular design accommodating I/O boards for analogue and digital audio, DSP boards for audio processing, custom routing boards for data or switching signals and fibre-optic interface boards for interconnecting base devices.

By adopting a proprietary protocol to transmit audio and control data, Nexus combines high reliability with low latencies. The network is created by connecting several base devices with XFOC cards, each offering four ports for fibre-optics. Available connections include point-to-point, daisy-chain, star- and mesh-shaped networks. Nexus also relays all the system's control information via the fibres. Each XCPU board incorporates a word clock connector allowing Nexus to function as a master or to be synchronised to external sources. Video sync can be fed directly and, when working in an IP ST2110-based environment, Nexus switches to PTP ST 2059 system timing.

In parallel to the router, Stagetec's team developed the Nexus network, with all its inputs, outputs and complex signal routing



Stagetec's director of business development, Jean-Paul Moerman, at ISE 2023

ability, as the basis for multiple digital mixing consoles, the first of which was Cantus in 1994, becoming the first digital console to be installed, a year later, at Bavarian public service broadcaster, Bayerischer Rundfunk. The same TDMA technology integrated within the DSP of the consoles has been transferred into the Nexus router. Without the burden of creating tie-lines between studios, engineers were provided with unrestricted access to all the resources within the network.

As demand grew for a switching node for large audio networks, the Stagetec designers launched the Nexus Star in 2000, with the ability to route 4,096 inputs to 4,096 outputs and network 31 Nexus base devices up to 100km. The 6U, 19-inch rack-mounted unit comprises I/O boards for connection to Nexus base devices together with external MADI equipment, a wide range of synchronisation options and redundant power supply units.

"With Nexus Star, the concept remains the same," explains Stagetec's director of business development, Jean-Paul Moerman. "With each additional audio format that is brought to market, there is added demand for more resources whereby all the channel strips on the console need to be routed to the network. The Star is not limited to the whole network. If you have a 400-channel console, there is a multiplier of eight, which is the number of connections required to connect the console to the outside world."

High hardware standards, including the development of compact, lightweight modules with low power consumption, has spawned intelligent, flexible products. Subsequent consoles have built on the proven Cantus concept with its unique I/O matrix and user interface. Cinetra, launched in 1997, was followed by Aurus, Auratus, Crescendo, On Air 24, Aurus platinum, Crescendo platinum and, most recently, Avatus.

Continued innovations – including the patented 32-bit TrueMatch converter without analogue gain stage, resulting in a 158dB dynamic range – have contributed to Stagetec's rising brand value. "If feeding a microphone signal directly without preamp stage into a 24-bit convertor, you would be using only 8–10 bits, making it unusable," says Moerman. "The extra 8 bits of the 32-bit convertor push down the noise floor virtually by some 48dB. The gain is done after the AD-convertor in the digital domain. As a result, there is no risk of clipping, no added distortion or spectrum change from an analogue preamp."

From the outset, most software and hardware including circuits and PCB layouts has been designed by Stagetec's inhouse development team. This has led to the availability of the Nexus Logic Control (2004), loudness metering (2011), Dante connectivity (2012) when integrating the Nexus XDIP interface card, Nexus XRT routing for more than 8,000 channels and Nexus XACI for complex control tasks (2015). A single Nexus configuration can be scaled up to 655,362 addressable I/Os, 72 million cross points, a maximum of 63 base devices or nodes, up to 2,048 audio channels of non-compressed PCM per fibre and 32 streams of 256 audio channels per AoIP port.

Nexus has been largely futureproofed with AVoIP capabilities. "Nexus has always adapted to current requirements, but it can also allow an engineer to connect to MADI and legacy audio formats," says Moerman. "As technology increasingly operates over IP with AES67, Dante and ST2110 connectivity, Nexus has interfaced with these evolving networks, and that has renewed the life of the product. By replacing the fibre-optics with an IP stream, Stagetec has created a Nexus IP Link, which is essentially the same AES3-based 32-bit transparent mode format used in fibre TDM. The traditional fibre is 32-bit in AES3 transparency mode, which consists of 24-bit audio plus four users and four databits for communicating. An ST2110-31 audio stream is 32-bit format, which is also referred to as a transparent format, with space to add the Nexus UDP protocol. This allows the base devices to communicate to one another over the datacentre on a TCP/IP layer 3 broadcast backbone. The beauty is, it has become backwards compatible. Nexus has evolved to become a hybrid system and can operate with TCP/IP layer 3 or our traditional TDM fibre or mix TDM and IP. A customer with an existing system can gradually upgrade by replacing a couple of IP boards with fibre



The Nexus Compact was launched in 2022

boards. Those base devices become the edge- or endpoints in an IP workflow."

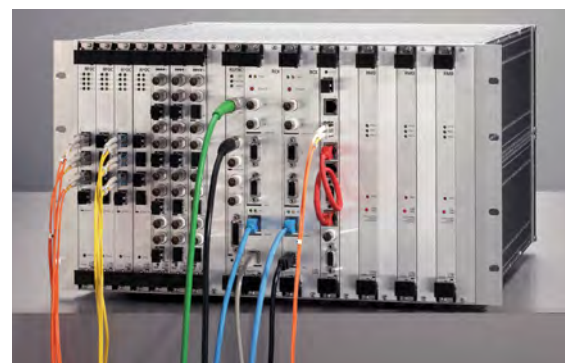
IP connectivity can be expanded by adding more IP interfaces. "The transition can be made in one go or a full IP-based Nexus system can be acquired, so the most budget-friendly transition into IP fits perfectly in what Stagetec calls its intergeneration compatibility. Whatever format, on the router page the sources and destinations present themselves to the user in a uniform, uncluttered way. Just as the whole system can be connected over IP, consoles such as Avatus can also be connected over IP to a switch or a datacentre and finally to the core. "The console is connected to the core as simply as a laptop to the local network by assigning an IP address."

The rack-mounted hardware has enjoyed limited penetration in remote production and recording studios, workstations with local audio sources and broadcast cameras with mounted microphones. Therefore, the compact TrueMatch was recently engineered in response to demands for a compact, IP-based, standalone system to interface with on-camera, eight-channel immersive microphone arrays. Offering a low channel count with basic audio processing as an extension to existing Nexus networks, the portable unit supports established protocols including EmBER+, NMOS IS-04/05 and SMPTE 2110/AES67/Ravenna AoIP formats and can be equipped with a Dante interface.

Although TrueMatch dates from the 1990s, users continue to specify the technology on account of the wide dynamic range it offers. "The lack of clipping owing to the astronomical headroom is a huge benefit," asserts Moerman. "The Nexus compact TrueMatch, which is scaled down to an internal 82 x 82 matrix, is a further evolution of the Nexus family. Designed as non-configurable, it is fixed with eight microphone inputs, eight analogue outputs and four AES3 in- and outputs plus GPIO. A 64-channel AoIP interface completes the Nexus compact and connects to the outside audio world. As it's then connected over IP to other Nexus base devices, access to all the resources within the network is available from a console surface. There's no difference in operation if the microphone is connected via analogue, digital or over IP. Phantom power and other functions are transmitted to the interface, an internal http GUI is available in any browser and Nexus compact is easily accessible via a tablet, even remotely."



Singapore's Star Performing Arts Centre benefits from a Nexus router



The Nexus Star router



The concert hall of Singapore's Esplanade – Theatres on the Bay is installed with a Nexus Star router



Nexus with the XDIP Dante audio-over-IP interface and XACI control board

Having launched Nexus compact TrueMatch at Tonmeistertagung 2021, Stagetec is acquainting itself with new end users. “Some engineers have cited the PoE [power-over-Ethernet] function as a distinct benefit,” says Moerman. “In addition, the external microphone inputs and local GPIOs have been cited as desirable features for TV studios. With GPIO-configured source selection, producers can play content to guests during or after rehearsals by installing this compact node. Furthermore, with access to the network, the compact TrueMatch can be programmed as a commentary box, using the internal DSP to mix interviews and provide IFBs, leaving out latency issues. The Nexus compact can also be used as an extra to add a few resources to existing networks or record a few microphones on location.”

As well the broadcast market, Nexus also has a vast customer base in theatres, opera houses and public buildings across the globe. “The market share between broadcast and live sound varies from country to country,” adds Moerman “Globally it’s around 50/50, with a large intake from applications where audio is being transmitted from point A to point B with a third-party control system. The systems integrators and consultants we interface with at ISE in Barcelona are completely different from those broadcast devotees attending IBC in Amsterdam. Although Stagetec showcases console technology to catch the eye, there is increasing interest in the less visible network devices. For each installed console with a Nexus configuration, there are ± 10 Nexus systems without a console in museums, parliaments, conference centres, motorsports, amusement parks, military buildings and even space agencies.”

However, Nexus wasn’t released with a development roadmap ahead of it. “Customer feedback played a significant role in its evolution, and the compact TrueMatch is a good example,” says Moerman. “In principle, the original Nexus from 15–20 years ago is still relevant – it has simply evolved from a TCP/IP layer 1 using the same SFPs as the IT industry, to using a TCP/IP layer 3 format which we call Nexus IP-link, streaming 24-bit audio plus control in the eight user and databits entirely over the network in a compatible SMPTE 2110-31 (32-bit transparent mode) format



A Stagetec console in production



The Nexus system consists of one or more base devices

layer 3, so anyone can have access to it. Sure, in an ST2110 environment, Nexus nodes are used as so-called edge- or endpoints, but the concept and purpose still stand.”

Nexus has been working reliably and consistently for up to 30 years in many applications, but Moerman admits that some engineers continue to be unaware of its existence. “I occasionally show these operators exactly what it is. Promoting the achievements of Nexus remains a challenge because it stays hidden, operating flawlessly backstage like an unsung hero.”

Reliability, connectivity, flexibility, portability and ultimately longevity – Nexus’s place in a less illuminated section of the hall of fame is assured.

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